

## Success Factors to Promote Digital Learning Platforms: An Empirical Study From an Instructor's Perspective

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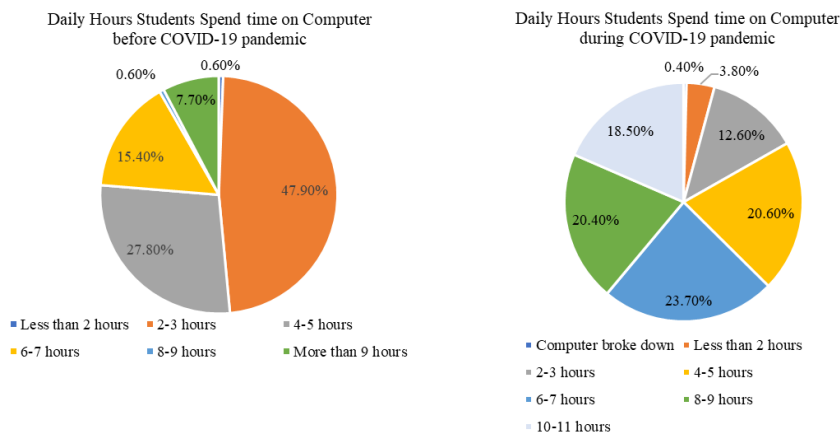
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**Abstract**—Digital learning platforms have been used as teaching aids in many countries; however, their success factors are not well established in Thailand. The primary objective of this study was to identify and confirm the success factors to promote digital learning platforms in Thailand from instructors' perspectives. The sample included 788 Thai instructors. The confirmatory factor analysis (CFA) method indicates a good fit of a four-factor model to the observed data. The CFA construct revealed four success factors in promoting digital learning platforms: education policy, online classroom management, online learning system, and training method. The results explain the influence each of the four factors. Finally, this paper proposes guidelines for the promotion of digital learning platforms.

**Keywords**—education policy, online classroom management, online learning system, training method

## 1 Introduction

The advent of the digital era has resulted in the increasing application of internet technologies in everyday life. Many industries have transformed from offline to online, allowing them to gain new development opportunities. The internet in education has transformed traditional learning platforms and created digital learning platforms which have enhanced learning classrooms [1]. Particularly during the COVID-19 pandemic, most institutions have chosen digital learning platforms for teaching tasks which have led to learners facing work online longer. Before the COVID-19 pandemic, 47.9% typically did not spend more than three hours in front of a computer, while 27.8% spent no more than five hours a day using a computer. Most learners did not spend more than five hours on a computer daily. However, the COVID-19 pandemic has had a remarkable impact on how long learners spend working at a computer, with 23.7% of learners spending six hours, 20.4% spending eight hours, and 18.5% spending ten hours per day at a computer as shown in Figure 1 [2].



**Fig. 1.** The number of hours learners spent on computers before and during the COVID-19 pandemic [2]

With this, it is time to actively encourage instructors across all levels of education to promote the adoption of digital learning platforms properly. Haji, et al. [3] wrote that information and communications technology (ICT) in education enhances learning, provides education to learners with no or limited computer access, promotes social mobility, facilitates instructor training, and enhances 21st-century skills among learners. Additionally, digital learning platforms can improve learning, make subjects more appealing, and facilitate problem-solving, communication, research skills, and decision-making processes [4]. Waluyo [5] supported that digital learning platforms positively predict attainment among mathematics, science, and reading learners since it facilitates learning, teaching, and research activities.

The Thai education eco-system blueprint [6] strategically offers a vision for the education system and learners' aspirations that the Thai education system needs and deserves. Strategic and operational shifts are required to achieve that vision. A significant shift required is a focus on the standard national digital learning platform to increase the quality of learning in Thailand to provide internet access and digital learning environments to all institutions. Moreover, the national education policy clearly reflects that the Thai educational system needs to use ICT in teaching, learning, and educational management [7]. The use of digital learning platforms to support learning is essential and a common phenomenon of the 21st century [8]. With this challenge, the Thai Ministry of Education (MOE) is expected to impact learner learning outcomes positively. To promote digital learning platforms in Thailand, the success factors must be studied in depth using a statistical approach. The present study considers the success factors of using a digital learning platform as an essential element that must be reviewed based on best practice and statistical analysis. Many countries have conducted empirical studies to examine the success factors of using digital learning platforms in their own country [9]. The present study aimed to investigate the factors affecting digital learning platforms in Thailand. Additionally, this research advances our understanding of defining success factors to promote digital learning platforms from instructors' perspectives and introduces digital learning success.

This study aims to identify the success factors of the digital learning platform and serves as guidelines for online learning for educators, school leaders and policy makers. The study holds significance in contributing to the global intellectual community, particularly in the fields of online learning and online classroom management. The results from the empirical study provides insight into how Thai instructors' perspective can be used to promote and support digital learning platforms in other developing countries.

## **2 Literature review**

This review focuses on articles that report the success factors of digital learning platforms. The selected studies were relevant to the use of digital learning platforms as an educational tool. The reviewed articles reveal four major elements to promoting digital learning platforms: (1) Education policy, (2) Online classroom management, (3) Online learning system, and (4) Training method. First, research papers were identified by a comprehensive search of various electronic databases such as EBSCO, ScienceDirect, Taylor & Francis, Emerald, SAGE, Scopus, Google Scholar, and Web of Science. All papers identified were published from the year 2011 to the year 2022. Table 1 lists the relevant search terms with their categorization (see Table 1).

**Table 1.** Influencing factors of a digital learning platform

		Proposed Factors of the Digital Learning Platform															Success factors									
Factor	Item	Description	Researchers																							
			Adeshola and Agoyi [10]	Celikkilik and Adigüzel Tüyük [11]	Malanga, et al. [12]	Matruk, et al. [13]	Panackal, et al. [14]	Alshare, et al. [15]	Yengin, et al. [16]	Hassanzadeh, et al. [17]	Kong, et al. [18]	Yu and Richardson [19]	Lee and Park [20]	Alhabeib and Rowley [21]	Barclay, et al. [22]	Kumi-Yeboah, et al. [23]	Alqurashi [24]	Al-Fraihat, et al. [25]	Cidral, et al. [26]	Fernando [27]	Liu and Pu [28]	Kim, et al. [29]				
1. Education policy	1.1	Quality of an online learning system																								
	1.2	Investment support for the study of online course design and production																								
	1.3	Teaching technology should be promoted for formal and non-formal education.																								
2. Online classroom management	2.1	Quality of lessons means lessons that are complete, correct, beneficial, reliable, interesting, clear, comprehensive, modern, comprehensible, and interesting in design																								
	2.2	Interaction between instructors and learners																								
	2.3	Interaction among learners																								
3. Online learning system	3.1	Use of the online learning system																								
	3.2	Access to the online learning system																								
4. Training method	4.1	Training learners and instructors to use an online learning system																								
	4.2	Instructors with prior teaching experience are ready to use technology																								

Note: Selection was influenced by the most frequent factors, while similar statements were considered important.

As the four success factors are expected to align with the context of a successful digital learning platform, we propose that four major factors could improve our understanding of a successful digital learning platform. In addition, given the importance of various aspects embedded in digital platforms, education policy, online classroom management, online learning system, and training method may influence current and future efforts to promote digital platforms and user adoption.

## **2.1 Digital learning platform**

A Digital learning platform (DLP) is an online space in which information, devices, and data resources are gathered to support and encourage educational management. Learning can be administered in various forms: demonstration videos, problem-solving exercises, and small exercises. Examples of DLP include an e-learning or learning management system (LMS) [30, 31]. The use of a DLP means using technology learning management in the context of technological changes and advancement. People are also encouraged to find knowledge by themselves from digital and social media, which creates interesting teaching and learning administration since one can learn anytime and anywhere. Interaction with learners is promoted, and existing lessons can be adjusted for individual learners. In the digital age, people can create and develop learning innovations to respond to learning needs and knowledge exchange by themselves from various learning online platforms, social media, and websites [32].

## **2.2 Education policy**

Education policy refers to guidelines that aim to improve the quality of education and instructor performance. The quality of online education consists of the convenience of use, ease of use, stability, system reliability, safety, the period of time of use, responses, navigation, and screen adjustment of a system according to responsive output devices [16, 25–27]. A good system quality results in operational and user satisfaction. Education in Beijing has been improved by creating digital learning resources for teaching and learning, which involves digital learning resources being improved, developed, procured, and shared in producing high-quality digital education information resources. Additionally, course development is coordinated through professional instructor teams, new mechanisms are created to provide resources effectively, and channels for various educational resources are shared with instructors. 21st-century skill development is promoted by e-learning and learning skill development via self-direction [18]. Besides, governments have encouraged core ICT courses, such as Singapore, where a basic ICT standard has been formulated for learners, along with assessment devices relevant for use by instructors. Taiwan and Hong Kong have also emphasized ICT and digital knowledge by requiring it as a necessary skill to develop formal courses at institutions. Some authority has been given to executives to create agreements with senior staff members, course coordinators, committee chiefs, instructors, and parents regarding the vision and direction of e-learning at the institution [18]. Finally, technology teaching should be promoted in formal and non-formal education [18]. For instance, Hong Kong has emphasized “ICT for Interactive Learning” since the end of the 20th century. ICT development for interactive learning is one of the four main missions for local course

development, and “ICT skills” are one of nine general skills supported by local curriculum reform in Hong Kong [33]. In some countries, there is support for pilot ICT class projects which involve experimenting with ICT classes at certain institutions. For instance, Singapore introduced the project Future Schools (FS@SG) in 2007 and funded cooperation between industry and university researchers to mobilize the use of ICT for teaching and learning. Learners require computer notebooks; therefore, government policy should encourage fundraising to provide hardware equipment to learners [18].

### **2.3 Online classroom management**

Online classroom management refers to lesson quality and techniques that instructors use to maintain interaction with learners and provide coworking opportunities between learners for academic production during class. Lesson quality refers to complete, correct, beneficial, reliable, interesting, clear, comprehensive, modern, comprehensible, and interesting design [16]. This makes learners satisfied with online learning [25–27]. Hong Kong supports the development of e-textbooks for e-learning. Well-designed lessons will leave learners satisfied with their learning and inculcate a desire to learn more. Lesson design should consider three factors: (1) learning objectives, (2) content, and (3) learning processes [28]. Besides, lessons should focus on their presentation, namely: (1) learning design which refers to how to conduct assessments and which devices should be used; (2) learning management, such as the course curriculum and learning activities; (3) communication forms including e-mail, chatrooms, discussion boards, and Facebook; and (4) learning follow-up such as grading, assessment, and feedback [16].

Consequently, institutions should interpret course objectives and structures by integrating ICT with learning to support effective ICT teaching and learning management [18]. For instance, in 2000, Singapore supported 30% of course structures, including ICT-based learning. Meanwhile, since 2009, Hong Kong has required 25% of learning time to be based on ICT. ICT skills should be taught to correspond to 21st-century skills. Taiwan, for instance, supports the concept of L4C (Learning for Competencies), including life-long learning, complicated problem solving, communication and coworking skills, critical thinking, and creative thinking, which are all fundamental skills for the 21st century.

Moreover, the interaction between instructors and learners is crucial [24] since online learning enables learners to communicate better with instructors. Some learners do not want to pose questions during the normal classroom; however, online interaction allows them to understand lessons and tasks better, resulting in improved grades and attainment (Kumi-Yeboah et al., 2018). Instructors should provide feedback to learners during learning and regularly check learners. Feedback should be useful and in-time [28]. Giving feedback like this improves emotional responses and increases perception and control of knowledge and understanding, which can lead to learners developing a greater interest in the learning results [34]. Learners who receive feedback from instructors are found to learn more effectively [35, 36]. Finally, interaction among learners makes them more satisfied with online classes [24, 26]. Examples of devices to promote coworking include discussion boards, chatrooms, blogs, or shared documents.

Coworking on these platforms leads to convenient communication between learners, especially those who have to study from home due to the COVID-19 pandemic.

Furthermore, it helps them to successfully finish their work and understand lessons better [20, 23]. However, the biggest issues with the online course were “feeling lost in cyberspace,” as well as technical difficulties with the computers and course administration platforms. In addition, problems with waiting too long for responses to their messages left them feeling abandoned online. Learners also complained that “there was no way to read body language” and that “the teachers did not get to know the students personally” [37].

## **2.4 Online learning system**

The online learning system should consist of clear operational processes, manuals, and operational steps in a cloud system so users can download them for free. A team should be set up to solve problems and design and provide consultancy concerning creating online lessons for instructors who are unfamiliar with online classrooms. This will impress users and enable them to keep using the system [25, 28]. In addition, online learning systems can be accessed from any location, whether at or outside the institution, so the learning is easier and more convenient [22]. Besides, institutions should have highly efficient computers for instructors, while internet networks should be improved at the institutions so that users can connect from anywhere and there is a stable signal [38].

## **2.5 Training method**

Training learners and instructors to use online learning systems will result in effective and successful teaching [21, 39]. The continuous training that emphasizes real practice will enable learners to use the system more confidently, promoting successful and sustainable online learning [40]. Moreover, instructors with prior teaching experiences who are ready to use technology can also consult new instructors, such as in the project of the ICT Mentor Program in Singapore [18]. This project selects and trains four instructors from each institution, who are later referred to as ICT mentors and are well-trained to use ICT for effective teaching and learning. After training, the instructors are responsible for consulting at least one subject with their peers for one academic year so that every instructor is sufficiently ready and skillful to use ICT effectively.

# **3 Methodology**

## **3.1 Participants**

Participants were selected using multistage sampling of instructors in Thailand. The sample is  $n=788$ . The multistage sampling method was applied as the hierarchical structure from clusters. A different level was randomly sampled from a name list of instructors based on clusters of specific subject areas. Demographics of the participants are presented in Table 2 Hair, et al. [41] suggested the use of confirmatory factor

analysis (CFA) to determine sample size. The heuristic requires ten times the construct with the number of structural paths. This method indicated  $10 \times 24 = 240$  as an adequate sample size. In this study using CFA, the first heuristic was considered. The usable sample size of 788 exceeded the suggested sample size of 240; thus, it was determined to be adequate by the power calculations.

**Table 2.** Demographic characteristics of participants

Demographic Information	Particular	Frequency (n)	Percentage (%)
Occupation	School administrator	53	6.73
	Instructor	735	93.27
Region of institution	North	53	6.73
	Northeast	40	5.08
	Central	604	76.65
	South	91	11.55
Experience	Less than 1 year	22	2.79
	1–10 years	300	38.07
	11–20 years	217	27.54
	21–30 years	173	21.95
	31–40 years	55	6.98
	More than 40 years	21	2.66

### 3.2 Procedures

This study employs mixed methods research, combining qualitative and quantitative [42]. A quantitative survey and qualitative interviews were utilized to examine the success factors relating to instructor perceptions regarding the promotion of digital learning platforms. First, a literature review was conducted to explore the success factors relating to digital learning platforms by selecting systematic reviews on the use of digital learning platforms as educational tools. Next, the survey questionnaire was adapted from Kumi–Yeboah, et al. [23], containing 24 questions concerning the perceived importance level of the success factors. The questionnaire items were rated using a five-point Likert scale, ranging from 1 for the least important to 5 for the most important factors relating to (1) education policy; (2) online classroom management; (3) online learning system; and (4) training method. There were 788 instructors in Thailand with simple random sampling by selecting two provinces in each region and



randomly selected by sending an online questionnaire to the sample group. It covers primary, secondary, and non-formal education and vocational education. Next, confirmatory factor analysis was conducted using LISREL to examine the structure of the contextual factors (CFA model). Then, interviews were conducted to verify and confirm the success factors. A total of 100 interviewees were contacted for open-ended recorded interviews. Finally, a guideline for the promotion of digital learning platforms was developed and proposed.

## 4 Results

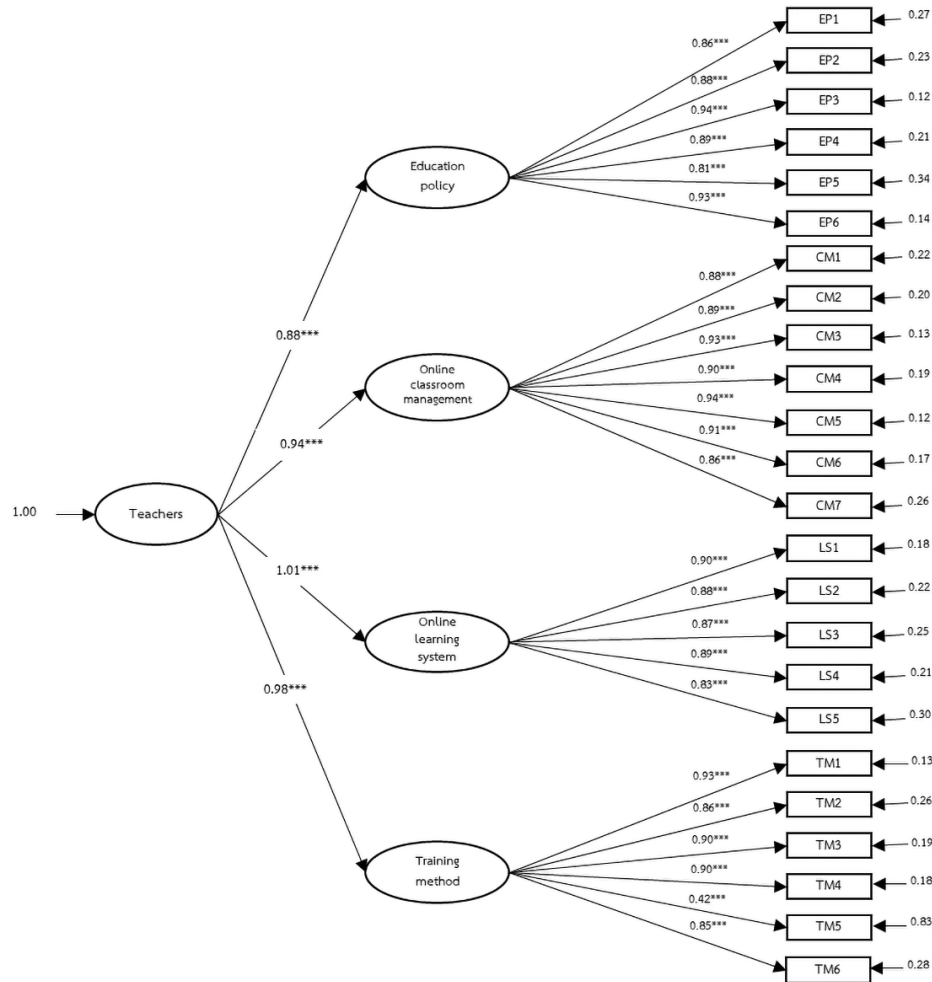
### 4.1 Confirmatory factor analysis

Confirmatory factor analysis following the maximum-likelihood estimation method was conducted using LISREL 8.80 to confirm the factor structure. Good model fit was evaluated by the Chi-square statistic, which compared the tested model and the independent model with the saturated model ( $\chi^2/df$ ), comparative fit indexes (CFI), goodness of fit index (GFI), adjusted goodness of fit index (AGFI) and root mean square error of approximation (RMSEA). According to Hair, et al. [43] and Jöreskog and Sörbom [44],  $\chi^2/df$  values less than 3.00, CFI values more than 0.92, GFI values more than 0.95, AFGI values more than 0.90, and RMSEA values less than 0.07 indicate a good-fitting model. Results of fit indexes are provided in Table 3. The study model showed acceptable values ( $\chi^2/df = 2.924$ , CFI = 1.000, GFI = 0.960, AGFI = 0.910, RMSEA = 0.049) which indicated good fit to the observed data.

**Table 3.** Fit indexes for the model

Fit Indexes	Level of Acceptable Fit	Model	Result
$\chi^2/df$	< 3.00	2.924	Pass
CFI	> 0.92	1.000	Pass
GFI	> 0.95	0.960	Pass
AGFI	> 0.90	0.910	Pass
RMSEA	< 0.07	0.049	Pass

The CFA results confirm that the four-factor model was appropriate to explain instructor perspectives on promoting digital learning platforms.



**Fig. 2.** CFA model shows how the four factors explain instructor perspectives on promoting digital learning platforms

Note: Chi-square=435.63, df=149, RMSEA=0.049, \*\*\*p < .001.

Figure 2 presents the CFA model with a four-factor structure. Factor loadings ranged from 0.88 (EP: Education policy) to 1.01 (LS: Online learning system). The “Online learning system (LS)” factor was the best indicator to promote the digital learning platform perceived by instructors, with “Training method (TM)” as the second most influential factor in instructor perspectives. While “Education policy (EP)” showed less ability to promote digital learning platforms, “Online classroom management (CM)” was the third indication.

At the item level, the CFA result disclosed that factor loadings varied from 0.42 (TM5: the training support from government agencies) to 0.94 (EP3: the country has a national policy to encourage institutions to promote self-learning) and (CM5: there

is always an interaction between learners and instructors in online learning system). In the factor of education policy, “EP3: country has a national policy to encourage institutions to promote self-learning” was strongly influential. In the factor of online classroom management, “CM5: there is always interaction between learners and instructors in online learning system” showed high potential. In the factor of an online learning system, “LS1: When there is a problem in online learning, Institution has technical support to solve the issue” was the most important. Finally, the factor of training method, “TM1: institution provide in-house training for instructors on how to use online learning system,” was the most powerful.

The data confirmed the four-factor model as a good fit to explain the observed data collected from instructors. Among the factors, the online learning system was more dominant than the other factors ( $\beta=1.01$ ), while education policy was found to have less effect on the promotion of digital learning platforms ( $\beta=0.88$ ) according to the instructors’ perspectives.

## **5 Discussion**

The results from the comparison of success factors for digital learning platforms among instructors according to quantitative and qualitative data indicated that the factors of online learning systems, including media and equipment supporting online teaching management, had the most weight. This aligns with the qualitative data obtained from interviews. In other words, learners require electronic devices and an internet connection in online learning to keep online teaching and learning running smoothly. However, learners in many institutions across Thailand lack the necessary electronic devices, internet access, and stable internet signal required for online learning. This finding corresponds to the claim made by IPST [45] that revealed the results from PISA’s research that Thai learners still lacked facilities for online learning, including quiet places, learning equipment, and the internet. Therefore, online learning can be effective if students have the necessary resources.

The training method factor is the second most important key factor for online learning and teaching success. This complies with the existing qualitative data. When a device for managing online teaching is available, instructor training and development is the next step to enable the management of effective online teaching. The nature of the training or professional development of quality instructors should be characterized in terms of specific training topics of training and emphasize active learning and action in addition to offering cooperative learning and support from experts. When training is complete, feedback should be provided and reflected upon. Moreover, what has been learned must be applied in practice in teaching and learning [46, 47]. Instructor development must be performed in all aspects, including the knowledge, techniques, and skills related to equipment, media, and tools.

The third factor is online classroom management. Qualitative data prioritizes online classroom management after the online learning system and training method factors. Some interviewees reasoned that when instructors have a good online learning system with media and teaching equipment ready for use and have been trained on the management of online teaching, the next thing to consider is the quality of online teaching.

Consequently, instructors should know about educational technology to design teaching and learning and use technology for effective and quality learning. Quality online lessons should include such elements such as clear learning objectives, information to learners about the learning steps or methods of a course, participatory learning activities, emphasis on the interaction between instructors and learners and between learners, as well as a focus on hands-on help and guidance provided when learners have problems or doubts in the use of technology in their studies, and regular feedback to learners [48, 49].

The factor of education policy for online teaching and learning was the least weighted factor. The qualitative data collected through interviews is inconsistent with the quantitative data derived from the questionnaire since the interview data gave priority to the education policy factor of online teaching and learning management because guidelines were required for clear and systematic implementation. The research results may be inconsistent because Thailand lacks a clear education policy that explicitly addresses online teaching and learning and only has a policy relating to using technology in teaching and learning. Nonetheless, due to the COVID-19 pandemic, regular teaching at the institution was changed to an online format. Therefore, it is a temporary solution to issues that enable uninterrupted teaching and learning. Suppose the government starts thinking and formulating an education policy on online teaching. In that case, it will significantly benefit Thai education because the COVID-19 pandemic may continue, and online learning will persist after the epidemic [50]. Therefore, the education system must learn to adopt and adapt to current conditions and prepare for the near future. Good, clear policies will help the education system cope with upcoming situations.

COVID-19 is a global pandemic that has forced institutions in almost every country to adopt the same online learning approach instead of traditional face-to-face learning. Our findings confirm the similarities of success factors in promoting digital learning platforms worldwide [12, 28]. Our empirical data bolsters the common success factors globally to promote digital learning platforms.

## **6 Conclusion and practical implications**

This research presents the results of the success factors to promote digital learning platforms from the confirmatory factor analysis (CFA). It was found that four key factors determine the success of promoting digital learning platforms containing: (1) education policy, (2) online classroom management, (3) online learning system, and (4) training method. These four factors had statistically significant component weights ( $p < .001$ ) for all factors, with the element weight in the standard rating ranging from 0.88 to 1.01. This implies that these four factors were statistically significant indicators for a successful digital learning platform. The most important success factors for a digital learning platform were an online learning system with media and devices to support online teaching management ( $\beta = 1.01$ ), training methods for instructor development ( $\beta = 0.98$ ),

online classroom management ( $\beta=0.94$ ), and education policy ( $\beta=0.88$ ). To implement the aforementioned factors, the government should give institutions the freedom to design their teaching according to their context. Furthermore, the government must not force or control individual institutions' teaching and learning operations. Instead, education policies that guide and are flexible should be established for institutions to implement, and support and assistance should be provided upon request.

The Ministry of Education should develop a national digital platform available for all learners and instructors. This platform should be improved to support all education systems, including basic, non-formal, and vocational sectors. Moreover, for online classroom management, instructors should utilize technology in teaching in conjunction with the theory of self-knowledge creation. At the same time, open spaces should be provided for learners to use their creativity in group or project work. Instructors should also use technology as a medium for both teaching and learning in addition to allowing learners to learn according to their level of proficiency since learners have different levels of learning ability; some may learn slowly while others learn quickly. Some students often require help, while others can study on their own.

For the online learning system, the government must support access to computers, smartphones, and high-speed internet for all learners and instructors. In addition, they should provide funding for instructors to create projects or design their online teaching to encourage them to develop interesting online teaching and learning management that is high quality and efficient. Finally, training methods should be provided to institutions to help instructors design online instruction and prevent them from worrying, while their efficiency and quality of online teaching management can be improved. In addition, organized training for instructors must be designed to have a clear purpose, and workshops should be organized for instructors to practice. Training topics should be kept up-to-date and appropriate to current situations.

Most importantly, academic leaders should support the exchange of knowledge among instructors even though COVID-19 is changing the education experience from traditional face-to-face learning to modern online learning. There are some limitations, such as instructors' or learners' resistance to retransition from traditional learning platforms to the digital learning platform. Noteworthy, many institutions still lack efficient ICT infrastructure or have not been fully embedded. It is suggested that future research should include study samples from other CLMV countries, for example, Cambodia, Laos, Myanmar, and Vietnam. These countries share social and cultural characteristics to determine whether they show differences in promoting digital learning platforms.

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## 8 References

- [1] T. Bates, *National strategies for e-learning in post-secondary education and training*. Unesco Paris, 2001.
- [2] N. H. Al-Kumaim, F. Mohammed, N. A. Gazem, Y. Fazea, A. K. Alhazmi, and O. Dakkak, "Exploring the impact of transformation to fully online learning during COVID-19 on Malaysian university students' academic life and performance," *International Journal of Interactive Mobile Technologies*, vol. 15, no. 5, 2021. <https://doi.org/10.3991/ijim.v15i05.20203>
- [3] S. A. Haji, G. E. Moluayonge, and I. Park, "Teachers' use of information and communications technology in education: Cameroon secondary schools perspectives," *Turkish Online Journal of Educational Technology-TOJET*, vol. 16, no. 3, pp. 147–153, 2017.
- [4] J. E. Hong, "Social studies teachers' views of ICT integration," *Review of International Geographical Education Online*, vol. 6, no. 1, pp. 32–48, 2016.
- [5] B. Waluyo, "The effects of ICT on achievement: Criticizing the exclusion of ICT from world bank's education sector strategy 2020," *Malaysian Online Journal of Educational Technology*, vol. 7, no. 2, pp. 71–87, 2019. <https://doi.org/10.17220/mojet.2019.02.005>
- [6] R. Heeks and R. Bukht, "Digital economy policy: The case example of Thailand," 2018. <https://doi.org/10.2139/ssrn.3540030>
- [7] W. Kiatruangkrai, E. Leelarasmee, W. V. Siricharoen, and P. Maneerat, "Energy saving by gamification method: Case study at a public school, Thailand," *International Energy Journal*, vol. 17, no. 4, 2017.
- [8] E. B. Meier, "Designing and using digital platforms for 21st century learning," *Educational Technology Research and Development*, vol. 69, no. 1, pp. 217–220, 2021. <https://doi.org/10.1007/s11423-020-09880-4>
- [9] Y. Adejare, "The impacts of integrated e-learning system toward the challenges facing education sector during and post Covid-19 pandemic," *Journal of e-Learning and Knowledge Society*, vol. 18, no. 1, pp. 34–44, 2022.
- [10] I. Adeshola and M. Agoyi, "Examining factors influencing e-learning engagement among university students during covid-19 pandemic: A mediating role of 'learning persistence,'" *Interactive Learning Environments*, pp. 1–28, 2022. <https://doi.org/10.1080/10494820.2022.2029493>
- [11] Y. Çelikbilek and A. N. Adıgüzel Tüylü, "Prioritizing the components of e-learning systems by using fuzzy DEMATEL and ANP," *Interactive Learning Environments*, vol. 30, no. 2, pp. 322–343, 2022. <https://doi.org/10.1080/10494820.2019.1655065>
- [12] A. C. M. Malanga, R. C. Bernardes, F. M. Borini, R. M. Pereira, and D. E. Rossetto, "Towards integrating quality in theoretical models of acceptance: An extended proposed model applied to e-learning services," *British Journal of Educational Technology*, vol. 53, no. 1, pp. 8–22, 2022. <https://doi.org/10.1111/bjet.13091>
- [13] A. M. Maatuk, E. K. Elberkawi, S. Aljawarneh, H. Rashaideh, and H. Alharbi, "The COVID-19 pandemic and e-learning: Challenges and opportunities from the perspective of students and instructors," *Journal of Computing in Higher Education*, vol. 34, no. 1, pp. 21–38, 2022. <https://doi.org/10.1007/s12528-021-09274-2>
- [14] N. Panackal, S. Rautela, and A. Sharma, "Modeling the enablers and barriers to effective e-learning: A TISM approach," *International Journal of Interactive Mobile Technologies*, vol. 16, no. 8, 2022. <https://doi.org/10.3991/ijim.v16i08.29455>
- [15] K. A. Alshare, R. D. Freeze, P. L. Lane, and H. J. Wen, "The impacts of system and human factors on online learning systems use and learner satisfaction," *Decision Sciences Journal of Innovative Education*, vol. 9, no. 3, pp. 437–461, 2011. <https://doi.org/10.1111/j.1540-4609.2011.00321.x>

- [16] I. Yengin, A. Karahoca, and D. Karahoca, "E-learning success model for instructors' satisfactions in perspective of interaction and usability outcomes," *Procedia Computer Science*, vol. 3, pp. 1396–1403, 2011. <https://doi.org/10.1016/j.procs.2011.01.021>
- [17] A. Hassanzadeh, F. Kanaani, and S. Elahi, "A model for measuring e-learning systems success in universities," *Expert Systems with Applications*, vol. 39, no. 12, pp. 10959–10966, 2012. <https://doi.org/10.1016/j.eswa.2012.03.028>
- [18] S. C. Kong, T.-W. Chan, R. Huang, and H. M. Cheah, "A review of e-learning policy in school education in Singapore, Hong Kong, Taiwan, and Beijing: Implications to future policy planning," *Journal of Computers in Education*, vol. 1, no. 2, pp. 187–212, 2014. <https://doi.org/10.1007/s40692-014-0011-0>
- [19] T. Yu and J. C. Richardson, "An exploratory factor analysis and reliability analysis of the student online learning readiness (SOLR) instrument," *Online Learning*, vol. 19, no. 5, pp. 120–141, 2015. <https://doi.org/10.24059/olj.v19i5.593>
- [20] J. Y. Lee and S. Park, "Analysis of critical success factors of online international learning exchange of Korean school pupils with English-speaking counterparts," *British Journal of Educational Technology*, vol. 48, no. 6, pp. 1228–1238, 2017. <https://doi.org/10.1111/bjet.12516>
- [21] A. Alhabeeb and J. Rowley, "E-learning critical success factors: Comparing perspectives from academic staff and students," *Computers & Education*, vol. 127, pp. 1–12, 2018. <https://doi.org/10.1016/j.compedu.2018.08.007>
- [22] C. Barclay, C. Donalds, and K.-M. Osei-Bryson, "Investigating critical success factors in online learning environments in higher education systems in the Caribbean," *Information Technology for Development*, vol. 24, no. 3, pp. 582–611, 2018. <https://doi.org/10.1080/02681102.2018.1476831>
- [23] A. Kumi-Yeboah, J. Dogbey, and G. Yuan, "Exploring factors that promote online learning experiences and academic self-concept of minority high school students," *Journal of Research on Technology in Education*, vol. 50, no. 1, pp. 1–17, 2018. <https://doi.org/10.1080/15391523.2017.1365669>
- [24] E. Alqurashi, "Predicting student satisfaction and perceived learning within online learning environments," *Distance Education*, vol. 40, no. 1, pp. 133–148, 2019. <https://doi.org/10.1080/01587919.2018.1553562>
- [25] D. Al-Fraihat, M. Joy, and J. Sinclair, "Evaluating e-learning systems success: An empirical study," *Computers in Human Behavior*, vol. 102, pp. 67–86, 2020. <https://doi.org/10.1016/j.chb.2019.08.004>
- [26] W. Cidral, M. Aparicio, and T. Oliveira, "Students' long-term orientation role in e-learning success: A Brazilian study," *Heliyon*, vol. 6, no. 12, p. e05735, 2020. <https://doi.org/10.1016/j.heliyon.2020.e05735>
- [27] E. Fernando, "Factors influence the success of e-learning systems for distance learning at the university," in *2020 International Conference on Information Management and Technology (ICIMTech)*, 2020: IEEE, pp. 294–299. <https://doi.org/10.1109/ICIMTech50083.2020.9211163>
- [28] N. Liu and Q. Pu, "Factors influencing learners' continuance intention toward one-to-one online learning," *Interactive Learning Environments*, pp. 1–22, 2020. <https://doi.org/10.1080/10494820.2020.1857785>
- [29] S. Kim, J. Lee, S.-H. Yoon, and H.-W. Kim, "How can we achieve better e-learning success in the new normal?," *Internet Research*, 2022. <https://doi.org/10.1108/INTR-05-2021-0310>
- [30] SAP, "E-Learning Platform Definition," 2020. Retrieved from <https://www.litmos.com/platform/e-learning-platform-definition>
- [31] Ryan, "What is an online learning platform?," ed, 2020.



- [32] Runghathai Bunphrom, “Digital Learning Platform,” 2020. [Online]. Available: [http://www.etrainingbma.net/Panyapat/Panyapat39\\_1/Content10.pdf](http://www.etrainingbma.net/Panyapat/Panyapat39_1/Content10.pdf)
- [33] C. D. Council, *Learning to learn: Life-long learning and whole-person development*. Curriculum Development Council, 2001.
- [34] S. B. Eom and N. J. Ashill, “A system’s view of e-learning success model,” *Decision Sciences Journal of Innovative Education*, vol. 16, no. 1, pp. 42–76, 2018. <https://doi.org/10.1111/dsji.12144>
- [35] S. J. Lee and K. Huang, “Online interactions and social presence in online learning,” *Journal of Interactive Learning Research*, vol. 29, no. 1, pp. 113–128, 2018.
- [36] Y. Yuan and X. Cun, “Exploring the interaction factors effecting the student retention in online courses,” 2018. <https://doi.org/10.2991/iccsh-18.2018.49>
- [37] B. El Mansour and D. M. Mupinga, “Students’ positive and negative experiences in hybrid and online classes,” *College Student Journal*, vol. 41, no. 1, p. 242, 2007.
- [38] Thanaphan Sapthanadol, “Factors affecting the teaching and learning management of online lessons at Nakhon Ratchasima Rajabhat university,” *Veridian E-Journal, Silpakorn University (Humanities, Social Sciences and Arts)*, vol. 4, no. 1, pp. 652–666, 2011.
- [39] S. C. Eze, V. C. Chinedu-Eze, C. K. Okike, and A. O. Bello, “Factors influencing the use of e-learning facilities by students in a private higher education institution (HEI) in a developing economy,” *Humanities and Social Sciences Communications*, vol. 7, no. 1, pp. 1–15, 2020. <https://doi.org/10.1057/s41599-020-00624-6>
- [40] M. A. Almaiah, A. Al-Khasawneh, and A. Althunibat, “Exploring the critical challenges and factors influencing the e-learning system usage during COVID-19 pandemic,” *Education and Information Technologies*, vol. 25, pp. 5261–5280, 2020. <https://doi.org/10.1007/s10639-020-10219-y>
- [41] J. Hair, W. Black, B. Babin, and R. Anderson, “Exploratory factor analysis,” *Multivariate Data Analysis, 7th Pearson New International ed.* Harlow: Pearson, 2014.
- [42] J. W. Creswell and J. D. Creswell, *Research design: Qualitative, quantitative, and mixed methods approaches*. Sage publications, 2017.
- [43] J. Hair, W. C. Black, B. Babin, R. Anderson, and R. Tatham, “Pearson new international edition,” *Multivariate Data Analysis, Seventh Edition*. Pearson Education Limited Harlow, Essex, 2014.
- [44] K. G. Jöreskog and D. Sörbom, *LISREL 8: User’s reference guide*. Scientific Software International, 1996.
- [45] IPST, “How well schools and students are ready for online learning: PISA findings.” [Online]. Available: <https://pisathailand.ipst.ac.th/issue-2020-51/>
- [46] L. Darling-Hammond, M. E. Hyster, and M. Gardner, “Effective teacher professional development,” *Learning Policy Institute*, 2017. <https://doi.org/10.54300/122.311>
- [47] Maria Kampen, “5 Ways to make teacher professional development effective [With Examples],” April 24, 2019. [Online]. Available: <https://www.prodigygame.com/in-en/blog/teacher-professional-development/>
- [48] Carol A. Ribeiro, “Six key components of effective online instruction,” Jan 15, 2017. [Online]. Available: <https://www.gettingsmart.com/2017/01/15/six-key-components-effective-online-instruction/>
- [49] George Veletsianos, “The 7 elements of a good online course,” June 11, 2020.
- [50] Cathy Li and Farah Lalani, “The COVID-19 pandemic has changed education forever. This is how,” 29 Apr 2020. [Online]. Available: <https://www.weforum.org/agenda/2020/04/coronavirus-education-global-covid19-online-digital-learning/>



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