

# Digital Literacy of Pre-service Teachers in the Period Time of COVID-19 Pandemic

Veena Prachagool

Faculty of Education, Mahasarakham University, Mahasarakham 44000, Thailand

E-mail: veena.p@msu.ac.th

Prasart Nuangchalerm (Corresponding author)

Faculty of Education, Mahasarakham University, Mahasarakham 44000, Thailand

E-mail: prasart.n@msu.ac.th

Parinda Yawongsa

Faculty of Education, Mahasarakham University, Mahasarakham 44000, Thailand

E-mail: byawongsa@gmail.com

Received: August 2, 2022    Accepted: August 31, 2022    Published: September 15, 2022

doi:10.5296/jei.v8i2.20135

URL: <https://doi.org/10.5296/jei.v8i2.20135>

## Abstract

Digital literacy is an important thing for modern pre-service teachers, they are key element to deal with technology for education and motivate classroom with effective infortion technology. This study aims to explore digital literacy of pre-service teachers during time of COVID-19 pandemic. The respondents were 54 pre-service teachers, rated the digital literacy based on the framework of teacher digital literacy, which consisted of 5 components: (1) social responsibility, (2) team-based learning, (3) information management, (4) processing and information presentation, and (5) digital integrity. Result revealed that the level of digital literacy of pre-service teachers is at high level in all components. It indicated that they are ready to deal with technology for education, but digital literacy is still engaged into them and in-service science teachers.

**Keywords:** Digital learning, Digital literacy, Pandemic, Teacher education, Technology education

## 1. Introduction

Due to the COVID-19 pandemic, it affects our livelihood and learning in such different normal ways. Learning cannot be stagnant even if there is an epidemic of pathogens deal with social activities, school need a suitable adaptation in teaching and learning (Langub & Lokey-Vega, 2017; Záhorec et al., 2019). Based on the belief, children cannot stop learning even though school is closed, children can learn through online or appropriate instructional methods. Teachers must find ways to improve development and lead to solutions by instructional diversity (Hobbs & Coiro, 2019; Spires et al., 2019). They don't have to be good at digital technology, but teachers who know technology need to be able to adapt (Spante et al., 2018; Christ, 2019; List, 2019).

Teachers need to be able to learn how to use the internet and other platforms to engage learners' learning. They need to learn how to collaborate on online networks, be responsible for applying technologies to balance them (Akarawang et al., 2015; Dostál et al., 2017a; Polat, 2021). The use of multiple teaching techniques requires stability and security as well as online learning or hybrid learning concerns. This kind of change in learning environments provide teachers with the necessary performance, especially technological performance, which is targeted at helping teachers lead the classroom to success (Prachagool et al., 2016; Rizal et al., 2019). We can see that learners who are in this new era have changed their learning and communications, have enormous access to resources, and these resources are reliable and accurate. If, assuming the teacher is understood to be able to choose the right tools, it will lead the learner to succeed in learning. It can be noted that modern learners have smartphones with a huge number of devices that provide access to classrooms and learning resources (Ata & Yildirim, 2014; Dostál et al., 2017b).

As pandemic appeared, communication skills for teachers and learners are very important, it has changed the world too quickly than can be predicted. In modern times, knowledge is shortened, and it is impossible to accurately predict or predict over a long period of time (Cote & Milliner, 2018; Madsen et al., 2018). Because the world is a volatile world, therefore, teachers can give learners to learn of whatever based on needs, is to prepare them knowingly to opt in as well as necessary for living in the future (Sadaf & Johnson, 2017; Hahim, 2018; Tomczyk, 2020). Teachers can provide teaching and learning during the period of pandemic by proper tools and methods. These are important goals for teaching and learning in the 21<sup>st</sup> century (Nuangchalerm, 2017). Self-understanding, understanding of others, knowing social responsibility, knowing how to lead to posting information that are important for all learners and also teachers.

The development of teachers is to know about the use of basic information technology as a computer device. Tools, especially when problems with computer devices are using issues. The use of information technology in teaching and learning requires to current situations and schooling (Jan, 2017). Teachers should design and develop modern teaching materials as well as integrating techniques to create a learning environment. In addition, they are responsible for the honor and does not violate other people's rights or violate works or copy works both intentionally and unintentionally (Castellví et al., 2020; Yasmin et al., 2020; Doni et al.,

2021). Therefore, the adoption of technology will improve the profession, develop both academic knowledge and develop the skills necessary for teachers. The application of information technology will lead to teachers continuing to develop themselves and be quality teachers in modern times (Asrizal et al., 2018; Bilyalova et al., 2019; Indriyani, 2019; Supardi, 2021).

Pre-service teacher is an in-service in the future, if they have no or less digital literacy it may cause quality of learners and quality of education in the following. Pre-service teachers need to learn and adapt their learning capability to meet the requirements of modern world. The pandemic situation, pre-service teachers need to prepare themselves to design and manage their classroom activities through smart choices, smart technology, and ready to deal with digital age. Nuangchalerm et al. (2020) studied the readiness of pre-service science teachers, they were mostly prepared themselves is at high level for digital learning. While their creativity and innovation for digital learning is at medium level (Nuangchalerm, 2017). They can employ search engines to explore useful information, but quite not sure that the information was reliable, cyber safety awareness, and so on. Also, the relationships between pre-service teachers' digital literacy level is significant to degree of educational technology and learning management (Bond et al., 2018; Bahcivan et al., 2019; Maher, 2020; Polat, 2021).

The relevant approach to promoting and developing information technology for teachers is that those involved in the policy, teachers must develop and provide training to enhance educational technology skills and digital learning competencies. In order to manage learning using the right techniques and to choose technology that meets nature, learners (Sahin & Sahin, 2021). These factors will help students to raise their academic achievements and also create a good attitude towards learning using information technology. This study aims to study perception of pre-service teachers on digital literacy during COVID-19 pandemic. It will be useful for educators to design and tailor their classroom to promote digital literacy as well as in-service teachers in the future.

## **2. Method**

This research purposes to examine the pre-service teachers' perception on digital literacy during COVID-19 pandemic, online learning situation and learn from home are base of surveying. An online survey was conducted during June-July 2021 for investigating pre-service teachers' perception on digital literacy.

### *2.1 Respondent*

The respondents were pre-service science teachers who enrolled course Selected Topics in Science Teaching and learning, 54 respondents participated and volunteered to express their perception on digital literacy. Due to the stream of online learning and social network are now important to all. They have to adopted and implied digital technology for education into their professional practices. Respondents were pre-service science teachers from one university, Thailand which was in field of bachelor in education, 4<sup>th</sup>-year of study in general sciences majoring, and joined by online communication.

## 2.2 Research Tool

Participants rated the digital literacy that they experienced on a Likert 5-point scale, ranging from 1 (lowest) to 5 (highest). The research tool was adapted from Sánchez-Cruzado et al. (2021) and drawn up from the responses to the validated questionnaire ACDC (Analysis of Common Digital Competences) (Garcia-Martin & Garcia-Sanchez, 2017; Touron et al., 2018). Based on the framework of teacher digital literacy, research tool is a questionnaire which consisted of 5 components: (1) social responsibility, (2) team-based learning, (3) information management, (4) processing and information presentation, and (5) digital integrity.

## 2.3 Data Collection

Data were collected by inviting pre-service teachers enrolled course Innovative Instruction in Sciences 1 from one university, located in the northeastern part of Thailand. They participated the classroom through online learning within COVID-19 pandemic, surveying was conducted in first semester, academic year 2021. The researcher requested all pre-service teacher response digital literacy through online survey. Data were collected, obtained, and recheck the completeness before generate to worksheet and interpretation.

## 2.4 Data analysis

Digital literacy of pre-service teachers was analyzed by descriptive statistics, mean and standard deviation. The level of digital literacy can be calculated and interpreted by indicating into 5 levels of mean for interpreting: highest (4.51-5.00), high (3.51-4.50), medium (2.51-3.50), low (1.51-2.50), and lowest (1.00-1.50). Data was presented in the descriptive exploration and discussed about digital learning.

## 3. Result and Discussion

The level of digital literacy of pre-service science teachers in this study is at high level in all components. Looking back to the item in each component can be reported that a few items is reach the highest level, *i.e.*, *Social responsibility*—I realized that cyber bullying was something not to do, I do not use the Internet to take advantage of other people, even if there are opportunities and times to act, and *Digital integrity*—I am aware of the right to use and access information online. But the medium level found only 1 item which occurred in *Team-based learning*—I like to work with friends who have group assignments online. The level of digital literacy of pre-service teachers during COVID-19 pandemic is at high level and indicated that they are ready to deal with technology for education (Table 1). In addition, they can design classroom to meet the requirements of teacher competency in 21<sup>st</sup> century. The learning and teaching barriers in such pandemic allowed and accelerated them to prepare technology for education.

Table 1. Level of digital literacy

Item	Mean	SD	Level of digital literacy
<i>Social responsibility</i>	4.31	0.88	High
I am aware of the dangers posed by internet use	4.23	0.84	High
My use of the Internet is not careful. Without causing trouble to others	4.47	0.65	High
I do not use the Internet to take advantage of other people, even if there are opportunities and times to act	4.60	0.88	Highest
I have politely and respectfully communicated with others over the Internet	4.30	0.66	High
I realized that cyber bullying was something not to do	4.91	0.28	Highest
When I saw that an inappropriate message had been posted, I will report media providers on the line	3.66	1.24	High
I can classify/bypass internet law in accordance with computer law	4.43	0.62	High
When a friend sees me at risk of acting inappropriately over the Internet, Friends are always on the protest	3.87	0.95	High
<i>Team-based learning</i>	4.05	0.96	High
I am ready to work and exchange learning together through online media	4.38	0.77	High
I learned to use programs to collaborate with my friends online	4.15	0.81	High
I like to work with friends who have group assignments online	3.30	1.08	Medium
I want to improve myself to be able to work with friends around the world online	4.36	0.74	High
<i>Information management</i>	3.80	0.76	High
I can plan a search for information	3.87	0.74	High
I can research information through trusted online sources	3.94	0.82	High
I can effectively classify information through online sources	3.70	0.72	High
I can systematically store information through online sources	3.66	0.81	High
I was able to use the stored information for my studies	3.83	0.70	High
<i>Processing and information presentation</i>	3.73	0.75	High
I can use the data to analyze and present it effectively	3.60	0.61	High
I am aware of the differences in presenting information through letters. Pictures or multimedia	4.11	0.70	High
I can use ICT to design presentations very well	3.64	0.82	High
I can use ICT to create presentations	3.66	0.79	High
I can analyze and present information sources	3.68	0.73	High
I can offer a wide range of knowledge such as PowerPoint, Blog, Website	3.74	0.77	High
I was able to process knowledge from a variety of sources	3.74	0.77	High
I can present myself in a variety of ways	3.64	0.74	High
<i>Digital integrity</i>	4.48	0.68	High
I am aware of the right to use and access information online	4.55	0.62	Highest
I am aware of the copyrights, texts and media that appear on the Internet	4.40	0.74	High

On the other hands, the level of digital literacy will be successful, if they bring theory into practice by learn to do with new technology or invite technological pedagogical and content knowledge (TPACK) for their students. TPACK framework is suitable for professional development program and also teacher preparation program (Mishra & Koehler, 2006; Chuang et al., 2015; Martin, 2015; Gill & Dalgarno, 2017; De Rossi & Trevisan, 2018; Nuangchalerm, 2020). The level of digital integrity may be highest mean score and following by social responsibility, team-based learning, information management, and processing and information presentation (Figure 1). It seems to be relevant to teacher's attributes in technology for education, they can introduce students learn in the appropriate way and the right practices (Nuangchalerm, 2011; Nuangchalerm, 2012; Koh et al., 2015).

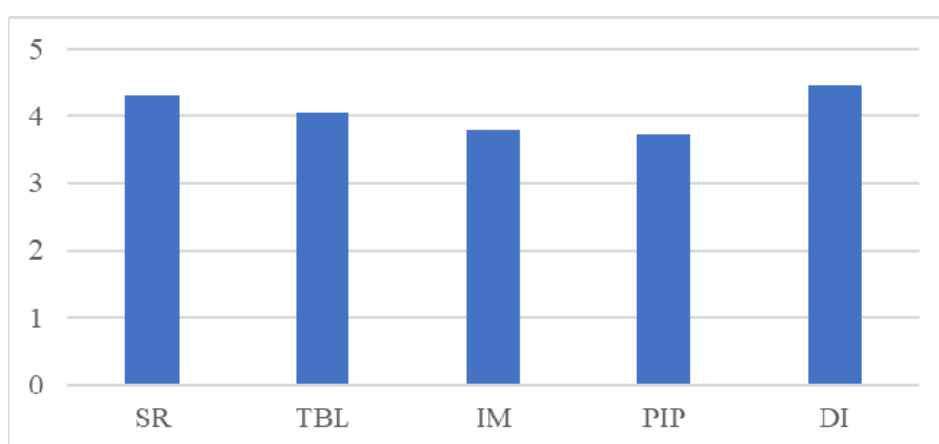


Figure 1. Digital literacy (SR-social responsibility, TBL-team-based learning, IM-information management, PIP-processing and information presentation, DI-digital integrity)

The result indicated that pre-service teachers have the positive and high level of digital literacy. The instructional design and practices can be more upgrade technology for education, engage students to deal with digital literacy, and inquire worldwide knowledge from internet. They can transfer cyber awareness to children and others who surrounding them. The framework of TPACK and integration help them to success in digital learning in the world of change and during or post pandemic (Blum-Ross & Kumpulainen, 2019; Dewi et al., 2019; Listiana et al., 2019; Cabero-Almenara et al., 2020; Juhji & Nuangchalerm, 2020; Nuangchalerm et al., 2020; Major & McDonald, 2021).

Digital literacy for pre-service science teachers is important to prepare qualifying teacher, Techataweewan and Prasertsin (2018) pointed that Thai undergraduate students should have digital literacy by 4 components. It consisted of operation skills, thinking skills, collaboration skills, and awareness skills which related to this study. Program of study in college and university level should promote digital literacy as well as necessary learning skills for 21<sup>st</sup> century, apply digital literacy to pedagogical strategies, and appropriate skills for educational technology integration. While Chanunan and Brückner (2019) assessed the level of digital

literacy of instructors at higher education from Thailand. Finding revealed that instructors had digital literacy at moderate level, several instructors still employed simple forms of digital technologies for instructional practices.

However, the study conducted in the period of COVID-19 pandemic and the participants are ready to work with modern classroom. Technology and digital learning are not difficult to learn and adopt to their students. The new challenge for digital learning concerns intrinsic factors especially, social responsibility, critical thinking and decision making based on authentic awareness about information technology uses (Lin & Chen, 2017; Saputra et al., 2020; Sayaf et al., 2021). Pre-service teachers can help students learn cognitive knowledge, but attributes and skills cannot be rejected from the school curriculum. Digital literacy should be motivated and promoted into learning areas for making information technology in effective and sustainable learning.

#### 4. Conclusion

Based on the framework of teacher digital literacy, research tool is a questionnaire which consisted of 5 components: (1) social responsibility, (2) team-based learning, (3) information management, (4) processing and information presentation, and (5) digital integrity. This study showed that pre-service science teachers had the level of digital literacy is at high level in all components. However, teacher in 21<sup>st</sup> century should have training and professional development in digital learning and dealing with digital literacy for helping their students to reach the goal of digital citizens and sustainable learning environments.

#### Acknowledgements

This research project was financially supported by Mahasarakham University.

#### References

- Akarawang, C., Kidrakran, P., & Nuangchalerm, P. (2015). Enhancing ICT competency for teachers in the Thailand basic education system. *International Education Studies*, 8(6), 1-8. <https://doi.org/10.5539/ies.v8n6p1>
- Asrizal, A., Amran, A., Ananda, A., Festiyed, F., & Sumarmin, R. (2018). The development of integrated science instructional materials to improve students' digital literacy in scientific approach. *Jurnal Pendidikan IPA Indonesia*, 7(4), 442-450. <https://doi.org/10.15294/jpii.v7i4.13613>
- Astuti, M., Arifin, Z., Mutohhari, F., & Nurtanto, M. (2021). Competency of digital technology: the maturity levels of teachers and students in vocational education in Indonesia. *Journal of Education Technology*, 5(2), 254-262. <https://doi.org/10.23887/jet.v5i3.35108>
- Ata, R., & Yıldırım, K. (2019). Exploring Turkish pre-service teachers' perceptions and views of digital literacy. *Education Sciences*, 9(1), 40. <https://doi.org/10.3390/educsci9010040>
- Bahcivan, E., Gurer, M. D., Yavuzalp, N., & Akayoglu, S. (2019). Investigating the relations among pre-service teachers' teaching/learning beliefs and educational technology integration competencies: A structural equation modeling study. *Journal of Science Education and*

*Technology*, 28(5), 579-588. <https://doi.org/10.1007/s10956-019-09788-6>

Bilyalova, A. A., Salimova, D. A., & Zelenina, T. I. (2019). *Digital transformation in education*. (pp. 265-276) International Conference on Integrated Science. Springer. [https://doi.org/10.1007/978-3-030-22493-6\\_24](https://doi.org/10.1007/978-3-030-22493-6_24)

Blum-Ross, A., & Kumpulainen, K. (2019). *Enhancing digital literacy and creativity*. London: Routledge. <https://doi.org/10.4324/9780429243264>

Bond, M., Marín, V. I., Dolch, C., Bedenlier, S., & Zawacki-Richter, O. (2018). Digital transformation in German higher education: student and teacher perceptions and usage of digital media. *International Journal of Educational Technology in Higher Education*, 15(1), 1-20. <https://doi.org/10.1186/s41239-018-0130-1>

Cabero-Almenara, J., Romero-Tena, R., & Palacios-Rodríguez, A. (2020). Evaluation of teacher digital competence frameworks through expert judgement: The use of the expert competence coefficient. *Journal of New Approaches in Educational Research*, 9(2), 275-293. <https://doi.org/10.7821/naer.2020.7.578>

Castellví, J., Díez-Bedmar, M. C., & Santisteban, A. (2020). Pre-service teachers' critical digital literacy skills and attitudes to address social problems. *Social Sciences*, 9(8), 134. <https://doi.org/10.3390/socsci9080134>

Chanunan, S., & Brückner, M. (2019). Digital literacy of higher education instructors in Thailand. *Journal of Education Naresuan University*, 21(3), 1-27.

Christ, T., Arya, P., & Liu, Y. (2019). Technology integration in literacy lessons: Challenges and successes. *Literacy Research and Instruction*, 58(1), 49-66. <https://doi.org/10.1080/19388071.2018.1554732>

Chuang, H. H., Weng, C. Y., & Huang, F. C. (2015). A structure equation model among factors of teachers' technology integration practice and their TPACK. *Computers and Education*, 86, 182-191. <https://doi.org/10.1016/j.compedu.2015.03.016>

Cote, T., & Milliner, B. (2018). A survey of EFL teachers' digital literacy: A report from a Japanese university. *Teaching English with Technology*, 18(4), 71-89.

De Rossi, M., & Trevisan, O. (2018). Technological Pedagogical Content Knowledge in the literature: how TPACK is defined and implemented in initial teacher education. *Italian Journal of Educational Technology*, 26(1), 7-23. <https://doi.org/10.17471/2499-4324/988>

Dewi, R. K., Wardani, S., Wijayati, N., & Sumarni, W. (2019). Demand of ICT-based chemistry learning media in the disruptive era. *International Journal of Evaluation and Research in Education*, 8(2), 265-270. <https://doi.org/10.11591/ijere.v8i2.17107>

Doni, C. P., Husain, D., Saleh, S. R., Pakaya, N. A., Tjalau, C. A., & Arsyad, B. (2021). Challenges of digital literacy education in pandemic period. *Journal of Education Review Provision*, 1(1), 18-22. <https://doi.org/10.55885/jerp.v1i1.43>

Dostál, J., Wang, X., & Nuangchalerm, P. (2017a). Experiments in education supported by



computer use: Teachers' attitudes towards computers. *Proceeding of the 9<sup>th</sup> International Conference on Computer Supported Education, April 21-23, 2017, Porto, Portugal* (pp. 248-254). <https://doi.org/10.5220/0006321302480254>

Dostál, J., Wang, X., Steingartner, W., & Nuangchalerm, P. (2017b). Digital intelligence-new concept in context of future school of education. *Proceedings of ICERI2017 Conference, November 16-18, 2017, Seville, Spain* (pp. 3706-3712). <https://doi.org/10.21125/iceri.2017.0997>

Garcia-Martin, J., & Garcia-Sanchez, J. N. (2017). Pre-service teachers' perceptions of the competence dimensions of digital literacy and of psychological and educational measures. *Computers & Education, 107*, 54-67. <https://doi.org/10.1016/j.compedu.2016.12.010>

Gill, L., & Dalgarno, B. (2017). A qualitative analysis of pre-service primary school teachers' TPACK development over the four years of their teacher preparation programme. *Technology, Pedagogy and Education, 26*(4), 439-456. <https://doi.org/10.1080/1475939X.2017.1287124>

Hashim, H. (2018). Application of technology in the digital era education. *International Journal of Research in Counseling and Education, 2*(1), 1-5. <https://doi.org/10.24036/002za0002>

Hobbs, R., & Coiro, J. (2019). Design features of a professional development program in digital literacy. *Journal of Adolescent & Adult Literacy, 62*(4), 401-409. <https://doi.org/10.1002/jaal.907>

Indriyani, V. (2019). Digital literacy competencies for teacher education students. *1st International Conference on Education Social Sciences and Humanities (ICESSHum 2019)* (pp. 1010-1018). Atlantis Press.

Jan, H. (2017). Teacher of 21st century: Characteristics and development. *Research on Humanities and Social Sciences, 7*(9), 50-54.

Juhji, J., & Nuangchalerm, P. (2020). Interaction between scientific attitudes and science process skills toward technological pedagogical content knowledge. *Journal for the Education of Gifted Young Scientists, 8*(1), 1-16. <https://doi.org/10.17478/jegys.600979>

Koh, J. H. L., Chai, C. S., Benjamin, W., & Hong, H. Y. (2015). Technological Pedagogical Content Knowledge (TPACK) and design thinking: A framework to support ICT lesson design for 21<sup>st</sup> century learning. *The Asia-Pacific Education Researcher, 24*(3), 535-543. <https://doi.org/10.1007/s40299-015-0237-2>

Langub, L. W., & Lokey-Vega, A. (2017). Rethinking instructional technology to improve pedagogy for digital literacy: A design case in a graduate early childhood education course. *TechTrends, 61*(4), 322-330. <https://doi.org/10.1007/s11528-017-0185-1>

Lin, M. H., & Chen, H. G. (2017). A study of the effects of digital learning on learning motivation and learning outcome. *Eurasia Journal of Mathematics, Science and Technology Education, 13*(7), 3553-3564. <https://doi.org/10.12973/eurasia.2017.00744a>

- List, A. (2019). Defining digital literacy development: An examination of pre-service teachers' beliefs. *Computers & Education, 138*, 146-158. <https://doi.org/10.1016/j.compedu.2019.03.009>
- Listiana, I., Abdurrahman, A., Suyatna, A., & Nuangchalerm, P. (2019). The effect of Newtonian dynamics STEM-integrated learning strategy to increase scientific literacy of senior high school students. *Jurnal Ilmiah Pendidikan Fisika Al-Biruni, 8*(1), 43-52. <https://doi.org/10.24042/jipfalbiruni.v8i1.2536>
- Madsen, S. S., Thorvaldsen, S., & Archard, S. (2018). Teacher educators' perceptions of working with digital technologies. *Nordic Journal of Digital Literacy, 13*(3), 177-196. <https://doi.org/10.18261/issn.1891-943x-2018-03-04>
- Maher, D. (2020). Pre-service teachers' digital competencies to support school students' digital literacies. *Handbook of Research on Literacy and Digital Technology Integration in Teacher Education* (pp. 29-46). IGI Global. <https://doi.org/10.4018/978-1-7998-1461-0.ch002>
- Major, C., & McDonald, E. (2021). Developing instructor TPACK: A research review and narrative synthesis. *Journal of Higher Education Policy and Leadership Studies, 2*(2), 51-67. <https://doi.org/10.52547/johepal.2.2.51>
- Martin, B. (2015). Successful implementation of TPACK in teacher preparation programs. *International Journal on Integrating Technology in Education, 4*(1), 17-26. <https://doi.org/10.5121/ijite.2015.4102>
- Mishra, P., & Koehler, M. (2006). Technological Pedagogical Content Knowledge: A framework for teacher knowledge. *Teachers College Record, 108*(6), 1017-1054.
- Nuangchalerm, P. (2011). In-service science teachers' pedagogical content knowledge. *Studies in Sociology of Science, 2*(2), 33-37. <https://doi.org/10.1111/j.1467-9620.2006.00684.x>
- Nuangchalerm, P. (2020). TPACK in ASEAN perspectives: Case study on Thai pre-service teacher. *International Journal of Evaluation and Research in Education, 9*(4), 993-999. <https://doi.org/10.11591/ijere.v9i4.20700>
- Nuangchalerm, P. (2012). Enhancing pedagogical content knowledge in preservice science teachers. *Higher Education Studies, 2*(2), 66-71. <https://doi.org/10.5539/hes.v2n2p66>
- Nuangchalerm, P. (2017). Preservice teachers' twenty first century learning skills: Three different majors of study. *International Journal of Advanced and Applied Sciences, 4*(7), 124-128. <https://doi.org/10.21833/ijaas.2017.07.018>
- Nuangchalerm, P., Prachagool, V., & Dostál, J. (2020). Digital learning of pre-service teachers during COVID-19 outbreak. *Journal of Technology and Information Education, 12*(2), 143-151. <https://doi.org/10.5507/jtie.2020.007>
- Nuangchalerm, P., Prachagool, V., Prommaboon, T., Juhji, J., Imroatun, I., & Khaeroni, K. (2020). Views of primary Thai teachers toward STREAM education. *International Journal of*

*Evaluation and Research in Education*, 9(4), 987-992. <https://doi.org/10.11591/ijere.v9i4.20595>

Polat, M. (2021). Pre-service teachers' digital literacy levels, views on distance education and pre-university school memories. *International Journal of Progressive Education*, 17(5), 299-314. <https://doi.org/10.29329/ijpe.2021.375.19>

Prachagool, V., Nuangchalerm, P., Subramaniam, G., & Dostal, J. (2016). Pedagogical decision making through the lens of teacher preparation program. *Journal for the Education of Gifted Young Scientists*, 4(1), 41-52. <https://doi.org/10.17478/JEGYS.2016116351>

Rizal, R., Setiawan, W., & Rusdiana, D. (2019). Digital literacy of preservice science teacher. *Journal of Physics: Conference Series*, 1157(2), 022058. <https://doi.org/10.1088/1742-6596/1157/2/022058>

Sadaf, A., & Johnson, B. L. (2017). Teachers' beliefs about integrating digital literacy into classroom practice: An investigation based on the theory of planned behavior. *Journal of Digital Learning in Teacher Education*, 33(4), 129-137. <https://doi.org/10.1080/21532974.2017.1347534>

Sahin, F., & Sahin, Y. L. (2021). Examining the acceptance of E-Learning systems during the pandemic: The role of compatibility, enjoyment and anxiety. *International Technology and Education Journal*, 5(1), 1-10.

Sánchez-Cruzado, C., Santiago Campión, R., & Sánchez-Compañá, M. (2021). Teacher digital literacy: The indisputable challenge after COVID-19. *Sustainability*, 13(4), 1858. <https://doi.org/10.3390/su13041858>

Saputra, M., Siddiq, A., & Huda, I. (2020). Social media and digital citizenship: The urgency of digital literacy in the middle of a disrupted society era. *International Journal of Emerging Technologies in Learning*, 15(7), 156-161. <https://doi.org/10.3991/ijet.v15i07.13239>

Sayaf, A. M., Alamri, M. M., Alqahtani, M. A., & Al-Rahmi, W. M. (2021). Information and communications technology used in higher education: An empirical study on digital learning as sustainability. *Sustainability*, 13(13), 7074. <https://doi.org/10.3390/su13137074>

Spante, M., Hashemi, S. S., Lundin, M., & Algers, A. (2018). Digital competence and digital literacy in higher education research: Systematic review of concept use. *Cogent Education*, 5(1), 1519143. <https://doi.org/10.1080/2331186X.2018.1519143>

Spires, H. A., Paul, C. M., & Kerkhoff, S. N. (2019). Digital literacy for the 21st century. *Advanced methodologies and technologies in library science, information management, and scholarly inquiry* (pp. 12-21). IGI Global. <https://doi.org/10.4018/978-1-5225-7659-4.ch002>

Supardi, S., Juhji, J., Azkiyah, I., Muqdamien, B., Ansori, A., Kurniawan, I., & Sari, A. F. (2021). The ICT basic skills: Contribution to student social media utilization activities. *International Journal of Evaluation and Research in Education*, 10(1), 222-229. <https://doi.org/10.11591/ijere.v10i1.20598>

Techataweewan, W., & Prasertsin, U. (2018). Development of digital literacy indicators for Thai undergraduate students using mixed method research. *Kasetsart Journal of Social Sciences*, 39(2), 215-221. <https://doi.org/10.1016/j.kjss.2017.07.001>

Tomczyk, Ł. (2020). Skills in the area of digital safety as a key component of digital literacy among teachers. *Education and Information Technologies*, 25(1), 471-486. <https://doi.org/10.1007/s10639-019-09980-6>

Touron, J., Martín, D., Navarro, E., Pradas, S., & Inigo, V. (2018). Construct validation of a questionnaire to measure teachers' digital competence (TDC). *Revista Española Pedagogía*, 76, 25-54. <https://doi.org/10.22550/REP76-1-2018-02>

Yasmin, H., Khalil, S., & Mazhar, R. (2020). COVID 19: Stress management among students and its impact on their effective learning. *International Technology and Education Journal*, 4(2), 65-74. <https://doi.org/10.22550/REP76-1-2018-02>

Záhorec, J., Hašková, A., & Munk, M. (2019). Teachers' Professional Digital Literacy Skills and Their Upgrade. *European Journal of Contemporary Education*, 8(2), 378-393. <https://doi.org/10.13187/ejced.2019.2.378>

### **Copyright Disclaimer**

Copyright for this article is retained by the author(s), with first publication rights granted to the journal.

This is an open-access article distributed under the terms and conditions of the Creative Commons Attribution license (<http://creativecommons.org/licenses/by/3.0/>).