

The study of digital literacy components for youths during the COVID-19 pandemic in Bangkok, Thailand

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ABSTRACT

This research paper investigates digital literacy components for youths in Bangkok. The first phase used a qualitative method. The key informants were eight experts in information and communication technology (ICT), human resource (HR), and education. The second phase was to develop the measurement of digital literacy components using the confirmatory factor analysis (CFA) approach with a sample consisting of 1,362 youths in Bangkok. Data collection was conducted through a questionnaire with 52 questions. The results revealed that digital literacy criteria for youths in Bangkok consisted of four factors containing 13 indicators. The first factor and its related access components was three subcomponents, which are: i) use of tools and devices; ii) data collection in the cloud; and iii) internet connection. The second factor was understanding components consisting of evaluation, ethics, and legal literacy. The third factor was use of components consisting of safeguarding, search, sharing, and innovation. The fourth factor was creating components consisting of creating weblogs/applications, presenting on website/application, and safeguarding. CFA was employed to test the construct validity of the research latent variables that revealed the harmony correlation of empirical data contained in this research model. These results were employed to develop a digital literacy for youth during the COVID-19 pandemic in Bangkok, Thailand.

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1. INTRODUCTION

The COVID-19 pandemic has changed almost every aspect of human life since the first reported COVID-19 patient on 1 December 2019 in the capital of Hubei Province, Wuhan, China, a city with a total population of over 11 million [1]. The outbreak was announced to the public on December 31, 2019. In Wuhan City, the World Health Organization (WHO) identified 44 instances of respiratory illness with unclear origin, 11 of which were severe [2], [3]. On the 20th of January 2020, China, Thailand, Japan, and the Republic of Korea reported 282 confirmed cases imported from Wuhan. Ten days later, the WHO declared a Public Health Emergency of International Concern (PHEIC). The WHO officially named the novel coronavirus as the Coronavirus disease 'COVID-19' in February 2020. COVID-19 soon spread to more than 127 countries and territories worldwide (Coronavirus Update, 2020, March 13). By 28 February 2020, confirmed cases increased to 83,652, with 4,691 positive cases and 87 deaths outside of China. On 11 March 2020, the WHO declared the COVID-19 as a pandemic [2]. From March to April 2020, almost all

affected countries announced some sort of lockdown to control the spread of COVID-19, requiring strict physical separation of at least 1 meter. These often unpredictable quarantine measures and lockdowns has created mental trauma in societies [4].

Based on the same source, it is written that since May 2020, as many as 177 countries have shut down schools. According to UNESCO data, it was found that most developed nations decided to close schools during the start of the epidemic and replace classroom instruction with online learning systems [5]. Meanwhile, depending on the severity of the situation, certain developing countries insisted on implementing local closures. A number of difficulties in implementing online learning in underdeveloped countries have been reported: Technological, educational/literacy, and socioeconomic factors all play a role in Nepal [6]; mental and technical online learning readiness in Malaysia [7]–[9]; many academic institutions that had previously been hesitant to adapt their traditional pedagogical method now have no choice but to fully embrace online teaching-learning [10]; Despite the advanced technology in education, scant attention has been paid to university students' online learning experience [11]. However, due to the rapid increase of cases around the world, almost all of the developing countries finally had to take a tough decision to switch to distance learning, along with all its consequences, including Thailand.

In the period of the Covid -19 pandemic, digital literacy is a powerful weapon to keep civilization safe and prevent the spread of the deadly Coronavirus. People have been obliged to work, teach, and learn from home. During this pivotal time, social networking sites, as well as the use of information and communication technology (ICT) and the internet, were crucial in altering the way people communicate, collaborate, create works, solve problems, make decisions, and consume information [12].

Digital literacy has been a concern for, and considered important by, both the public and governments, especially toward youths. Youths can now access information and develop public opinion in decentralized ways thanks to digital media. Youths with high digital literacy abilities will be better equipped to evaluate information and distinguish fact from fiction. This ability is extremely useful when a problem emerges. A solid public opinion may also lead to strong civic participation [13]. Without digital literacy, one may not have the social and participation skills to join conversations online, which can include both factual and fake messages that confuse youths and even impact societal development; thus, digital literacy should be promoted to enhance youths' ability to handle information and communication technology usage [14]–[16]. However, in this era of decreased direct interaction, digital literacy is even more important to support all aspects of research work [17].

Digital literacy issues are increasingly important in Bangkok, with additional need to understand whether digital literacy can reduce the level of online risks, especially for youths. Therefore, one of the best protections is to embed digital literacy into the education system for children and youths so that they can understand the basics of law and computer crimes, and be able to analyze and evaluate media on the internet in a nuanced and efficient manner, which it will protect children and youths from any risks or illegal behavior, that may disguise in media and technology in any other ways. Now that the importance of the subject has been recognized, it is time for researchers to address this gap. Therefore, this research aims to study digital literacy components for youths in Bangkok, Thailand.

2. LITERATURE REVIEW

2.1. Digital literacy definition

Digital literacy has various meanings and apply in various situations. The phrase “digital literacy” refers to the abilities and skills that people need to engage in a digitally empowered society. Digital literacy was first defined as the capacity to understand and apply several branches of information science from a variety of sources in order to present information on a computer. This definition emphasizes conceptual mastery over technical proficiency [18]. A framework for digital literacy with three categories: i) finding and consuming digital content; ii) creating digital content; iii) communicating or sharing digital content [19].

As a result of the compilation of ideas from many educators, it was found that the definition of digital literacy is the ability to manage information, collaborate, communicate, share knowledge, create material and knowledge, evaluate and solve problems, and perform technical operations. It shifted educators' attention from competency development to literacy development [20], [21]. Literacy education will continue to play an important part in modern schooling. In light of the rapid advancement of ICTs, information literacy has been promoted as a new educational goal [22]. Furthermore, digital literacy was described as the process of developing three abilities in order to create an information specialist's digital literacy: information management skills, digital tool usage, and the development of new material, as well as the consolidation of information. The three abilities are founded on the development of cognitive abilities, which must be incorporated into every stage of the developmental process [23].

2.2. Digital literacy during COVID-19 pandemic

COVID-19 affected educational institutions not just in Wuhan, China, where the virus originated, but also affected institutions around the world. Measures to limit the spread of coronavirus infection included the transfer of educational institutions to a remote working model. According to UNESCO data, more than 1.5 billion students in more than 180 countries have suffered from the biggest disruption to the education system since the inception of the United Nations [24]. The consequences of these dramatic changes for the education system, for students, schoolchildren, preschoolers, and their families, are being actively discussed today in the psychological and pedagogical community [25], [26]. This incident underlines the significance of widespread digital literacy throughout the community starting at a young age in order to have access to information. People will find it simpler to use the internet and digital media if they are digitally literate.

Digital literacy plays a significant role in one's ability to learn and master rapidly evolving technology. Digital illiteracy decreases self-control, which might result in online abuse. Children who struggle with digital literacy could develop an addiction to using devices. Children's self-control can be impacted by digital literacy since it enables them to grasp their responsibilities for when, where, and how long they can access online learning independently [27]–[31]. The educational institutions in China have made use of different modes of learning, including online learning based on different platforms to achieve the goal suggested by the Ministry of Education in China, “suspending classes without suspending learning,” since mid-February [32].

In Indonesia, dramatic changes also happened. The government moved to issue a policy to the public not to engage in any activity outside of the home and for all work to be carried out from home in order to inhibit the spread of COVID-19 [33]. Students in Indonesia also face so many difficulties due to this change in the learning experience. One of the solutions by the government of Indonesia is giving a free internet learning quota in cooperation with some available learning platforms.

Further research has been performed to examine the impact of the COVID-19 lockdown on undergraduate and postgraduate students at several West Bengal colleges and universities. Students were emailed a questionnaire link using Google Form via WhatsApp and e-mail, utilizing an online survey. A total of 232 students responded to the survey with complete information. The result showed that students have been facing various problems related to depression, anxiety, poor internet connectivity, and unfavorable study environments at home. This result suggests targeted interventions to create a positive space for study among students from the vulnerable section of society by using strategies that are urgently needed to build a resilient education system in the state to ensure the continued development of the skills for employability and productivity of these young minds [34].

The majority of students in Thailand preferred face-to-face classrooms to online learning, and the majority of them are unwilling to learn online in the future [11]. However, most of the students believed that their instructors were willing to provide them with some assistance and useful feedback during the period of ‘forced’ online learning. The findings provide important implications for instructors and teachers when it comes to online learning, and teaching in a similar context.

2.3. Digital literacy components

Academics and organizations involved in media and digital media use the term for talent that is under digital literacy. The components of digital literacy are categorized into eight elements as: access, manage, integrate, evaluate, create, and communication, analysis, synthesis [35]. Meanwhile, the competencies of digital and media literacy are divided into five performances as: information and data literacy, communication and collaboration, digital content creation, safety, and problem solving [36]. In turn, the ability of digital cognition is broken down into seven elements as: technical, information management, communication, collaboration, creativity, critical thinking, and problem solving [37]. As a result, digital literacy encompasses an individual's decision-making process. Information literacy is concerned with a user's conduct when searching the internet, hypertext navigation, knowledge assembly, and content evaluation [21].

Later, information literacy is considered a 21st-century digital skill that should include seven basic skills and five contextual skills [37]. Seven basic skills are: technical skills, information management, communication, teamwork, creativity, critical thinking, and problem-solving are among the basic competencies. Five contextual skills are as: ethical awareness, cultural awareness, flexibility, self-direction, and lifelong learning. More recently, it is suggested that there is a strong positive association between the students' inattentiveness to study and their psychological conditions which involve anxiety, depression, tension, restlessness, boredom, and fear/panic during the COVID-19 pandemic [38]. This contrasts with the research which revealed what students liked about learning from home during the COVID-19 crisis, which was grouped into three overarching themes flexibility and efficiency, self-care and self-development, and learning new technology [39].

In Thailand, digital literacy is described as the ability to use digital materials, which includes the ability to define, access, assess, manage, integrate, create, and communicate [40]. The ability to access,

manage, integrate, analyze, create, and communicate were characterized as six characteristics of digital literacy for Thai students [41]. There are 19 indicators in their model. Later, a research paper synthesized the digital literacy components as the following seven skills: access, analytical, evaluation, creative, communication, reflection, and taking action [42]. More recently, a research paper revealed that digital literacy criteria for Thai undergraduate students consisted of four factors containing 12 indicators [43]. The first factor and its related operation skills consisted of cognition, invention, and presentation. The second factor was thinking skills consisting of analysis, evaluation, and creativity. The third factor was collaboration skills consisting of teamwork, networking, and sharing. The fourth factor was awareness skills consisting of ethics, law literacy, and safeguarding self.

3. RESEARCH METHOD

This research used the exploratory design for mixed methods approach [44]. The research design started with qualitative data to explore the phenomenon of digital literacy for youths in Bangkok, Thailand during the COVID-19 pandemic. The results of the qualitative phase were developed into digital literacy criteria and verified by the quantitative phase. The research methodology employed two phases. The first phase used a qualitative method consisting of two processes. The first process was an analysis and synthesis of digital literacy for youths in Bangkok during the COVID-19 pandemic by reviewing documents and research in Thailand and elsewhere. The output of this process led to a definition of digital literacy plus a conceptual framework for digital literacy that applies to most of Bangkok society [45].

The second process involved verification of the framework through focus group discussion. The research tool for collecting data was a semi-structured question form evaluated by three experts for content validity of the questions. The approved questions earned an index of item objective congruence (IOC) score of 0.80-1.00 for the following questions: i) How is digital literacy important during COVID-19 pandemic?; ii) How does digital literacy enhance effectiveness education of youths in Bangkok?; iii) Which factor is the most important for youths in Bangkok? Why?; iv) What are the definitions of the digital literacy indicators?

The researchers made appointments with eight participants using the questions. The informants had expertise in education, digital technology, and human resource management. Data collection took place in December 2020. All data was analyzed for content and a framework of digital literacy was finalized for youths in Bangkok during the COVID-19 pandemic.

The third process involved analysis of the focus group discussion. This analysis had to fulfil four critical qualities – it had to be systematic, verifiable, sequential, and continuous. To provide an audit trail, the analysis plan must be documented in a reproducible manner that is understandable to all members of the research team. For a continuous analysis, the focus group is followed by subsequent discussion until no new ideas, categories, and themes emerge. Analyzing transcribed data of focus group discussions can be performed manually. In content analysis, the quotes are then arranged into categories. These categories may need to be divided into subcategories or combined into a larger category. Throughout the analysis, the main research question or study purpose guides the researcher's focus [45].

The second phase of the research used a quantitative method that aimed to develop the measurement of digital literacy indicators using confirmatory factor analysis (CFA) and a sample of 1,362 youths (13-18 years old) in Bangkok. In adherence to the principles of CFA, the number of samples followed the recommendations of Bentler and Chou, who suggest 5 to 20 samples for each parameter [46]. The Gagne and Hancock criterion was also followed, which required a minimum of 400 samples [47]. Data collection was conducted through a questionnaire containing 52 questions from April-June 2022. Questionnaires were used to obtain information. The questionnaire responses were categorized into five levels, from most to fewest.

There were four latent variables in the questionnaire's 52 questions. The first latent variable included 12 questions concerning access components (3 indicators consisting of 4 questions on use tool and device, 4 questions on data collection in the cloud, and 4 questions on internet connection). The second latent variable involved 12 questions on understanding (3 indicators consisted of 4 questions on evaluation, 4 questions on ethics, and 4 questions on legal literacy). The third latent variable had 12 questions of use (4 indicators consisting of 4 questions on safeguarding self, 4 questions on search, 4 questions on sharing, and 4 questions on networking). The last latent variable had 16 questions on creating (3 indicators consisting of 4 questions on creating a weblog/application, 7 questions on presenting websites/applications, and 4 questions on innovation). The analysis was performed through survey components analyzed on rotational axes using the Statistics Package for Social Sciences (SPSS) for Windows software and confirmative analyses using Linear Structural Relations (LISREL) 8.72.

4. RESULTS

The content analysis of the literature review and the interviews was used to validate the framework. This resulted in three dimensions of the definition of digital literacy: how to enhance the effectiveness of youths in Bangkok, plus identification of the factors and indicators of digital literacy for youths in Bangkok. The definition of digital literacy included a set of abilities to utilize and be aware of digital information, technology, and media for access components, understanding components, use components, and creating components. Here are sample quotes from each of the interviewees that provide an overview of each perspective of digital literacy:

“The issue of technology literacy must be examined in the context of Thai society, which has a parity issue, as well. Even in the country’s capital, the wealth gap between the rich and the poor is far too wide. Different technologies have an impact on how people comprehend and use them. The discretion in the use of technological media, for example, can determine how readily it can mislead online. One evident example is the use of electronic media with prudence, which might affect how readily one can mislead online, particularly among young people.” (participants, December 12, 2021)

“The impact of technology on end-users is solely technological, such as being duped, duped, or using words or messages to abuse each other online. The young are not sufficiently protected from these issues. Furthermore, information sharing, including illicit access to information, is critical since these difficulties coincide with the maturation of children and young people in this COVID-19 era who are unable to interact with real people.” (participants, December 12, 2021)

“In this modern day, there are a variety of ways for teenagers to gain life skills. We must also include the capacity to use modern technologies or digital media when determining what knowledge, skills, and abilities today’s youngsters require, and to what extent will they be accepted and used in real-world scenarios. Personally, I believe that the capacity to create innovative digital media and communicate information through social media platforms is a critical talent.” (participants, December 12, 2021)

“Today’s technology evolves at a breakneck pace, with a plethora of platforms opting to store a variety of confidential data on hand. Knowing how to use the Internet, Wi-Fi, Bluetooth, and cloud data are all important skills. In the COVID-19 era, where teachers may not be the sole determinant in obtaining knowledge and growing competence, the more proficient the systematic storing of data and the faster the retrieval of information, and the larger the competitive advantage. Because who is competent is determined not by who knows more, but by who can use their knowledge more accurately, swiftly, and creatively online.” (participants, December 12, 2021)

The digital literacy (DL) factors and indicators for youths in Bangkok, Thailand during the COVID-19 pandemic were synthesized from documents and interviews. The results revealed four factors comprising access (ACC), understanding (UND), use (USE), and creating (CRE), which consist of 13 indicators. Access components consist of three indicators: tool and device use (UTD), data collection in the cloud (CDC), and internet connection (CNT). The first indicator is a tool and device use, which refers to the ability to use tools, equipment, digital technology, and other task management systems in order to gain access to knowledge and cooperate with others to meet learning objectives. The data collection in the cloud indicator refers to instant access to data as well as the capacity to modify and send files to others over the internet, interact successfully, and work on projects together. Internet connection refers to access to cellular mobile networks, wireless LAN, Bluetooth, ZigBee, ultra-wideband networks, Wi-Fi, and satellite networks.

Understanding components consist of three indicators: evaluation (EVA), ethics (ETC), and legal literacy (LGL). Evaluation refers to analyzing, comparing, and critically evaluating the credibility and trustworthiness of data, information, and digital content sources. Ethics refers to activities that are generally acceptable by society or that are based on theology. In digital technology communications, this involves the netiquette of recognizing the diversity and inequality of social groups. Legal literacy is the knowledge, comprehension, and adherence to laws and regulations governing the use and accessibility of information technology and digital media.

Use components consist of four indicators: safeguarding self (SGS), search (SEA), sharing (SHA), and networking (NET). Safeguarding self is the ability to manage personal data with awareness of the risks that exist on the internet to protect your device, content, personal data, and privacy in the digital environment, including protecting physical and mental health and realizing digital technology for social well-being and social inclusion while being aware of the environmental impact of digital technology and its use. Search refers to articulating information needs, searching for data, information, and content in digital

environments, accessing them, and navigating between them in order to create and update personal search strategies. Sharing is the ability to offer shared resources along with data connectivity. The user is no longer tied to a particular location or device to upload, access, or share data, which has enabled users to add more mobile devices/computing on such networks to improve their mobility and reduce infrastructure costs for personal data sharing. Networking is the technique of transferring and sharing data between nodes through a shared medium. The design, development, and use of a network are all part of networking, as is the management, maintenance, and operation of the network infrastructure, software, and policies.

Creating components consist of three indicators: creating a weblog/application (CWA), presenting websites/applications (PRE), and innovation (INV). Creating a weblog/application refers to creating data information by means of design, improvement, and application to solve problems or create new works that produce creative expressions, media output, and programming; and dealing with applying intellectual property rights and licenses. The presenting websites/applications is the effectiveness of the skills and knowledge to present information/data effectively through digital devices and applications in various formats such as the selection of an appropriate format for a given target audience and for receiving effective feedback. Innovation is the skills and knowledge to use ICT devices and applications for further development and contribution to education.

The digital literacy factors and indicators were employed in the questionnaire that contained 52 questions. The collection of data was analyzed by the correlation of variables as shown in Table 1. The parameters of the digital literacy scale for youths in Bangkok during the COVID-19 pandemic were organized into two levels. In Table 1, the correlation matrix analysis of the 13 observed variables shows the correlation among latent variables with a significant level of statistical correlation at 0.01. The correlation value ranged between 0.028 and 0.742. This revealed that the model fit the empirical data with the following: Chi-square=24.24 for 12 degrees of freedom; $p=0.01888$; root mean square error of approximation (RMSEA)=0.028; root mean square residual (RMR)=0.0015; goodness of fit index (GFI)=1.00; adjusted goodness of fit index (AGFI)=0.98; Model Akaike information criterion (AIC)=184.24; Saturated AIC=182.00; Model consistent Akaike information criterion (CAIC)=678.95; Saturated CAIC=744.73.

Table 1. Correlation coefficients of characteristic variables on the digital literacy scale for youths in Bangkok during the COVID-19 pandemic

VAR	UTD	CDC	CNT	EVA	ETC	LGL	SGS	SEA	SHA	NET	CWA	PRE	INV
Utd	1.000												
Cdc	0.728	1.000											
Cnt	0.736	0.768	1.000										
Eva	0.512	0.487	0.604	1.000									
Etc	0.451	0.501	0.482	0.510	1.000								
Lgl	0.307	0.346	0.369	0.317	0.501	1.000							
Sgs	0.402	0.349	0.398	0.343	0.528	0.710	1.000						
Sea	0.240	0.182	0.275	0.258	0.342	0.378	0.468	1.000					
Sha	0.200	0.162	0.213	0.255	0.275	0.231	0.339	0.623	1.000				
Net	0.294	0.226	0.228	0.234	0.294	0.315	0.399	0.666	0.766	1.000			
Cwa	0.380	0.478	0.449	0.267	0.402	0.339	0.359	0.436	0.441	0.452	1.000		
Pre	0.273	0.345	0.271	0.204	0.298	0.183	0.244	0.330	0.486	0.409	0.643	1.000	
Inv	0.270	0.331	0.331	0.236	0.308	0.222	0.288	0.407	0.488	0.451	0.691	0.640	1.000
Mean	3.446	3.558	3.553	3.487	3.856	3.947	4.028	4.445	3.865	4.337	3.887	4.656	4.482
SD	0.639	0.746	0.688	0.732	0.823	0.698	0.775	0.624	0.925	0.698	0.783	0.884	0.760

The first order factor analysis of the 13 components revealed complete standardization weights from 0.568 to 0.933, and reliability ranging from 0.268 to 0.846. The weight factors of latent variables (access, understanding, use, and creating) were 0.867, 0.893, 0.828, and 0.546, respectively. The value of reliability according to Cronbach's alpha coefficient of correlation was 0.456, 0.803, 0.688, and 0.358, respectively. The measurement model of digital literacy for youths in Bangkok during the COVID-19 pandemic is shown in Figure 1.

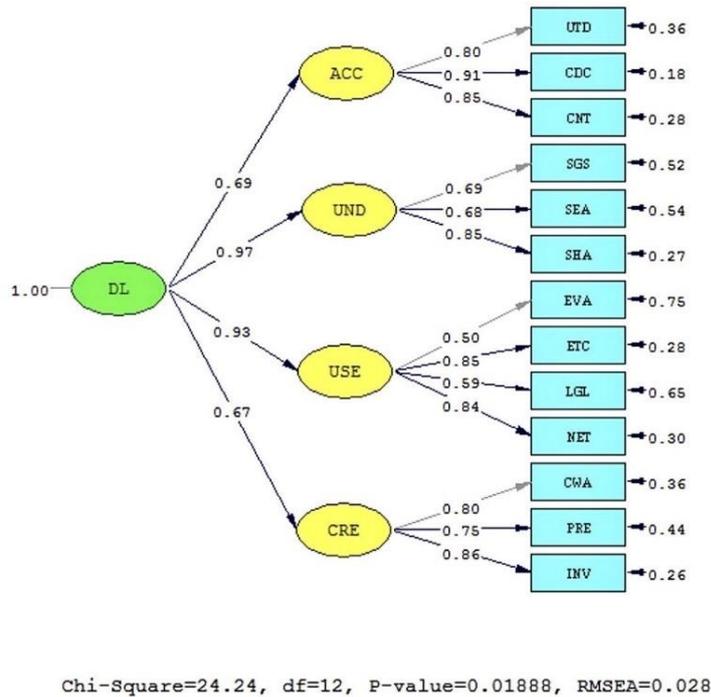


Figure 1. Measurement model of digital literacy for youths in Bangkok during the COVID-19 pandemic

5. DISCUSSION

Our findings on digital literacy factors support the following previous studies. Jamieson who found that literacy factors are determined by access, use, understanding, critical thinking, collaborating, creating, and communication [48]; Phuapan *et al.* who determined the following elements of digital literacy: define, access, evaluate, manage, integrate, create, and communicate [41]; Komcharoen and Polnigongit who specified that digital literacy is described in detail as: access, analytical, evaluation, creative, communication, reflect, and taking action [42]; Techataweewan and Prasertsin who determined the following elements of digital literacy skills: operation skills, thinking skills, collaboration skills, and awareness skills [43]. The research results enable educators and teachers to develop youth skills in the post COVID-19 era. Especially, the elements of digital literacy skills may be adapted into a digital literacy learning for improve students' skills. The learning of digital literacy among students would protect them from online social threat.

6. CONCLUSION

Digital literacy consists of a dynamic combination of mindset, behaviors, and skills that are employed to change and enhance youths in Bangkok through the use of digital literacy. The research addressed the definition and factors of digital literacy which are appropriate to youths in Bangkok, Thailand during the COVID-19 pandemic through document research and focus group discussion. The definition of digital literacy is the set of abilities to utilize and be aware of access, understanding, use, and creating. The qualitative data were analyzed to determine the factors and indicators of digital literacy for youths in Bangkok during the COVID-19 pandemic. The researchers used confirmatory factor analysis (CFA) to verify the factors and indicators. CFA is a powerful tool for the study of complex areas of behavioral scientific concern. It is also the exploratory factor analysis technique most used in factor analysis to uncover latent variables or factors.

The construct validity of research latent variables was found through the harmonious correlation of empirical data contained in the digital literacy model. Access, understanding, use, and creating components are mandatory factors in digitally literate youths. Access components refer to the ability to choose and use digital tools optimally. The equation includes hardware and software for accessibility and diverse information sources. To possess understanding components, youths must also demonstrate use components which include the ability to use computers and the Internet, which requires the necessary technical skills with the ability to use computer programs such as internet search engines, word processors, web browsers, and other communication tools. The creating components allow youths to create information with digital technology by

means of adapting, applying, designing, inventing, or writing information in various formats. Moreover, for digital literacy, youths must also create weblogs/applications, present them on websites/applications, and develop innovation. They must be aware of the impact of digital use and sharing information on themselves and society. Digital literacy includes legal literacy, evaluating, ethics, and safeguarding self.

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REFERENCES

- [1] J. Bryner, "1st known case of coronavirus traced back to November in China," *Live Science*, 2020. [Online]. Available: <https://www.livescience.com/first-case-coronavirus-found.html> (accessed Feb. 09, 2020).
- [2] WHO, "Pneumonia of unknown cause – China," *Disease Outbreak News*. WHO, Jan. 2020. [Online]. Available: <https://www.who.int/csr/don/05-january-2020-pneumonia-of-unknown-cause-china/en/> (accessed Feb. 09, 2020).
- [3] Y.-T. Xiang *et al.*, "Timely mental health care for the 2019 novel coronavirus outbreak is urgently needed," *The Lancet Psychiatry*, vol. 7, no. 3, pp. 228–229, Mar. 2020, doi: 10.1016/S2215-0366(20)30046-8.
- [4] C. Xiao, "A Novel Approach of Consultation on 2019 Novel Coronavirus (COVID-19)-Related Psychological and Mental Problems: Structured Letter Therapy," *Psychiatry Investigation*, vol. 17, no. 2, pp. 175–176, Feb. 2020, doi: 10.30773/pi.2020.0047.
- [5] J. Crawford *et al.*, "COVID-19: 20 countries' higher education intra-period digital pedagogy responses," *Journal of Applied Learning and Teaching*, vol. 3, no. 1, pp. 09–28, 2020, doi: 10.37074/jalt.2020.3.1.7.
- [6] S. Subedi, S. Nayaju, S. Subedi, S. K. Shah, and J. M. Shah, "Impact of E-learning during COVID-19 Pandemic among Nursing Students and Teachers of Nepal," *International Journal of Science and Healthcare Research*, vol. 5, no. 3, p. 68, 2020.
- [7] A. A. Kamal, N. M. Shaipullah, L. Truna, M. Sabri, and S. N. Junaini, "Transitioning to online learning during COVID-19 Pandemic: Case study of a Pre-University Centre in Malaysia," *International Journal of Advanced Computer Science and Applications*, vol. 11, no. 6, pp. 217–223, 2020.
- [8] E. Chung, G. Subramaniam, and L. C. Dass, "Online learning readiness among university students in Malaysia amidst Covid-19," *Asian Journal of University Education*, vol. 16, no. 2, pp. 45–58, 2020, doi: 10.24191/AJUE.V16I2.10294.
- [9] S. P.-L. Sim, H. P.-K. Sim, and C.-S. Quah, "Online Learning: A Post Covid-19 Alternative Pedagogy For University Students," *Asian Journal of University Education*, vol. 16, no. 4, p. 137, Jan. 2021, doi: 10.24191/ajue.v16i4.11963.
- [10] S. Dhawan, "Online Learning: A Panacea in the Time of COVID-19 Crisis," *Journal of Educational Technology Systems*, vol. 49, no. 1, pp. 5–22, 2020, doi: 10.1177/0047239520934018.
- [11] P. Imsa-Ard, "Thai university students' perceptions towards the abrupt transition to 'forced' online learning in the COVID-19 situation," *Journal of Education Khon Kaen University*, vol. 43, no. 3, pp. 30–44, 2020.
- [12] J. Lobo and K. R. Dhuri, "Positive Impact of Covid-19 Pandemic in Enhancing Digital Literacy Skills Among Library Professionals: A Study," *Library Philosophy and Practice*, vol. 2021, pp. 1–18, 2021.
- [13] A. Yue, E. Nekmat, and A. R. Beta, "Digital literacy through digital citizenship: Online civic participation and public opinion evaluation of youth minorities in Southeast Asia," *Media and Communication*, vol. 7, no. 2, pp. 100–114, 2019, doi: 10.17645/mac.v7i2.1899.
- [14] S. Jan, "Investigating the Relationship between Students' Digital Literacy and Their Attitude towards Using ICT," *International Journal of Educational Technology*, vol. 5, no. 2, pp. 26–34, 2018, [Online]. Available: <http://educationaltechnology.net/ijet/>.
- [15] V. Ratten, "Coronavirus disease (COVID-19) and sport entrepreneurship," *International Journal of Entrepreneurial Behavior & Research*, vol. 26, no. 6, pp. 1379–1388, Jul. 2020, doi: 10.1108/IJEBR-06-2020-0387.
- [16] R. Simpson and O. A. Obdalova, "New Technologies in Higher Education – ICT Skills or Digital Literacy?" *Procedia - Social and Behavioral Sciences*, vol. 154, pp. 104–111, Oct. 2014, doi: 10.1016/j.sbspro.2014.10.120.
- [17] S. E. Pramono, A. Wijaya, I. S. Melati, Z. Sahudin, and H. Abdullah, "COVID-Driven Innovation in Higher Education: Analysing the Collaboration of Leadership and Digital Technology during the Pandemic in UiTM Malaysia and UNNES Indonesia," *Asian Journal of University Education*, vol. 17, no. 2, pp. 1–15, Jun. 2021, doi: 10.24191/AJUE.V17I2.13393.
- [18] P. Gilster, *Digital Literacy*. IGI Global, 2013.
- [19] L. Loewus, "What Is Digital Literacy?" *EducationWeek*. [Online]. Available: <https://www.edweek.org/teaching-learning/what-is-digital-literacy/2016/11> (accessed Feb. 09, 2020).
- [20] A. Ferrari, *Digital Competence in Practice: An Analysis of Frameworks*. Publications Office of the European Union, 2013.
- [21] L. M. Ungerer, "Digital curation as a core competency in current learning and literacy: A higher education perspective," *International Review of Research in Open and Distance Learning*, vol. 17, no. 5, pp. 25–27, 2016, doi: 10.19173/irrodl.v17i5.2566.
- [22] O. E. Hatlevik, I. Throndsen, M. Loi, and G. B. Gudmundsdottir, "Students' ICT self-efficacy and computer and information literacy: Determinants and relationships," *Computers & Education*, vol. 118, pp. 107–119, Mar. 2018, doi: 10.1016/j.compedu.2017.11.011.
- [23] S. Kaeophanuek, N.-S. Jaitip, and P. Nilsook, "How to Enhance Digital Literacy Skills among Information Sciences Students," *International Journal of Information and Education Technology*, vol. 8, no. 4, pp. 292–297, 2018, doi: 10.18178/ijiet.2018.8.4.1050.
- [24] G. V. Pavlenko and A. I. Pavlenko, "Digital Literacy as a Condition for Positive Experience of the COVID-19 Lockdown for Families with Preschool Children," *Proceedings of the Research Technologies of Pandemic Coronavirus Impact (RTCOV 2020)*, 2020, doi: 10.2991/assehr.k.201105.090.
- [25] M. D. Snape and R. M. Viner, "COVID-19 in children and young people," *Science*, vol. 370, no. 6514, 2020, doi: <https://doi.org/10.1126/science.abd6165>.

- [26] I. P. Samuelsson, J. T. Wagner, and E. Ødegaard, "The Coronavirus Pandemic and Lessons Learned in Preschools in Norway, Sweden and the United States: OMEP Policy Forum," *International Journal of Early Childhood*, vol. 52, no. 2, pp. 129–144, 2020, doi: 10.1007/s13158-020-00267-3.
- [27] E. M. Meyers, I. Erickson, and R. V. Small, "Digital literacy and informal learning environments: An introduction," *Learning, Media and Technology*, vol. 38, no. 4, pp. 355–367, 2013, doi: 10.1080/17439884.2013.783597.
- [28] S. Mohammadyari and H. Singh, "Understanding the effect of e-learning on individual performance: The role of digital literacy," *Computers & Education*, vol. 82, pp. 11–25, Mar. 2015, doi: 10.1016/j.compedu.2014.10.025.
- [29] S. A. Bahrainian, K. Alizadeh, M. R. Raeisoon, O. Hashemi Gorji, and A. Khazaei, "Relationship of Internet addiction with self-esteem and depression in university students," *Journal of Preventive Medicine and Hygiene*, vol. 55, no. 3, pp. 86–89, 2014, doi: 10.15167/2421-4248/JPMH2014.55.3.433.
- [30] E. J. Helsper and D. Smahel, "Excessive internet use by young Europeans: psychological vulnerability and digital literacy?" *Information Communication and Society*, vol. 23, no. 9, pp. 1255–1273, 2020, doi: 10.1080/1369118X.2018.1563203.
- [31] C. H. Wang, D. M. Shannon, and M. E. Ross, "Students' characteristics, self-regulated learning, technology self-efficacy, and course outcomes in online learning," *Distance Education*, vol. 34, no. 3, pp. 302–323, 2013, doi: 10.1080/01587919.2013.835779.
- [32] C. Wang and H. Zhao, "The Impact of COVID-19 on Anxiety in Chinese University Students," *Frontiers in Psychology*, vol. 11, 2020, doi: 10.3389/fpsyg.2020.01168.
- [33] Zaharah, W. Anissa, and G. I. Kirilova, "Impact of Corona Virus Outbreak Towards Teaching and Learning Activities in Indonesia," *SALAM: Jurnal Sosial & Budaya Syar-i*, vol. 7, no. 3, pp. 269–282, 2013.
- [34] N. Kapasia *et al.*, "Impact of lockdown on learning status of undergraduate and postgraduate students during COVID-19 pandemic in West Bengal, India," *Children and Youth Services Review*, vol. 116, 2020, doi: 10.1016/j.childyouth.2020.105194.
- [35] P. Phuapan, C. Viriyavejakul, and P. Pimdee, "Elements of digital literacy skill: A conceptual analysis," *Asian International Journal of Social Sciences*, vol. 15, no. 4, pp. 88–99, Oct. 2015, doi: 10.29139/aijss.20150406.
- [36] R. Vuorikari, Y. Punie, and S. Carretero, *DigComp 2.1: The Digital Competence Framework for Citizens with eight proficiency levels and examples of use*. Publications Office of the European Union, 2017.
- [37] V. Ester Laar, V. Alexander J.A.M. Deursen, V. Jan A.G.M. Dijk, and D. Jos Haan, "The relation between 21st-century skills and digital skills: A systematic literature review," *Computers in Human Behavior*, vol. 72, pp. 577–588, 2017.
- [38] M. Muniruzzaman and M. R. Siddiky, "Association between Students' Inattentiveness to Study and their Psychological Conditions during the COVID-19 Pandemic," *Asian Journal of University Education*, vol. 17, no. 2, pp. 27–38, 2021, doi: 10.24191/AJUE.V17I2.11011.
- [39] M. D. H. Rahiem, "Indonesian University Students' Likes and Dislikes about Emergency Remote Learning during the COVID-19 Pandemic," *Asian Journal of University Education*, vol. 17, no. 1, pp. 1–18, 2021, doi: 10.24191/ajue.v17i1.11525.
- [40] S. Jongsermtrakoon and J. Nasongkhla, "A Group Investigation Learning System for Open Educational Resources to Enhance Student Teachers' Digital Literacy and Awareness in Information Ethics," *International Journal of Information and Education Technology*, vol. 5, no. 10, pp. 783–788, 2015, doi: 10.7763/ijiet.2015.v5.611.
- [41] P. Phuapan, C. Viriyavejakul, and P. Pimdee, "An analysis of digital literacy skills among Thai university seniors," *International Journal of Emerging Technologies in Learning*, vol. 11, no. 3, pp. 24–31, 2016, doi: 10.3991/ijet.v11i03.5301.
- [42] P. Komcharoen and W. Polnigongit, "Digital Literacy: Evolution, Definition, and Skills Synthesis," *Journal of Applied Informatics and Technology (JIT)*, vol. 1, no. 2, pp. 72–81, 2018, doi: <https://doi.org/10.14456/jait.2018.6>.
- [43] W. Techataweewan and U. Prasertsin, "Development of digital literacy indicators for Thai undergraduate students using mixed method research," *Kasetsart Journal of Social Sciences*, vol. 39, no. 2, pp. 215–221, 2018, doi: 10.1016/j.kjss.2017.07.001.
- [44] E. Berman, "An Exploratory Sequential Mixed Methods Approach to Understanding Researchers' Data Management Practices at UVM: Integrated Findings to Develop Research Data Services," *Journal of eScience Librarianship*, vol. 6, no. 1, p. e1104, 2017, doi: 10.7191/jeslib.2017.1104.
- [45] R. Siriwattanarat, "Model of Digital Literacy Development for Youths in Bangkok, Thailand," *European Journal of Education Studies*, pp. 59–71, 2018.
- [46] P. M. Benter and C. Chou, "Practical issues in structural modeling," *Sociological Methods and Research*, vol. 16, no. 1, pp. 78–117, 1987.
- [47] P. Gagné and G. R. Hancock, "Measurement model quality, sample size, and solution propriety in confirmatory factor models," *Multivariate Behavioral Research*, vol. 41, no. 1, pp. 65–83, 2006, doi: 10.1207/s15327906mbr4101_5.
- [48] H. Jamieson, "Digital literacy in the workplace: Deciphering the Gobbledygook." 2016. [Online]. Available: <https://www.linkedin.com/pulse/digital-literacy-workplace-deciphering-gobbledygook-helen-jamieson/> (accessed Feb. 09, 2020).

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