Research Article https://doi.org/10.12973/eu-jer.12.2.1109

European Journal of Educational Research
Volume 12, Issue 2, 1109- 1121.
ISSN: 2165-8714
http://www.eu-jer.com/

The Factors Influencing Digital Literacy Practice in Vocational Education: A Structural Equation Modeling Approach

Dwi Jatmoko* Universitas Muhammadiyah Purworejo, INDONESIA
Suyitno Suyitno Universitas Muhammadiyah Purworejo, INDONESIA
Mohamad Sattar Rasul Universiti Kebangsaan Malaysia, MALAYSIA
Muhammad Nurtanto Sultan Ageng Tirtayasa University, INDONESIA
Nur Kholifah Yogyakarta State University, INDONESIA
Alias Masek Universiti Tun Hussein Onn Malaysia, MALAYSIA
Hamid Ramadhan Nur Yogyakarta State University, INDONESIA

Received: October 7, 2022 ▪ Revised: February 1, 2023 ▪ Accepted: March 16, 2023

Abstract: In the future, vocational students will face all changes and developments in technology and information. In this context, students' digital literacy skills need to be trained to adapt to the demands of the world of work. This article aims to present the results of a study on factors that can improve the digital literacy practice for vocational students as a roadmap for digital learning in the current era. The sampling technique used purposive random sampling of 8 Vocational Schools in East Java Province, Indonesia. The number of respondents in this study amounted to 355 second-year students. The study has found that online learning, motivation, and technology introduction are influenced by students' digital literacy practices, while teacher readiness and infrastructure must be mediated by online learning. The findings in this study indicate that collaboration from various parties is needed from teachers, school administrators, and policymakers in planning learning that focuses on students' digital abilities.

Keywords: *Digital literacy practice, PLS-SEM, teacher readiness, vocational education.*

To cite this article: Jatmoko, D., Suyitno, S., Rasul, M. S., Nurtanto, M., Kholifah, N., Masek, A., & Nur, H. R. (2023). The factors influencing digital literacy practice in vocational education: a structural equation modeling approach. *European Journal of Educational Research, 12*(2), 1109-1121. https://doi.org/10.12973/eu-jer.12.2.1109

Introduction

The paradigm in education, especially in vocational education, currently places more emphasis on developing the abilities or skills of students in preparing for work (Shin et al., 2014). Experts explain that the use of technology as one of the learning tools has increased rapidly in the last two decades. Digital technology is a new foundation and a crucial factor in fulfilling student competencies (Falloon, 2020). In Indonesia, the practice of digital technology in education, especially vocational education, is still very new. The COVID-19 pandemic has prompted education practitioners to focus on developing learning using digital technology (Kholifah et al., 2020; and Kholifah et al., 2023). East Java, as one of the provinces with the third largest number of vocational students in Indonesia, has a low level of job absorption for students. This is evidenced by the open unemployment rate (OUR) data showing that vocational education graduates are the highest contributor to unemployment in East Java Province, Indonesia. This contradicts the objectives of implementing vocational education in various countries, including providing practical skills and knowledge relevant to work life and careers. The rapid development of digital technology is a serious consideration for how digital literacy practices can be improved during vocational learning.

Experts define *digital literacy* as a social practice that involves digital technology to process and access texts with which we can generate, communicate, and negotiate meaning in a socially recognizable way (Coiro et al., 2008). There is much research on the use of digital technology in education, but there still needs to be more in understanding effective digital literacy practices in vocational education. Several studies have shown that digital literacy practices are appropriate in helping students improve vocational technology skills, increase creativity and critical thinking skills, and help students prepare for jobs in the digital era in the future (Nurtanto et al., 2023; Patmanthara & Hidayat, 2018; and van Laar et al., 2020). However, the success of learning with digital technology is faced with significant challenges, including the role of

* **Corresponding author:**
Dwi Jatmoko, Universitas Muhammadiyah Purworejo, Central Java, Indonesia. ✉ dwijatmoko@umpwr.ac.id

vocational teachers who lack training, the curriculum needs to be revised, and policies that still need to support the development of effective digital literacy practices (Nurtanto et al., 2022; and Suwarto et al., 2022).

In addition, the problem of digital literacy aligns with the widespread use of digital as a source of information. Information boundaries are disappearing along with digitalization in all aspects of life (Pereira et al., 2020). Several studies have stated that students with low digital literacy skills have a lower cognitive level than students with high (Nurtanto, Sofyan, et al., 2019; and Sutiman et al., 2022). Students may still need to acquire the critical thinking skills needed to evaluate information online or in other media (Meneses, 2021). The need to utilize existing information sources will impact student competence. Another impact is low self-control which can lead students to harmful activities. Vocational school students' understanding of information security needs more attention (Gallego-Arrufat et al., 2019; and Ključnikov et al., 2019). In this case, research conducted by Perdana et al. (2020) explains that digital literacy among vocational students in Indonesia is still low. In addition, Johnson (2007) explains the need for cognitive skills in accessing and operating the internet. These cognitive skills can help vocational students apply new information or skills in life situations (Bataeva, 2019; and Khlaisang & Likhitdamrongkiat, 2015).

Problems in implementing digital literacy practices require several coordination efforts from various stakeholders, including teachers, instructors, students, and the role of schools and related parties in education policy. One of the solutions to improve digital literacy practices in vocational education is by increasing training and support for vocational teachers, increasing access to and use of digital technology, and increasing collaboration between various parties, namely schools, industry, and other educational institutions. Based on previous studies, the success of digital technology practices is influenced by motivation and technology introduction (Irfak, 2022). This study shows that introducing technology and the right motivation can affect a person's performance in using technology. The success of digital technology practices is also influenced by infrastructure readiness and teacher readiness factors, as expressed by Chauhan (2017) and these two factors also influence the success of online learning (Wagiran et al., 2022). Thus, the success of digital literacy practices is influenced by various factors, including instructor readiness, teacher readiness, motivation, the introduction of technology, and online learning.

Meanwhile, the success of online learning is also influenced by the variables of instructor and teacher readiness. This study aimed to measure the relationship between instructor readiness, teacher readiness, motivation, the introduction of technology, and online learning on digital literacy practices for vocational students. For vocational education, this research contributes to improving the quality of education, preparing students to enter the digital world of work, and increasing the productivity and quality of future vocational student work.

Literature Review

The study considers five factors that influence students' digital literacy practices. Some researchers have considered online learning a high-potential factor in encouraging interest in learning and maintaining student learning motivation (Bates & Khasawneh, 2007; Hong et al., 2017; Shen et al., 2013). In the context of vocational education in Indonesia, teacher readiness in terms of the use of digital technology is also a strong reason for vocational students to make good use of digital technology. Support from schools in terms of infrastructure and policies has also been reported to be important when students decide to use technology and change their beliefs. Therefore, we select these variables and have incorporated them into our research model

Teacher Readiness, Infrastructure Readiness, and Online Learning in Digital Literacy Practice

The practice of digital literacy is the ability to use digital technology and information effectively and critically (Press et al., 2019). Literacy skills include finding, evaluating, producing and sharing information appropriately. Digital literacy practices (DLP) include skills in operating support tools, understanding social media, validating online information and managing personal data security. The DLP assists students in developing the skills needed to succeed in the world of work as digitalization challenges. Vocational students can develop creativity and innovation abilities in producing helpful technological solutions. This study uses measuring parameters including literacy, media literacy skills, ICT literacy skills, and visual literacy, which have been developed by Martens and Hobbs (2015).

Previous studies revealed that several aspects, including teacher readiness, infrastructure readiness, and online learning implementation, influence DLP's success. The study conducted (Bahanshal & Khan, 2021) shows that teacher readiness in integrating technology significantly affects the success of students' digital literacy practices. Teacher readiness to use technological devices is a parameter in achieving online learning goals as stated (Kasımoğlu et al., 2022) that the readiness of school infrastructure positively influences the success of students' digital literacy practices. Limitations in infrastructure are the cause of the low quality of learning. In addition (Tejedor et al., 2020) shows that effective online learning positively influences the success of students' digital literacy practices. Thus, the factors supporting the success of DLP are good instructional design, technical support and active student involvement, which can potentially improve students' abilities in digital literacy. This study uses measuring parameters in the form of online assessment, aspects of learning and learner control adapted from Karyotaki and Drigas (2016). Thus, hypothesis testing can be carried out, including:

H_1: There is a significant influence of teacher readiness on the success of digital literacy practices.

H_2: There is a significant effect of infrastructure readiness on the success of digital literacy practices.

H_3: There is a significant effect of implementing online learning on the success of digital literacy practices.

Motivation, Technology Introduction in Digital Literacy Practice

It is strongly suspected that aspects of motivation and technology introduction influence the success of vocational students' digital literacy practices. Aspects of motivation such as support from peers, family, and the community can influence the success of digital literacy practices in students (Hobbs & Tuzel, 2017). This social support can help students feel more confident using technology and increase their motivation to learn and use it effectively. Support from family and community can provide moral and physical support through access to the resources and tools needed for digital learning. Studies show that social support from family and community can increase students' motivation and skills in digital literacy (Ulum, 2022).

On the other hand, aspects of introducing technology, such as pressure to use technology and attitudes towards technology, can also affect the success of digital literacy practices in students (Frolova et al., 2019). Pressure to use technology can introduce students to technology and encourage them to improve their digital literacy skills (Frolova et al., 2019). Students' attitudes toward technology can also influence their abilities in digital literacy. Studies show that a positive attitude towards technology can improve students' skills in digital literacy (Blackwell et al., 2014).

Overall, social support and the introduction of technology can affect the success of digital literacy practices in students. Social support can help students feel comfortable using technology and increase their motivation to learn and use technology effectively. Introducing technology through pressure to use technology and attitudes towards technology can introduce students to technology and improve their abilities in digital literacy. Thus it is necessary to test the hypothesis as follows:

H_4: There is a significant effect of student motivation on the success of digital literacy practices.

H_5: There is a significant influence of the introduction of technology on the success of digital literacy practices.

Online Learning in Teacher Readiness and Infrastructure Readiness on Digital Literacy Practice

Online learning is learning that is carried out virtually, which allows interaction between teachers and students remotely. During the COVID-19 pandemic, online learning was the best alternative for the education sector worldwide. Online learning uses various strategies through various platforms, video conferencing applications or social media (Kholifah et al., 2020; and Nurtanto, Widjanarko, et al., 2019). Online learning becomes more flexible because it is not limited by space and time. The success of implementing online learning is influenced by several aspects, including teacher readiness in teaching and the availability of infrastructure or infrastructure as learning support.

The study (Hung, 2016) revealed that teacher readiness to teach online is a crucial factor in the success of online learning. Teachers unfamiliar with learning technology and needing to manage online learning cause students to experience boredom and failure in learning activities. According to Scherer et al. (2021) teacher readiness in online learning includes technological skills, technical knowledge and evaluation skills. Furthermore, the success of online learning is also influenced by infrastructure support (Coman et al., 2020) in facilitating effective learning. Infrastructure support includes infrastructure management and governance and administrative support adapted from Ellis and Bliuc (2019). In a study conducted by Wagiran et al. (2022) student academic performance is determined by the readiness of school infrastructure. Existing studies are used as a rationale for re-testing the implementation of online learning based on teacher readiness and infrastructure readiness.

H_6: There is a significant influence of teacher readiness on digital literacy practices through online learning.

H_7: There is a significant influence of infrastructure readiness on digital literacy practices through online learning.

This study examines the relationship between variables as stated in the hypothesis. The following is a conceptual framework for interpreting the success of digital literacy practices in vocational students (see Figure 1).

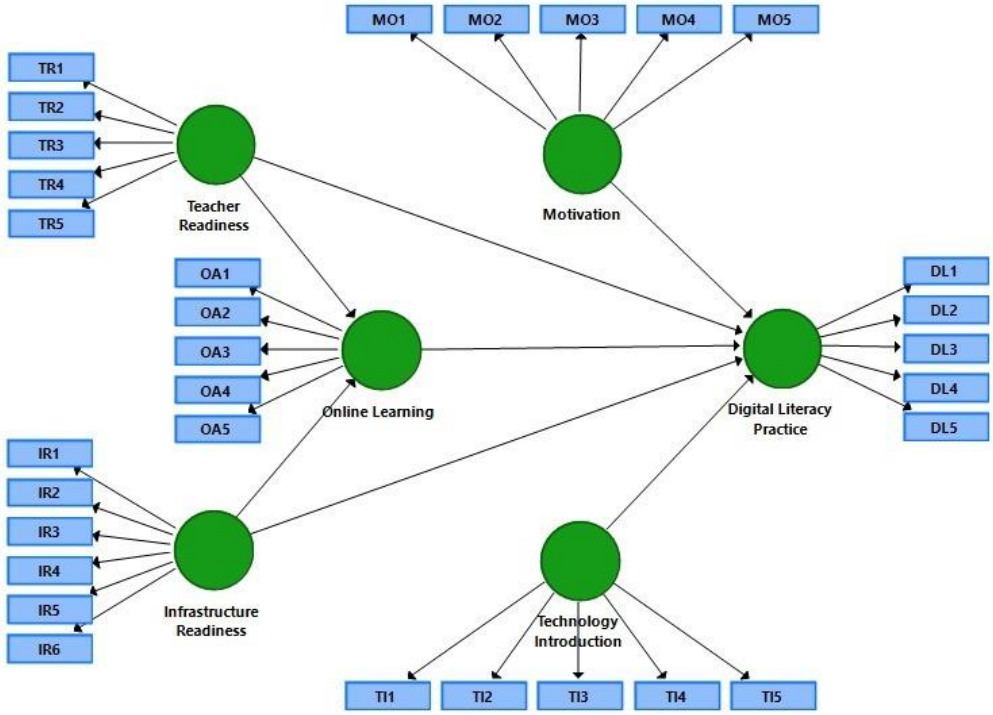

Figure 1. Conceptual Framework of Digital Literacy Practice

Methodology

Research Design

This study uses a quantitative research design with an ex-post facto approach. The population in this study are vocational schools in East Java, Indonesia, which carry out online learning and digital literacy practices. Respondents were selected using an adapted proportional random sampling technique (Taro, 1967). As many as 335 vocational education students were involved in the research with specific criteria, namely having made a minimum online learning transition in semesters two and four. Vocational education students consist of various genders, namely men and women. They are derived from public and private schools in East Java, Indonesia and represent three areas of expertise: technology and engineering, tourism, and ICT. Table 1 presents the background of vocational education students in digital literacy practices.

Table 1. Background of Participants

Dimensions	Category	Public School	Private School	t-value	Sig.
		F (%)	F (%)		
Gender	Male	83 (24.8)	104 (31.0)	2.333	0.157
	Female	55 (16.4)	93 (27.8)	2.333	0.157
Field of expertise	Technology and Engineering	40 (11.9)	96 (28.7)	0.719	0.531
	Tourist	36 (10.7)	105 (31.5)	0.719	0.531
	ICT	26 (7.8)	32 (9.6)	0.719	0.531
Study Experience	Semester 2	76 (22.7)	89 (26.6)	0.523	0.710
	Semester 4	85 (25.4)	85 (25.4)	0.523	0.710

Data Collection

Data was collected using a questionnaire that contained statements of the measurable variables. The instrument was constructed from a review of relevant literature and then developed according to the needs of vocational education students. A total of 30 question items representing each indicator and variable are:

1. Teacher readiness (TR) consists of technological skills, pedagogical skills, and evaluative skills consisting of 5 statement items;
2. Infrastructure readiness (IR) consisting of infrastructure management and governance and administrative support consisting of 5 statement items;
3. Online learning (OL) consists of online assessment, aspects of learning and learner control consisting of 5 statement items;

4. Technology introduction (IT) consisting of a pressure to use technology and attitude toward technology consisting of 5 statement items;

5. Motivation (MO) consists of peer support, family support and community support consisting of 5 statement items; and

6. Digital literacy practice (DL) consists of information literacy, media literacy skills, ICT literacy skills, and visual literacy, consisting of 5 statement items.

All statement items have been randomized and weighed 1-4 (Strongly Disagree to Agree). The instrument was distributed online in the East Java region, Indonesia, from December 2021 to March 2022. Outside the predetermined criteria, the data has been deleted and not used. Furthermore, the validity and reliability of the survey items have been ascertained from existing studies and re-examined the confidence level. The following instrument table consists of variables, indicators and item codes developed for digital literacy practice in vocational education students (see Table 2).

Table 2. Instruments Grid (N=31)

Construct	Indicator	Item	Code
Teacher Readiness (TR) (Falloon, 2020; Martens & Hobbs, 2015)	Technological Skill	2	TR1, TR2
	Pedagogical Skill	2	TR3, TR4
	Evaluative Skill	1	TR5
Infrastructure Readiness (IR) (Bidin et al., 2022; Ellis & Bliuc, 2019)	Infrastructure Management and Governance	3	IR1, IR2, IR3
	Administrative Support	2	IR4, IR5
Online Learning (OL) (Dhawan, 2020; Karyotaki & Drigas, 2016; Wagiran et al., 2022)	Online Assessment	1	OL1
	Aspect of Learning	2	OL2, OL3
	Learner Control	2	OL4, OL5
Technology Introduction (TI) (Frolova et al., 2019; Khlaif et al., 2022)	Pressure to Use Technology	3	TI1, TI2, TI3
	Attitude toward Technology	2	TI4, TI5
Motivation (MO) (Hobbs & Tuzel, 2017; Pintrich, 2000)	Peer Support	1	MO1
	Family Support	2	MO2, MO3
	Community Support	2	MO4, MO5
Digital Literacy Practice (DL) (Astuti et al., 2022; Mutohhari et al., 2021; Pavlova, 2009)	Information Literacy	1	DL1
	Media Literacy Skill	2	DL2, DL3
	ICT Literacy Skill	1	DL4
	Visual Literacy	1	DL5

Data Analysis

Analysis of this study using SEM-PLS, structural equation model (SEM) is a type of multivariate analysis that allows simultaneous testing of a series of hypotheses by taking into account errors and providing flexibility for complex model testing (Nitzl, 2016). SEM-PLS can be seen as a combination of confirmatory factor analysis (CFA) and path analysis (Leguina, 2015), which aims to maximize the value of R^2 and minimize residual or prediction errors. This study used Smart-PLS 3.2.9 software to identify the relationship between infrastructure readiness, teacher readiness, online learning, and cognitive skills to digital literacy practice in vocational students.

Results

Evaluation of Measurement Model

The first criterion in the measurement model that must be evaluated is the reliability of internal consistency. The consistency reliability test uses Cronbach's alpha (α), rho_A, and composite reliability (CR) indicators. The value of each measurement is considered reliable and must be above .70. Based on Table 3 it is known that all constructs have values ranging from .852 to .929 for (α), .856 to .932 for rho_A and .895 to .946 for CR. This test concluded that all construct measurements got values above .70. So, it can be said that all the constructs for measuring the digital literacy practice of vocational students have been reliable.

Table 3. Reliabilities Instrument of the Digital Literacy Practice, Infrastructure Readiness, Motivation, Online Learning, Teacher Readiness, and Technology Introduction

Construct	α ≥ .70	rho_A ≥ .70	CR ≥ .70	AVE ≥ .50
Digital Literacy Practice	.853	.856	.895	.630
Infrastructure Readiness	.900	.902	.923	.667
Motivation	.895	.899	.923	.705
Online Learning	.929	.932	.946	.780
Teacher Readiness	.872	.876	.907	.660
Technology Introduction	.852	.856	.895	.630

The next stage is to evaluate convergence validity using the outer loading of all indicators and average variance extracted (AVE). High outer loading identifies indicators that can be explained by constructs measured by the condition that outer loading must be above .70 and high AVE values indicate that the average of a construct describes the variance of its indicators (Leguina, 2015).

The results of the PLS Algorithm in Table 4, the outer loading values on all indicators range from .743 to .912 (> .70 is acceptable). The outer loading requirement above .70 can explain that the variance of each indicator is 50% (the result of $.70^2$ is close to 50%). Based on Table 4, the AVE value range ranges from .630 to .780, which is more than the minimum limit of > .50. This means that all measurement constructs on digital literacy practice have absorbed information from the indicators more than 63%.

Table 4. Validities and Reliabilities Instruments

No Items	Outer Loading							VIF
	Construct	DL	IR	MO	OL	TI	TR	
1	DL1	.789						2.624
2	DL2	.765						1.599
3	DL3	.786						2.469
4	DL4	.759						2.185
5	DL5	.864						3.283
6	IR1		.873					3.537
7	IR2		.787					2.995
8	IR3		.813					2.613
9	IR4		.864					3.083
10	IR5		.806					3.241
11	IR6		.753					2.034
12	MO1			.807				2.968
13	MO2			.774				2.175
14	MO3			.903				3.464
15	MO4			.881				3.322
16	MO5			.828				2.711
17	OL1				.873			3.491
18	OL2				.839			2.794
19	OL3				.885			3.675
20	OL4				.912			4.611
21	OL5				.903			3.702
22	TI1					.764		1.831
23	TI2					.776		2.016
24	TI3					.743		2.323
25	TI4					.843		2.728
26	TI5					.837		2.461
27	TR1						.809	2.047
28	TR2						.785	2.187
29	TR3						.830	2.407
30	TR4						.828	2.792
31	TR5						.809	2.126

The validity of the discriminant indicates the degree to how much a constructed variable differs from another construct. There are three approaches to assessing the validity of descriptors: Cross-loading, Fornell-Larcker criterion and Heterotrait – Monotrait (HTMT). Based on the output of Table 5, the Heterotrait – Monotrait (HTMT) value for each construct is below .796 which is enough to meet the maximum criteria of .900 (Henseler et al., 2015).

Table 5. The HTMT Value Result of the DL, IR, MO, OL, TR, and TI

	DL	IR	MO	OL	TR	TI
DL	**1**					
IR	.526	**1**				
MO	.574	.625	**1**			
OL	.678	.737	.615	**1**		
TR	.570	.791	.697	.796	**1**	
TI	.639	.651	.659	.696	.714	**1**

Goodness-of-fit indicators in this study used three test models: Chi-Square, Standardized Root Mean Square (SRMR), and Normal Fit Index (NFI). The model would be considered to have goodness-of-fit and acceptable if the value of SRMR is below .10 (Garson, 2016). A model is acceptable if the Chi-Square value is more than .90 (Bentler & Bonett, 1980). NFI values range from 0 to 1, whereas values close to 1 indicate a high goodness-of-fit model. Table 6 obtained the results of SRMR saturated and estimated model .077, which are both less than .10. The Chi-Square value for saturated and estimated models is 2680.859, more than .90, while for NFI saturated and estimated model values, the value is the same at .715.

Table 6. Model Goodness of Fit Test Result of the SRMR, Chi-Square and NFI

The goodness of fit indices	Saturated Model	Estimated Model
SRMR	0.077	0.077
Chi-Square	2680.859	2680.859
NFI	0.715	0.715

Evaluation of Structural Model

The path analysis method is used to study the direct and indirect influence (effect) of exogenous variables on endogenous variables. Path analysis can also be used to test causal hypotheses and interpret certain relationships. Table 6 shows the testing of seven hypotheses. Infrastructure readiness and teacher readiness are not significant to the digital literacy practices of students with *path coefficient* values β (-.002 and -.029) and p-values (.986 and .701) > .050, so H_1 and H_2 are rejected. Online Learning, Motivation, and Technology Introduction are significant to students' digital literacy practices with p-values (.000, .008 and .001) < .010, so that H_3, H_4 and H_5 are accepted. Infrastructure readiness and teacher readiness mediated with online learning are significant to students' digital literacy practices with p-values (.002 and .000) < .01, so that H_6 and H_7 are accepted (see Table 7).

Table 7. Path Analysis Test Result

H	Path	*β*	M	SD	*t* statistics	p-values	Decision
H1	Infrastructure Readiness → Digital Literacy Practice	-.002	-.001	.090	.018	.987	Not Accepted
H2	Teacher Readiness → Digital Literacy Practice	-.032	-.028	.077	.383	.678	Not Accepted
H3	Online Learning → Digital Literacy Practice	.399	.396	.077	5.224	.000*	Accepted
H4	Motivation → Digital Literacy Practice	.173	.180	.067	2.633	.010*	Accepted
H5	Technology Introduction → Digital Literacy Practice	.228	.217	.063	3.436	.000*	Accepted
H6	Infrastructure Readiness → Online Learning → Digital Literacy Practice	.131	.101	.032	3.136	.000*	Accepted
H7	Teacher Readiness → Online Learning → Digital Literacy Practice	.197	.148	.040	3.698	.000*	Accepted

Note. * p < .01; *β = path coefficient*; *M = sample mean; and SD = standard deviation*

The second step of the structural model is evaluating the value of the determinant coefficient (R^2). The value of R^2 has a range of .75, .50 and .25 or can be assessed as predictive power at substantial, moderate, and weak levels (Leguina, 2015). The table shows that Technology Introduction is explained by 50.1%, Digital Literacy Practice is 44%, and Online Learning is explained by 61.4%. Furthermore, he conducted a predicted relevance test (Q^2), using the blindfolding procedure in PLS-SEM. Q^2 effect size according to (Kock, 2011; Leguina, 2015) is grouped into three categories, namely weak (.02), medium (.15) and large (.35). In the values predict relevance (Q^2) for cross-validity redundancy against all endogenous variables, Technology Introduction 32.5%, Digital Literacy Practice 25.9%, and Online Learning 47.3%, which is greater than zero ($Q^2 > 0$) (see Table 8).

Table 8. Path Analysis Test Result of the Digital Literacy Practice and Online Learning

Construct	R^2	R^2 adjusted	Predictive Power	Q^2 Redundancy	Effect Size
Digital Literacy Practice	.440	.432	Weak	.259	Medium
Online Learning	.616	.611	Moderate	.473	Large

The structural analysis model for digital literacy practices used is presented in Figure 2. It can be observed that the construct relationship between teacher readiness and infrastructure readiness towards digital literacy practice obtained a p-value exceeding 0.05, indicating that it is not significant and not positive. Meanwhile, the other constructs have fulfilled the test and shown a significant and positive relationship.

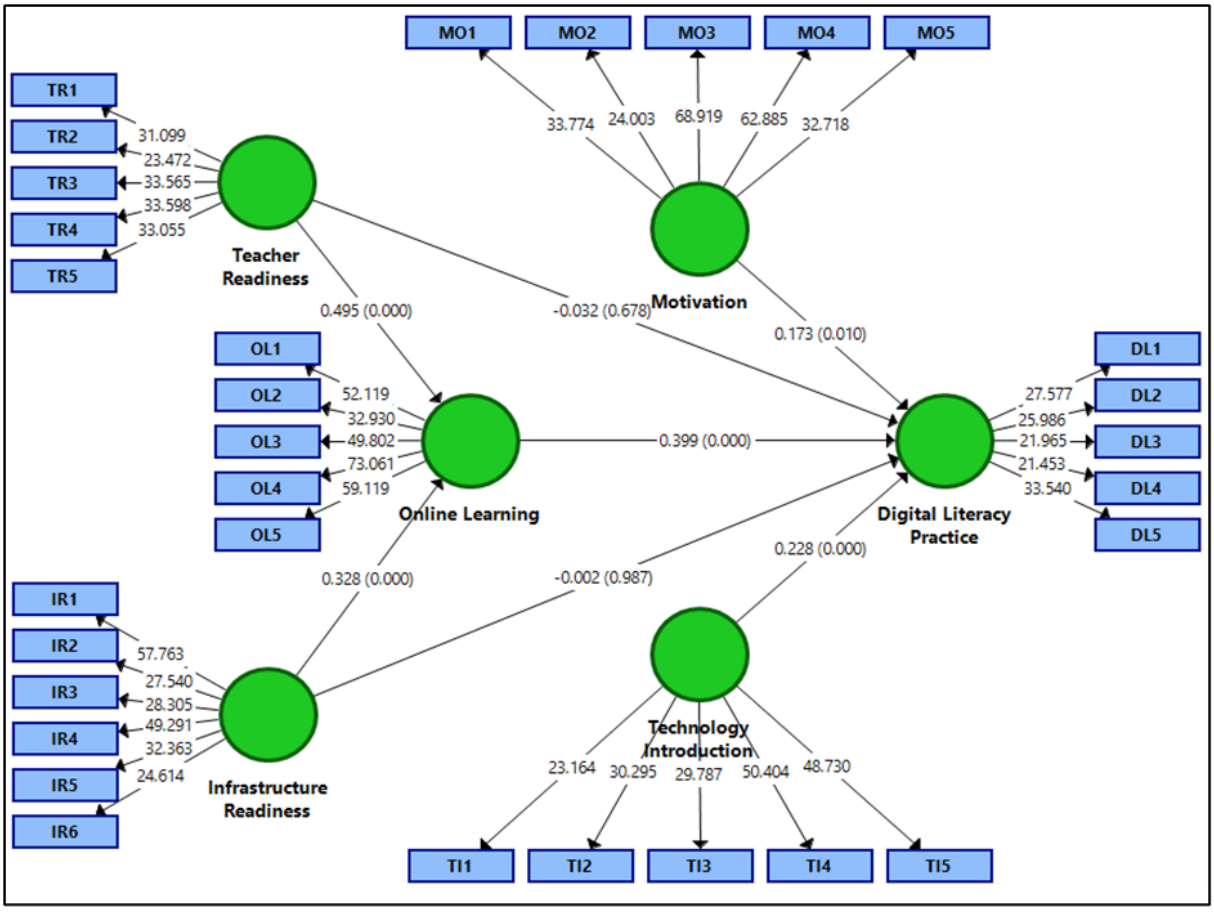

Figure 2. SEM Analysis Result for Teacher Readiness, Online Learning, Infrastructure Readiness, Technology Introduction, Motivation, and Digital Literacy Practice

Discussion

This research explores the practice of digital literacy in the classroom in second-year vocational high school students. In general, this study investigates extrinsic factors (teacher readiness and infrastructure readiness) and intrinsic factors (motivation and introduction of technology) in the digital literacy practice of vocational students. This research also involves the factor of online learning as a mediator to students' digital literacy practices.

The results of hypothesis testing H_1 and H_2 based on Table 6, namely infrastructure readiness and teacher readiness for digital literacy practices, obtained path coefficients β (H_1 and H_2) of -.002 and -.029 and p values of (.986 and .701) >. 05 proves there is no strong connection with increasing digital literacy practices. Infrastructure readiness does not have a significant impact. It becomes an illogical problem, considering that infrastructure is the dominant factor. However, it is strongly suspected that the school has not been involved in implementing online learning and facilitation in its totality (Gherheş et al., 2021). The school management has neglected and left facilities matters to teachers and parents (Barrett et al., 2019), because learning is not implemented in vocational schools. In addition, teacher readiness does not have a positive impact on digital literacy practices. Several supporting reasons are the teacher's shared understanding of digital literacy, lack of training, low support from the school, and inadequate infrastructure support (Li &Yu, 2022).

Furthermore, it can be observed based on the results of the H_3 hypothesis test, namely digital literacy online learning, the path coefficient β (H_3) is 0.400 and p-value (0.000) < 0.01, which proves a positive and significant relationship with increasing vocational students' digital literacy practices. Significantly online assessment, aspects of learning and learner

control positively influence digital literacy practices. In line with research conducted (Karagul et al., 2021) that online learning, especially online assessment feedback, can improve students' digital literacy skills. Another study (Arono et al., 2022) aimed to examine the effects of online learning modes and control of learning by students on digital literacy performance. In addition, a positive relationship between online learning and increasing digital literacy was also revealed (Kasımoğlu et al., 2022; and Nurtanto et al., 2018), which showed that online learning was proven to be a trigger for increasing digital literacy in vocational students in particular. Online learning provides many advantages, especially practicality in accessing and obtaining information. Adedoyin and Soykan (2023) added that online learning had provided a clear roadmap for educators to make decisions about creating ways of learning and teaching that student can accept well. Online learning is a crucial factor in increasing the digital competence of vocational students. This study suggests that online assessment, aspects of learning and learner control are aspects of improving digital literacy practices that can help students find the information and skills they need, especially in facing competition in the world of work.

The results of testing the H_4 hypothesis, namely digital competence motivation, obtained a path coefficient β (H_4) of 0.176 and a p-value (0.008) <0.01, which proves a positive and significant relationship with increasing vocational students' digital literacy practices. Substantial evidence is that peer support, family support, and confirmed community support help improve digital literacy practices. Several studies include (Kolhar et al., 2021) that support from peers, (Purnama et al., 2021) that support from the community, (Jun, 2020) support from family has a positive effect on student access and use of technology. However, vocational students must get proper access and direction in using digital literacy. A robust motivational drive gives students complete confidence in exploring their digital abilities, making them more accustomed to the development of the digital world itself. Strong motivation also has an impact on increasing student self-confidence. Some researchers also suggest that schools do not need to design a separate platform for learning digital skills but must be embedded in the teaching and learning process of all subjects. Students must also be motivated to acquire digital competencies to remain relevant to modernity. This study reinforces existing studies that support the surrounding environment as a contribution to improving digital literacy practices, especially for vocational students.

Furthermore, based on the results of hypothesis testing H_6 and H_7, it can be observed, namely infrastructure readiness and teacher readiness mediated by online learning. The path coefficients β (H_6 and H_7) are 0.100 and 0.150, and the p-value is (0.002 and 0.000) < .01, which proves that there is a relationship between positive and significance with increasing digital literacy practice of vocational students. The study conducted (Summak et al., 2010) as evidence that teacher readiness positively affects technology integration and understanding of digital literacy. Likewise, with the study (Wagiran et al., 2022), infrastructure readiness positively affects students' digital literacy. This finding is supported by the expert opinion of Alda et al. (2020) that school managers need to provide training to teachers on the importance of developing online learning. An understanding of online platform navigation and finding innovative ways to use these platforms to improve the teaching and learning process in class. Several factors and reasons for teacher absence in increasing the digital competence of vocational students are teachers' lack of experience in online learning and the absence of assistance provided to teachers.

Conclusion

Digital literacy practice is one of the strategies for forming students' digital technology competencies, this is important because it can improve student performance and skills in utilizing technology as a source of information. This research was conducted on second-year vocational students in East Java, Indonesia. The factors of teacher readiness and infrastructure readiness mediated by online learning have a high level of significance for increasing students' digital literacy practice, besides that motivation and technology introduction also have a high significance level. Further research is expected to explore further personal factors, family, school readiness and other potential factors related to increasing students' digital literacy practices. Deeper and more comprehensive research is needed to determine the factors that can improve students' digital technology capabilities. Support from various parties is very much needed, especially in facilitating vocational students to improve digital literacy skills. Digital literacy practices are becoming increasingly important in the future of education, especially in online learning, motivation to learn, and introduction to technology. This study contributes to vocational education providers who focus on successful digital literacy practices requiring strong support from teacher abilities, technical aspects and a supportive environment in digital literacy.

Recommendations

More in-depth and comprehensive research with qualitative methodologies is needed to analyze the factors that can improve students' digital technology capabilities. Further research is expected to explore internal and external factors such as student personal, family, school readiness and other potential factors related to improving students' digital literacy practices. Furthermore, future research must also design, test and create suitable models to effectively improve the mastery of vocational students' digital literacy. In addition, the aspects of teacher digital literacy need to be explored more deeply. Teachers, as role models and sources of knowledge for students, need to pay attention to the aspects of digital literacy owned by their professional work.

Limitations

This research examines extrinsic factors (teacher readiness and infrastructure readiness) and intrinsic factors (motivation and introduction to technology) in the digital literacy practice of vocational students. This research also involves online learning factors mediating students' digital literacy practices. The above factors are taken from previous research studies that can improve digital literacy practices in vocational students as a roadmap for digital learning in the current era. Many factors still affect the mastery of digital literacy in students. The factors in question include personal, family, school readiness and other potential factors. However, in this study, infrastructure readiness, teacher readiness, online learning, and the introduction of technology and motivation were taken because these factors needed to be analyzed in depth and could obtain specific results. The subsequent study is hoped to be carried out by testing other factors that affect digital literacy in students to uncover and expand what factors affect students' digital literacy in addition to the factors in this study.

Authorship Contribution Statement

Jatmoko: Study framework development, and instrument development. Suyitno: Data collection and manuscript writing. Rasul: Data analysis, and manuscript summiting. Nurtanto: Manuscript writing and data analysis. Kholifah: Data input and visualization/presentation of data in the text. Masek: Manuscript writing, English proofreading and correction. Nur: Evidence, data input, typing; correction, and edition.

References

Adedoyin, O. B., & Soykan, E. (2023). Covid-19 pandemic and online learning: The challenges and opportunities. *Interactive Learning Environments*, *31*(2), 863-875. https://doi.org/10.1080/10494820.2020.1813180

Alda, R., Boholano, H., & Dayagbil, F. (2020). Teacher education institutions in the philippines towards education 4.0. *International Journal of Learning, Teaching and Educational Research*, *19*(8), 137–154. https://doi.org/10.26803/ijlter.19.8.8

Arono, Arsyad, S., Syahriman, Nadrah, & Villia, A. S. (2022). Exploring the effect of digital literacy skill and learning style of students on their meta-cognitive strategies in listening. *International Journal of Instruction*, *15*(1), 527–546. https://doi.org/10.29333/iji.2022.15130a

Astuti, M., Arifin, Z., Nurtanto, M., Mutohhari, F., & Warju, W. (2022). The maturity levels of the digital technology competence in vocational education. *International Journal of Evaluation and Research in Education*, *11*(2), 596–603. https://doi.org/10.11591/ijere.v11i2.22258

Bahanshal, D., & Khan, I. A. (2021). Effect of COVID-19 on education in Saudi Arabia and e-learning strategies. *Arab World English Journal*, *7*, 359–376. https://doi.org/10.24093/awej/call7.25

Barrett, P., Treves, A., Shmis, T., Ambasz, D., & Ustinova, M. (2019). *The impact of school infrastructure on learning.* World Bank Group.

Bataeva, E. V. (2019). Cognitive and metacognitive skills of students in the context of smart-education. *The Education and Science Journal, 21*(4), 36–59. https://doi.org/10.17853/1994-5639-2019-4-36-59 [In Russian]

Bates, R., & Khasawneh, S. (2007). Self-efficacy and college students' perceptions and use of online learning systems. *Computers in Human Behavior*, *23*(1), 175–191. https://doi.org/10.1016/J.CHB.2004.04.004

Bentler, P. M., & Bonett, D. G. (1980). Significance tests and goodness of fit in the analysis of covariance structures. *Psychological Bulletin*, *88*(3), 588–606. https://doi.org/10.1037/0033-2909.88.3.588

Bidin, M. A. F., Shuhidan, S. M., & Sahid, N. Z. (2022). Reliability analysis of the effect of digital literacy on performance among secondary school students in Malaysia. *Proceedings*, *82*(1), Article 102. https://doi.org/j39g

Blackwell, C. K., Lauricella, A. R., & Wartella, E. (2014). Factors influencing digital technology use in early childhood education. *Computers and Education*, *77*(8), 82–90. https://doi.org/10.1016/j.compedu.2014.04.013

Chauhan, S. (2017). A meta-analysis of the impact of technology on learning effectiveness of elementary students. *Computers and Education*, *105*, 14-30. https://doi.org/10.1016/j.compedu.2016.11.005

Coiro, J., Knobel, M., Lankshear, C., & Leu, D. J. (Eds.). (2008). *Handbook of research on new literacies* (1st ed.). Routledge. https://doi.org/10.4324/9781410618894

Coman, C., Țîru, L. G., Meseșan-Schmitz, L., Stanciu, C., & Bularca, M. C. (2020). Online teaching and learning in higher education during the coronavirus pandemic: Students' perspective. *Sustainability*, *12*(24), Article 10367. https://doi.org/10.3390/su122410367

Dhawan, S. (2020). Online learning: A panacea in the time of COVID-19 crisis. *Journal of Educational Technology Systems*, *49*(1), 5–22. https://doi.org/10.1177/0047239520934018

Ellis, R. A., & Bliuc, A. M. (2019). Exploring new elements of the student approaches to learning framework: The role of online learning technologies in student learning. *Active Learning in Higher Education*, *20*(1), 11–24. https://doi.org/10.1177/1469787417721384

Falloon, G. (2020). From digital literacy to digital competence: The teacher digital competency (TDC) framework. *Educational Technology Research and Development*, *68*, 2449–2472. https://doi.org/10.1007/s11423-020-09767-4

Frolova, E. V., Ryabova, T. M., & Rogach, O. V. (2019). Digital technologies in education: Problems and prospects for "Moscow electronic school" project implementation. *European Journal of Contemporary Education*, *8*(4), 779–789.

Gallego-Arrufat, M. J., Torres-Hernández, N., & Pessoa, T. (2019). Competence of future teachers in the digital security area. *Comunicar*, *27*(61), 57-67. https://doi.org/10.3916/C61-2019-05

Garson, G. D. (2016). *Partial least squares: Regression and structural equation models*. Statistical Publishing Associates. https://www.scirp.org/%28S%28351jmbntvnsjt1aadkozje%29%29/reference/referencespapers.aspx?referenceid=2895188

Gherheş, V., Stoian, C. E., Fărcaşiu, M. A., & Stanici, M. (2021). E-learning vs. face-to-face learning: Analyzing students' preferences and behaviors. *Sustainability*, *13*(8), Article 4381. https://doi.org/10.3390/SU13084381

Henseler, J., Ringle, C. M., & Sarstedt, M. (2015). A new criterion for assessing discriminant validity in variance-based structural equation modeling. *Journal of the Academy of Marketing Science*, *43*, 115–135. https://doi.org/10.1007/s11747-014-0403-8

Hobbs, R., & Tuzel, S. (2017). Teacher motivations for digital and media literacy: An examination of Turkish educators. *British Journal of Educational Technology*, *48*(1), 7–22. https://doi.org/10.1111/bjet.12326

Hong, J.-C., Hwang, M.-Y., Tai, K.-H., & Lin, P.-H. (2017). Intrinsic motivation of Chinese learning in predicting online learning self-efficacy and flow experience relevant to students' learning progress. *Computer Assisted Language Learning*, *30*(6), 552–574. https://doi.org/10.1080/09588221.2017.1329215

Hung, M.-L. (2016). Teacher readiness for online learning: Scale development and teacher perceptions. *Computers & Education*, *94*, 120–133. https://doi.org/10.1016/j.compedu.2015.11.012

Irfak, R. (2022). Literature review the effect of motivation and work environment on employee productivity & performance. *International Journal of Education Management And Social Science*, *3*(5), 719–730. https://bit.ly/3U5D3vR

Johnson, G. M. (2007). Functional Internet Literacy: Required Cognitive Skills with Implications for Instruction. *E-Learning and Digital Media*, *4*(4), 433–441. https://doi.org/10.2304/elea.2007.4.4.433

Jun, W. (2020). A study on the current status and improvement of the digital divide among older people in Korea. *International Journal of Environmental Research and Public Health*, *17*(11), Article 3917. https://doi.org/10.3390/ijerph17113917

Karagul, B. I., Seker, M., & Aykut, C. (2021). Investigating students' digital literacy levels during online education due to COVID-19 pandemic. *Sustainability*, *13*(21), Article 11878. https://doi.org/10.3390/su132111878

Karyotaki, M., & Drigas, A. (2016). Online and other ICT-based training tools for problem-solving skills. *International Journal of Emerging Technologies in Learning*, *11*(6), 35–39. https://doi.org/10.3991/ijet.v11i06.5340

Kasımoğlu, S., Bahçelerli, N. M., & Çelik, M. U. (2022). Digital literacy during COVID-19 distance education; evaluation of communication-based problems in line with student opinions. *Frontiers in Psychology*, *13*, Article 809171. https://doi.org/10.3389/fpsyg.2022.809171

Khlaif, Z. N., Sanmugam, M., Joma, A. I., Odeh, A., & Barham, K. (2022). Factors influencing teacher's technostress experienced in using emerging technology: A qualitative study. *Technology, Knowledge and Learning*. Springer Nature. https://doi.org/10.1007/s10758-022-09607-9

Khlaisang, J., & Likhitdamrongkiat, M. (2015). E-learning system in blended learning environment to enhance cognitive skills for learners in higher education. *Procedia - Social and Behavioral Sciences*, *174*, 759–767. https://doi.org/10.1016/j.sbspro.2015.01.612

Kholifah, N., Irwanto, I., Ramdani, S. D., & Nurtanto, M. (2020). Vocational skills learning model strategies during covid-19. *Journal of Physics: Conference Series*, *1700*(012092). https://doi.org/10.1088/1742-6596/1700/1/012092

Kholifah, N., Kurdi, M. S., Nurtanto, M., Mutohhari, F., Fawaid, M., & Subramaniam, T. S. (2023). The role of teacher self-efficacy on the instructional quality in 21st century : A study on vocational teachers, Indonesia. *International Journal of Evaluation and Research in Education*, *12*(2), 998–1006. https://doi.org/10.11591/ijere.v12i2.23949

Ključnikov, A., Mura, L., & Sklenár, D. (2019). Information security management in smes: Factors of success. *Entrepreneurship and Sustainability Issues*, *6*(4), 2081–2094. https://doi.org/10.9770/jesi.2019.6.4(37)

Kock, N. (2011). Using WarpPLS in e-collaboration studies: Mediating effects, control and second order variables, and algorithm choices. *International Journal of E-Collaboration*, *7*(3), 1–13. https://doi.org/10.4018/jec.2011070101

Kolhar, M., Kazi, R. N. A., & Alameen, A. (2021). Effect of social media use on learning, social interactions, and sleep duration among university students. *Saudi Journal of Biological Sciences*, *28*(4), 2216–2222. https://doi.org/10.1016/J.SJBS.2021.01.010

Leguina, A. (2015). A primer on partial least squares structural equation modeling (PLS-SEM). *International Journal of Research & Method in Education*, *38*(2), 220–221. https://doi.org/10.1080/1743727x.2015.1005806

Li, M., & Yu, Z. (2022). Teachers' satisfaction, role, and digital literacy during the COVID-19 pandemic. *Sustainability*, *14*(3), Article 1121. https://doi.org/10.3390/su14031121

Martens, H., & Hobbs, R. (2015). How media literacy supports civic engagement in a digital age. *Atlantic Journal of Communication*, *23*(2), 120–137. https://doi.org/10.1080/15456870.2014.961636

Meneses, L. F. S. (2021). Thinking critically through controversial issues on digital media: Dispositions and key criteria for content evaluation. *Thinking Skills and Creativity*, *42*, Article 100927. https://doi.org/10.1016/j.tsc.2021.100927

Mutohhari, F., Sutiman, S., Nurtanto, M., Kholifah, N., & Samsudin, A. (2021). Difficulties in implementing 21st century skills competence in vocational education learning. *International Journal of Evaluation and Research in Education*, *10*(4), 1229–1236. https://doi.org/10.11591/ijere.v10i4.22028

Nitzl, C. (2016). The use of partial least squares structural equation modelling (PLS-SEM) in management accounting research: Directions for future theory development. *Journal of Accounting Literature*, *37*(1), 19–35. https://doi.org/10.1016/j.acclit.2016.09.003

Nurtanto, M., Nurhaji, S., Widjanarko, D., Wijaya, M. B. R., & Sofyan, H. (2018). Comparison of scientific literacy in engine tune-up competencies through guided problem-based learning and non-integrated problem-based learning in vocational education. *Journal of Physics: Conference Series*, *1114, Article* 012038. https://doi.org/10.1088/1742-6596/1114/1/012038

Nurtanto, M., Sofyan, H., Fawaid, M., & Rabiman, R. (2019). Problem-based learning (PBL) in industry 4.0: Improving learning quality through character-based literacy learning and life career skill (LL-LCS). *Universal Journal of Educational Research*, *7*(11), 2487–2494. https://doi.org/10.13189/ujer.2019.071128

Nurtanto, M., Sudira, P., & Sofyan, H. (2023). A bibliometric analysis of teacher professional identity (TPI) for vocational education from 2004 to 2021. *AIP Conference Proceedings*, *2671*(1), Article 050017. https:/doi.org/10.1063/5.0114242

Nurtanto, M., Sudira, P., Sofyan, H., Kholifah, N., & Triyanto, T. (2022). Professional identity of vocational teachers in the 21 st century in Indonesia. *Journal of Engineering Education Transformations*, *35*(3), 30–36. https://doi.org/10.16920/jeet/2022/v35i3/22085

Nurtanto, M., Widjanarko, D., Sofyan, H., Rabiman, R., & Triyono, M. B. (2019). Learning by creating: Transforming automotive electrical textual material into visual animation as a creative learning products (clp). *International Journal of Scientific and Technology Research*, *8*(10), 1634–1642. http://bit.ly/3Md5YfQ

Patmanthara, S., & Hidayat, W. N. (2018). Improving vocational high school students digital literacy skill through blended learning model. *Journal of Physics: Conference Series*, *1028, Article* 012076. https://doi.org/10.1088/1742-6596/1028/1/012076

Pavlova, M. (2009). Technology and vocational education for sustainable development. *Technology and Vocational Education for Sustainable Development*. Springer Science Business Media B.V. https://doi.org/10.1007/978-1-4020-5279-8

Perdana, R., Jumadi, J., Rosana, D., & Riwayani, R. (2020). The online laboratory simulation with concept mapping and problem based learning (Ols-cmpbl): Is it effective in improving students' digital literacy skills? *Cakrawala Pendidikan*, *39*(2), 382–394. https://doi.org/10.21831/cp.v39i2.31491

Pereira, C. S., Durão, N., Fonseca, D., Ferreira, M. J., & Moreira, F. (2020). An educational approach for present and future of digital transformation in portuguese organizations. *Applied Sciences*, *10*(3), Article 757. https://doi.org/10.3390/app10030757

Pintrich, P. R. (2000). The role of goal orientation in self-regulated learning. *Handbook of Self-Regulation*. https://doi.org/10.1016/b978-012109890-2/50043-3

Press, N., Arumugam, P. P., & Ashford-Rowe, K. (2019). Defining digital literacy: A case study of Australian universities. In Y. W. Chew, K. M. Chan & A. Alphonso (Eds.), *2019: ASCILITE 2019 Conference Proceedings: Personalised learning. Diverse goals. One heart* (pp. 255-263). Singapore University of Social Science. https://doi.org/10.14742/apubs.2019.272

Purnama, S., Ulfah, M., Machali, I., Wibowo, A., & Narmaditya, B. S. (2021). Does digital literacy influence students' online risk? Evidence from Covid-19. *Heliyon*, *7*(6), Article e07406. https://doi.org/10.1016/j.heliyon.2021.e07406

Scherer, R., Howard, S. K., Tondeur, J., & Siddiq, F. (2021). Profiling teachers' readiness for online teaching and learning in higher education: Who's ready? *Computers in Human Behavior*, *118*, Article 106675. https://doi.org/10.1016/j.chb.2020.106675

Shen, D., Cho, M. H., Tsai, C. L., & Marra, R. (2013). Unpacking online learning experiences: Online learning self-efficacy and learning satisfaction. *The Internet and Higher Education*, *19*, 10–17. https://doi.org/10.1016/j.iheduc.2013.04.001

Shin, W. S., Han, I., & Kim, I. (2014). Teachers' technology use and the change of their pedagogical beliefs in Korean educational context. *International Education Studies*, *7*(8), 11–22. https://doi.org/10.5539/ies.v7n8p11

Summak, M. S., Bağlibel, M., & Samancioğlu, M. (2010). Technology readiness of primary school teachers: A case study in Turkey. *Procedia - Social and Behavioral Sciences*, *2*(2), 2671–2675. https://doi.org/10.1016/j.sbspro.2010.03.393

Sutiman, Sofyan, H., Soenarto, Mutohhari, F., & Nurtanto, M. (2022). Students' career decision-making during online learning: The mediating roles of self-efficacy in vocational education. *European Journal of Educational Research*, *11*(3), 1669–1682. https://doi.org/10.12973/eu-jer.11.3.1669

Suwarto, D. H., Setiawan, B., & Machmiyah, S. (2022). Developing digital literacy practices in Yogyakarta elementary schools. *Electronic Journal of E-Learning*, *20*(2), 101–111. https://doi.org/10.34190/ejel.20.2.2602

Taro, Y. (1967). *Statistics: An introductory analysis* (2nd ed.). Harper and Row.

Tejedor, S., Cervi, L., Pérez-Escoda, A., & Jumbo, F. T. (2020). Digital literacy and higher education during COVID-19 lockdown: Spain, Italy, and Ecuador. *Publications*, *8*(4), Article 48. https://doi.org/10.3390/publications8040048

Ulum, H. (2022). The effects of online education on academic success: A meta-analysis study. *Education and Information Technologies*, *27*, 429–450. https://doi.org/10.1007/s10639-021-10740-8

van Laar, E., van Deursen, A. J. A. M., van Dijk, J. A. G. M., & de Haan, J. (2020). Determinants of 21st-century skills and 21st-century digital skills for workers: A systematic literature review. *SAGE Open*, *10*(1), 1–14. https://doi.org/10.1177/2158244019900176

Wagiran, W., Suharjana, S., Nurtanto, M., & Mutohhari, F. (2022). Determining the e-learning readiness of higher education students: A study during the COVID-19 pandemic. *Heliyon*, *8*(10), Article e11160. https://doi.org/10.1016/j.heliyon.2022.e11160