PEDAGOGICAL DESIGN AND DIGITAL TECHNOLOGY ON E-LEARNING AMONG INDONESIAN VOCATIONAL SCHOOL TEACHERS

JOHAR MAKNUN*, LILIS WIDANINGSIH, VINA DWIYANTI, ANA RAMDANI SARI, EMMA MASSAADAH

Universitas Pendidikan Indonesia, Bandung, Indonesia
*Corresponding Author: joharmaknun@upi.edu

Abstract

This research aimed to analyse the impact of understanding e-learning pedagogical design and digital technology on the implementation of online learning systems. A descriptive correlational method was adopted with a cross-sectional design. Data on independent and dependent variables were collected simultaneously using a questionnaire consisting of 22 items. The research was conducted at Vocational High School in West Java Province, Indonesia, with 210 respondents of different education levels. The number of items for pedagogical design (X1), digital technology (X2), and online learning system implementation (Y) was 7, 7, and 8, respectively. Data analysis was conducted using descriptive statistical calculations and impact analysis through simple and multiple linear regression. The results showed that the average understanding of e-learning pedagogical design was 2.97, categorized as "high". Furthermore, the understanding level of digital technology and the ability to implement online learning was 3.30 and 3.03, both categorized as "high". The magnitude of the impact was based on the coefficient of determination (R-square). Understanding e-learning pedagogical design and digital technology had a positive impact of 57.8% and 38.6%, respectively, on the ability to implement online learning systems. These two variables had a combined positive impact of 59.0%. The dominant factors influencing online learning implementation were the understanding of e-learning pedagogy and digital technology by teachers as learning facilitators. In conclusion, teachers in Vocational High School should be provided with training in e-learning pedagogy and digital technology to successfully implement online learning.

Keywords: Digital technology, E-learning, Online learning, Pedagogical design, Vocational School.

1. Introduction

Vocational high school (known as sekolah menengah kejuruan; VHS) is an institution that prepares graduates to have the ability to immediately work in the business and industrial sectors [1-4]. Concerning technological developments and changing needs in the workforce, VHS teachers must possess mastery of technology. Teachers should be able to use knowledge, teaching materials, learning processes, and technology.

The UNESCO Framework emphasized the need for teachers to students collaborate, solve problems, and be creative through the use of information and communication technology (ICT). Students need to be taught how to use ICT to generate new knowledge. Furthermore, teachers must have good technology knowledge and skills to effectively and efficiently integrate technology into learning [5, 6].

The essential requirement for a teacher's pedagogical competence is the ability to design learning to effectively achieve objectives. The quality is determined by the teacher's ability to prepare learning components based on theory. Within e-learning systems, there are three fundamental components, namely the Learning Management System (LMS), e-content, and e-services [7, 8]. These components are carried out by three different actors and interaction with students is closely related to the used technology and pedagogy. Therefore, the development and use of e-learning systems should be comprehensive [9]. Pedagogy is concerned with educational activities and practices, or activities of educating children. This concept is a teaching skill and an ability to manage learning that teachers must possess. Some researchers reported four learning models, namely learning by being shown, told, constructing meaning, and joining a knowledge-generating community.

In contemporary times, the learning process is already familiar with the assistance of ICT and the is often implemented online [10-14]. ICT-assisted learning challenges individuals to be more creative and innovative. The use of ICT in learning refers to various technological devices and applications to facilitate the teaching-learning process. The competency standards for ICT-based learning are listed in the ICT Competency Framework for Teachers (ICT-CFT) by UNESCO. This framework contained the competencies needed for teachers to integrate ICT into the learning process and professional practice.

Furthermore, digital education standards for teachers can also refer to the Australian Qualification Framework (AQF) found in the TAE80316 Graduate Certificate. The AQF, more specifically Digital Education qualification serves as the basis for developing the instruments considering the AQF was often referred to by Indonesia's National Qualification Standard. The ICT competencies of teachers are grouped into six aspects, namely understanding ICT in education, curriculum and assessment, pedagogy, ICT, organization and administration, as well as professional teacher learning. Teacher ICT competencies based on the UNESCO ICT-CFT framework consisted of three levels of proficiency namely technology literacy, knowledge deepening, and creation.

Online learning components consist of: (i) models; (ii) instructional strategies; and (iii) media. On the other hand, internet-based learning is the most popular manifestation of e-learning, providing various advantages. such as enriching materials, enlivening the process, improving effectiveness, and supporting students

to learn independently. Previous research showed that teachers play the role of facilitators in online learning.

2. Method

The research used the descriptive correlational method, aimed at explaining the relationship (impact) between two independent and one dependent variables. A cross-sectional research design was adopted, showing that data on independent and dependent variables were collected simultaneously. The research was conducted at VHS in West Java, Indonesia with 210 respondents of different educational levels. The questionnaire used consisted of 24 items, with the variable containing 8 question items each. A four-point Likert was used after being tested for validity and reliability. Validity testing was conducted to determine the degree of accuracy of the instrument. This type of test uses correlation analysis, and an item with a correlation coefficient greater than 0.4 is considered valid [15]. Reliability testing was carried out using Cronbach's Alpha formula and the result was 0.98, categorized as very high. Data analysis was carried out in 2 stages, namely descriptive statistical and impact calculations through regression and correlation analysis which are referred to. After obtaining the average score, the value was compared with the standards listed in Table 1.

Table 1. Criteria for interpreting research data.

Value Range	Criteria
3.51 – 4.00	Very understanding/very capable
2.51 – 3.50	Understand/capable
1.51 – 2.50	Enough understanding/enough capable
1.00 – 1.50	Not understanding/not capable

The impact calculation of Understanding e-learning Pedagogical Design (X1) and Digital Technology (X2) on the Implementation of Online Learning Systems (Y) for VHS teachers was conducted using multiple linear regression analysis. The calculations were carried out using SPSS software. Detailed information for the analysis using SPSS is explained elsewhere [16, 17].
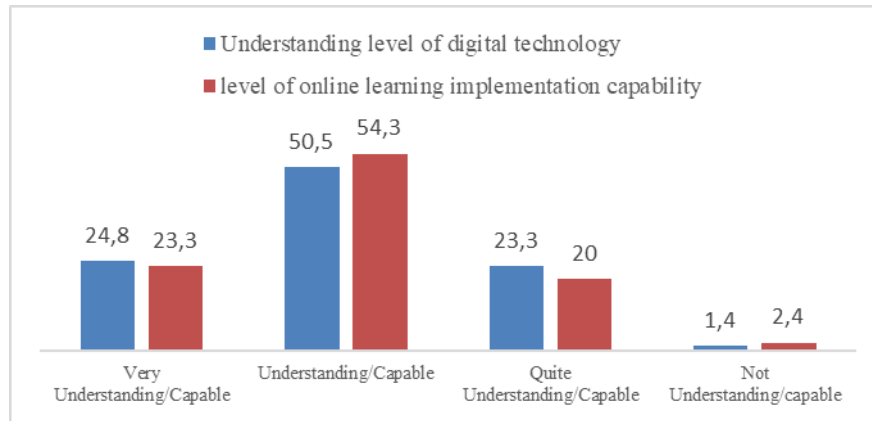
3. Results and Discussion

3.1. The level of understanding digital technology (X2) and online learning implementation (X1)

If seen separately, both understanding digital technology and learning implementation show comparatively similar results as most of the respondents were categorized in understanding and capable. The ability to design learning is a demand for pedagogical competence that is very important. Well-designed learning will effectively achieve the predetermined objectives. The quality is determined by the teacher's ability to prepare learning components based on specific theories. Online learning could be interpreted as a learning program where all materials are delivered online.

The average understanding of e-learning pedagogical design among VHS teachers in West Java was 2.97, categorized as high as seen in Fig. 1. The majority of VHS teachers in West Java have a positive understanding of e-learning

pedagogical design. The high understanding level regarding pedagogical design was expected to positively meet the demands of teacher competence in online learning. Furthermore, the skills needed by teachers are: (i) understanding the characteristics and needs of learners; (ii) adopting various models considering the needs and expectations of learner characteristics; (iii) understanding learning technology as a medium for delivering materials; and (iv) developing instructional materials and possessing the ability to effectively facilitate learning.
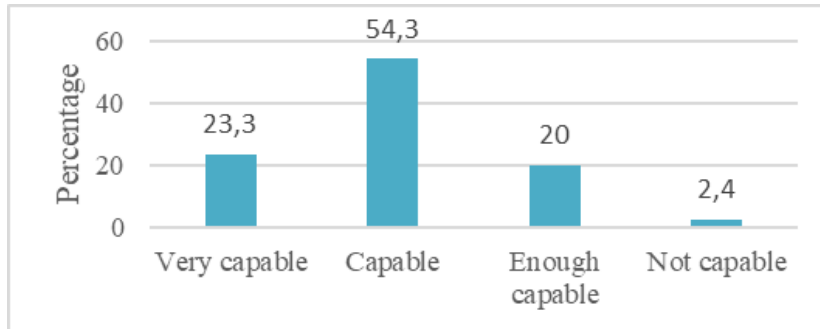

Fig. 1. The level of understanding digital technology and online learning implementation capability of VHS teachers in West Java, Indonesia.

The majority of VHS teachers in West Java have a positive understanding level of digital technology as shown by the average score of 3.30. This result showed that teachers' understanding of technology is good [18]. The research found that VHS teachers already have digital knowledge, attitudes, and competencies, as well as a foundation for digitizing teaching materials, media, and evaluations. The highest variable was professional engagement and digital resources. The lowest score was empowering students and facilitating students' digital competence, with a percentage of 75%.

3.2. Implementation of online learning system (Y)

The use of ICT for education is expected to enhance the efficiency and effectiveness of learning. The concept of utilizing ICT in learning is known as e-learning (online learning). This concept facilitates the delivery of teaching materials using the internet, intranet, or other computer network media to deliver content that could enhance knowledge and skills. This type of learning transforms conventional education into digital form, both in content and systems. Therefore, teachers are expected to have the ability to implement online learning. The ability of VHS teachers in West Java to implement online learning systems was in the high category, as shown by the average score of 3.03 (as shown in Fig. 2).

Figure 2 shows that the ability of VHS teachers in West Java to conduct online learning is in the "high" category, with 23.3% classified as "very capable" and 54.3% as "capable". The majority of VHS teachers in West Java were ready to implement online learning. This result was consistent with the result report of [19].

**Fig. 2. Level of online learning implementation capability
for vocational school teachers in West Java, Indonesia.**

3.3. Impact of understanding e-learning pedagogical design (X1) and understanding digital technology (X2) on online learning system implementation (Y)

The impact of understanding e-learning pedagogical design (X1) and understanding digital technology (X2) on the implementation of online learning systems (Y) was analysed using multivariate regression on SPSS software. The calculation results are shown in Tables 2 and 3.

Table 2. Model Summary X1, X2 and Yb.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.768a	0.590	0.586	0.43036

a. Predictors: (Constant), Understanding of Digital Technology, Understanding of e-learning Pedagogical Design

b. Dependent Variable: Implementation of Online Learning Systems

Table 3. Coefficients X1, X2, and Y[a].

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	0.442	0.200		2.206	0.028
Understanding e-learning Pedagogical Design	0.638	0.063	0.648	10.14	0.000
Understanding Digital Technology	0.209	0.086	0.156	2.438	0.016

a. Dependent Variable: Implementation of Online Learning Systems

The multivariate regression equation for the understanding of e-learning pedagogical design (X1) and digital technology (X2) on the implementation of online learning systems (Y) is in Eq. (1):

$$Y = 0.442 + 0.838 X1 + 0.209 X2 \tag{1}$$

Eq. (1) shows that the understanding of e-learning pedagogical design (X1) and digital technology (X2) have a combined positive impact on the implementation ability of online learning systems. The magnitude of the impact was based on the coefficient of determination (R-square). In this research, the value of R-square was 0.590 or 59.0%, suggesting that the ability of VHS teachers to implement online learning was based on understanding e-learning pedagogical design and digital technology. This result is consistent with previous research that the willingness of instructors to collaborate with students and solve technology issues enhances the quality of online learning [20].

Activities such as allowing students to ask questions, offering flexibility in assignment deadlines, and providing timely feedback contribute to the quality of online learning, particularly in terms of pedagogical understanding [21]. Previous research showed that Interaction was the most important element of online learning [22]. Online learning is characterized by interactivity, facilitated by technology [23]. The dominant factors influencing the implementation of online learning were the pedagogical understanding of e-learning and the digital proficiency of teachers as learning facilitators. Finally, this study adds new information as reported elsewhere [24-29].

4. Conclusion

As the driving force in education, teachers were required to have adequate competence in using ICT for more optimal delivery of lesson materials. The average understanding of e-learning pedagogical designed by VHS teachers in West Java was 2.97, categorized as "high". The understanding level of digital technology by VHS teachers in West Java was also high, as evidenced by an average score of 3.30. Furthermore, the ability of VHS teachers in West Java to implement online learning systems had an average score of 3.03, categorized as "high". The magnitude of the impact was based on the coefficient of determination (R-square). Understanding e-learning pedagogical design also had a positive impact of 57.8% on the ability to implement online learning systems. Similarly, understanding digital technology had a positive impact of 38.6% on the ability to implement online learning systems. Both variables had a combined positive impact of 59.0% on the ability to implement online learning systems. Based on this data, the dominant factors influencing online learning implementation were the understanding of e-learning pedagogy and digital technology by teachers.

References

1. Ana, A. (2020). Trends in expert system development: A practicum content analysis in vocational education for over grow pandemic learning problems. *Indonesian Journal of Science and Technology*, 5(2), 246-260.
2. Rosina, H.; Virgantina, V.; Ayyash, Y.; Dwiyanti, V.; and Boonsong. S. (2021). Vocational education curriculum: Between vocational education and industrial needs. *ASEAN Journal of Science and Engineering Education*, 1(2), 105-110.
3. Maryanti, R.; and Nandiyanto, A.B.D. (2021). Curriculum development in science education in vocational school. *ASEAN Journal of Science and Engineering Education*, 2(1), 151-156.

4. Handayani, M.N.; Ali, M.; Wahyudin, D.; and Mukhidin, M. (2020). Green skills understanding of agricultural vocational school teachers around West Java Indonesia. *Indonesian Journal of Science and Technology,* 5(1), 21-30.

5. Guzman, A.; and Nussbaum, M. (2009). Teaching competencies for technology integration in the classroom: Technology integration in the classroom. *Journal of Computer Assisted Learning*, 25(5), 453-469.

6. Koehler, M.J.; Mishra, P.; Bouck, E.C.; DeSchryver, M.; Kereluik, K.; Shin, T.S.; and Wolf, L.G. (2011). Deep-play: Developing TPACK for 21st-century teachers. *International Journal of Learning Technology*, 6(2), 146-163.

7. Soko, Y.; Mpundu, M.; and Yangailo, T. (2024). Determinants of learning management system (LMS) adoption by university students for distance learning. *Indonesian Journal of Educational Research and Technology*, 4(2), 171-186.

8. Al Husaeni, D.N.; and Hadianto, D. (2022). The influence of spada learning management system (LMS) on algorithm learning and programming of first grade students at Universitas Pendidikan Indonesia. *Indonesian Journal of Multidiciplinary Research*, 2(1), 203-212.

9. Gunawan, I. (2014). Pedagogi dan teknologi dalam e-learning studi kasus: Pengembangan e-learning di fakultas Tarbiyah dan Keguruan IAIN Raden Intan Lampung. *Jurnal Ilmiah Pendidikan Fisika Al-Biruni*, 3(2), 16-23.

10. Akinoso, S.O. (2023). Motivation and ICT in secondary school mathematics using unified theory of acceptance and use of technology model. *Indonesian Journal of Educational Research and Technology*, 3(1), 79-90.

11. Bolaji, H.O.; and Onikoyi, O.A. (2024). Usability of ICT for class size remediation and learning among secondary schools. *Indonesian Journal of Educational Research and Technology*, 4(1), 23-28.

12. Jadhav, P.; Gaikwad, H.; and Patil, K.S. (2022). Teaching and learning with technology: Effectiveness of ICT integration in schools. *ASEAN Journal for Science Education*, 1(1), 33-40.

13. Daramola, F.O. (2023). Utilization of ICT resources for teaching among some selected lecturers in colleges of education in Kwara State. *ASEAN Journal of Educational Research and Technology*, 2(1), 1-10.

14. Sanni, A.M. (2023). ICT tools for teaching the Arabic language. *ASEAN Journal of Religion*, *Education, and Society*, 2(2), 67-74.

15. Straub, D.; Boudreau, M.C.; and Gefen, D. (2004). Validation guidelines for IS positivist research. *Communications of the Association for Information Systems*, 13, 380-427.

16. Fiandini, M.; Nandiyanto, A.B.D.; Al Husaeni, D.F.; Al Husaeni, D.N.; and Mushiban, M. (2024). How to calculate statistics for significant difference test using SPSS: Understanding students comprehension on the concept of steam engines as power plant. *Indonesian Journal of Science and Technology*, 9(1), 45-108.

17. Afifah, S.; Mudzakir, A.; and Nandiyanto, A.B.D. (2022). How to calculate paired sample t-test using SPSS software: From step-by-step processing for

users to the practical examples in the analysis of the effect of application anti-fire bamboo teaching materials on student learning outcomes. *Indonesian Journal of Teaching in Science*, 2(1), 81-92.

18. Sumardi, K.; Gafar, A.A.; and Rohendi, D. (2022). Kemampuan digitalisasi bahan, media dan evaluasi pembelajaran guru SMK. *Jurnal Pengabdian Kepada Masyarakat Nusantara* (*JPkMN*), 4(4), 3687-3694.

19. Wolango, D.A.; Haris, I.; and Arifin. (2022). Kemampuan guru dalam menggunakan aplikasi e-learning di MTs Hubulo kabupaten Bone Bolango. *Jurnal Normalita*, 10(3), 231-242.

20. Abbasi, S.; Ayoob, T.; Malik, A.; and Memon, S.I. (2020). Perceptions of students regarding E-learning during Covid-19 at a private medical college. *Pakistan Journal of Medical Sciences*, 36, S57.

21. Walker, S.; and Graham, L. (2021). At risk students and teacher-student relationships: student characteristics, attitudes to school and classroom climate. *International Journal of Inclusive Education*, 25(8), 896-913.

22. Moore, M.G. (2001). Surviving as a distance teacher. *American Journal of Distance Education*, 15(2), 1-5.

23. Blocher, J.M.; Montes, L.S.; Willis, E.M. and Tucker, G. (2002). Online learning: Examining the successful student profile. *The Journal of Interactive Online Learning*, 1(2), 1-12.

24. Adeniran, T.A.; and Onasanya, S.A. (2024). Impact of e-learning on college of education lecturers' knowledge of quantitative data analysis in SPSS. *Indonesian Journal of Educational Research and Technology*, 4(2), 121-128.

25. Savytri, A.; and Ratri, D. (2023). A comprehensive design guide to adaptive e-learning system based on VARK learning styles. *Indonesian Journal of Multidiciplinary Research*, 3(2), 453-464.

26. Llupar, M.L.; Malones, L.J.L.; Sombria, A.J.F.; and Calixtro, V.L. (2022). Development of folk-dance videos for e-learning. *Indonesian Journal of Teaching in Science*, 2(1), 1-6.

27. Estrellan, A.; Ferrariz, K.J.; Lazona, P.A.; Madres, V.E.; and Estrellan, J.C. (2021). E-learning amidst the pandemic: Teachers' perspective in the Philippines. *ASEAN Journal of Science and Engineering Education*, 1(2), 93-96.

28. Nafsi, N.R.R.; and Maryanti, M. (2022). Analysis of teacher skills in e-learning content development during distance learning during the Covid-19 pandemic. *ASEAN Journal for Science Education*, 1(1), 23-32.

29. Susilawati, A.; Al-Obaidi, A.S.M.; Abduh, A.; Irwansyah, F.S.; and Nandiyanto, A.B.D. (2025). How to do research methodology: From literature review, bibliometric, step-by-step research stages, to practical examples in science and engineering education. *Indonesian Journal of Science and Technology*, 10(1), 1.