Analysis of Information and Communication Technology (ICT) Literacy Skills of Vocational High School Teachers in the Era of Industrial Revolution 4.0

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Abstract

This paper aims to provide an overview of the information and communication technology (ICT) literacy skills of Vocational High School (SMK) teachers in the era of the industrial revolution 4.0. The development of this era is marked by the digitization of internet-based information and the use of *artificial intelligence,* which requires teachers to have ICT literacy competencies so that they can prepare their students to have a 21st century competitive advantage. This paper answers questions about what ICT literacy competence means, what is its urgency, what is the level of information and communication technology (ICT) literacy skills of SMK teachers; and how to improve teachers' ICT literacy competencies. The method of writing is descriptive qualitative through literature review obtained from scientific journals and related books. The results of the discussion show that the average ICT literacy skills of SMK teachers are still classified as low - medium. A number of efforts are needed as a solution to improve the ICT literacy skills of SMK teachers.

Keywords: *Competence, ICT Literacy Competence, SMK, Era 4.0.*

INTRODUCTION

The era of the industrial revolution 4.0 is characterized by the digitization of information and the massive use of *artificial intelligence*. According to Schwab in (Santoso & Lestari, 2019): *"This era is disruptive and marked by the rapid development of information technology as the main base that has a big influence in every line of human life, both education, economics, social, and various other fields of life."* This era has brought fundamental changes in life and work, affecting the economic, social, educational and other aspects.

This era requires the ability of organizations, including educational institutions, to adapt and adjust if they want to maintain their existence. In other words, educational institutions must be able to build and develop organizational designs that are in accordance with the demands of this disruption era, including structure, leadership, culture, human resources and supporting technical matters such as the application of technology. And teachers as key human resources in educational institutions are required to develop competencies that meet the challenges of this disruption era in order to prepare students who have 21st century competitive advantages, namely: *leadership, digital literacy, communication, emotional intelligence, entrepreneurship, global citizenship, problem solving.* Teachers as facilitators in the educational process are expected to be able to utilize communication and information technology so that they can prepare a creative, conducive and fun learning space to optimize the potential of students.

The development of the quality of education human resources will rely on teachers who are expected to be able to become agents of transformation in strengthening human resources in building the talents and skills of students. (Nuryani & Handayani, 2020). Teachers must also master the skills that

students must have, including mastery of digital literacy and technology integration.

In addition to the issue of improving the quality of human resources, other education issues are character education, innovation development and vocational education. Vocational education at the secondary education level is known as Vocational High School (SMK) which the Ministry of Industry is expected to be involved in the *link and match* vocational education program since 2019. It is targeted that 2600 SMKs and 750 industries join the vocational education program. The purpose of this program is to provide guidance and assistance to industry players at SMKs in their area in order to realize the target of providing certified workers (SMK graduates) (Kominfo, 2019).

Of course, this is a challenge for SMK managers and teachers to optimize the program by improving the competence of SMK teachers. The competency demands are stated in Permendiknas No. 16/2007 on the standards of academic qualifications and teacher competencies. In the pedagogical competence sub-chapter point five, teachers are required to be able to utilize Information and Communication Technology (ICT) for the benefit of organizing educational development activities. What is the reality?

Fitriyadi's (2012) research shows that the average ICT skills of vocational teachers are in the low category and the implementation of ICT in vocational productive learning is also in the medium category. Widaryanto (2016) also found that the relationship between students' perceptions of teachers' mastery of ICT skills and students' ICT skills was in the low category. Based on the initial observation of Jurhanah's research (2012), there are learning problems faced by SMK teachers in the Construction Technology and Property expertise program that are not in accordance with industry standards; and there are still

many teachers who have not mastered ICT skills. (Jurhanah, R. Backrani, n.d., 2012).. National data on the feasibility of SMK teachers teaching in accordance with their competencies is only 56.70% (Ministry of National Education, 2005). Data on the feasibility of teaching SMK teachers who manage learning when averaged less than 24 hours per week is 57.00%. With detailed criteria of 43.00% teaching 1 to 12 hours, 38.00% teaching 13 to 23 hours, 5.00% teaching 24 hours, 11.00% teaching 25 to 36 hours, and 2.00% above 36 hours. (National Department of Education, 2010).

The problem of teacher pedagogical competence related to mastering ICT literacy skills in the teaching process is not only a monopoly of third world countries, but also experienced by developed countries such as Norway. According to Saavedra & Opfer (2012), in (Instefjord & Munthe, 2017) "*There is an increasing demand for new types of teaching that support students' capacity building which includes the capacity to exploit technology to develop critical thinking, problem solving and communication skills.*" This means that schools need teachers with specific teaching competencies to help learners, rather than just providing the tools and technology.

This is confirmed by the European Commission's finding in 2013 that many schools have good access to computers and technology infrastructure to support teaching, but the use of these tools and technologies for pedagogical purposes of instructional technology is variable. In fact, the International Computer and Information Literacy Study (ICILS), which examines students' computer and information literacy outcomes, shows that Norwegian students score well above the international average on computer and information literacy, even though 75% of students report using computers at home every day, and only 8% report using computers at school. (Instefjord & Munthe, 2017). This is evidence that students are achieving this not because of teacher

competence; and that there is still a gap between the amount of technology available in classrooms and the use of technology for educational purposes. And apparently, more or less the same results were also found by researchers in Switzerland (Petko, 2012), the US (Gray, Thomas, & Lewis, 2010; Kopcha, 2012; Zhao, Pugh, Sheldon, & Byers, 2002) and in the Netherlands (Brummelhuis & Kuiper, 2008).

Departing from the above background and problems, this paper aims to: present an overview of the understanding, urgency and level of information and communication technology (ICT) literacy skills of SMK teachers; and how to improve these ICT literacy skills.

THEORETICAL STUDIES

a. Organization, HR and Competency Theory

The discussion of human resource (HR) competencies can be based on the *Scientific Management Theory* first proposed by F.W. Taylor in 1911. This theory requires rational and objective scientific management as the basis for managing the organization, including in the selection of employees as human resources in the organization. This theory requires organizations to ensure that each employee has responsibilities in accordance with their expertise or competence so that HR needs can be minimized so that the organization is effective and efficient in achieving goals (Heryana, 2018).

More or less the same thing is also stated in the *Bureaucracy Theory* proposed by Max Weber. This theory views employees as organizational assets who must have technical qualifications according to organizational development needs. In this bureaucratic theory, employees are asked to develop their abilities and careers as high as possible with their competencies (Heryana, 2018).

Mcclelland's Motivational Theory examines individual motivation that affects productivity and efficiency at work because it is driven by needs. These needs consist of three, namely: *achievement needs*, the need to get high achievement and be able to complete difficult and complex tasks; *power needs*, the need to show good performance in the organization in order to get responsibility, roles and influence; *affiliation needs*, the need to get social interaction and group acceptance (Heryana, 2018). With the encouragement of achievement needs, having power or power and social acceptance, individuals will build their competence.

According to D. Vernanda, et. all (2018) in S. Saripudin, et. all. (2021) the level of ICT literacy can refer to the *theory of Personal-Capability Maturity Model (P-CMM) and ICT-Literacy.* This theory explains that measuring ICT literacy can be done from the dimensions of knowledge, literacy experience, and other abilities, such as: the level of recognition, use, and purpose of using information and communication technology (ICT) and its derivations. (Syarifuddin, 2014).

b. **Competency Concept**

In Arifin et al.(2018)McClelland (1973) defines competence as: *"A set of behavior related to effective job performance."* Boyatzis (1982, 2008) states that competence is: *"Underlying set of traits that leads to effective job performance."*

Spencer & Spenser (1993): *"Ability and skills developed through training, job and life experience".* Hager, Gonczi, & Athanasou (1994) define competence as: *"The standard or quality as the outcome of the individual's performance."*

Hoffmann (1999) states: *"Underlying qualities or attributes of a person, observable behaviors, and standards on a person's performance."* Cernusca & Dima (2007) define competence: *"The right positions for an employee linked to performance and one's career development."*

From the opinions of these experts, it can be synthesized that competence is the ability a person has to be able to fulfill the demands of his job well so as to achieve the established performance standards, including finding creative solutions to problems that arise, in order to help the organization achieve its goals. Competence is a combination of expressions of a person's knowledge, skills, character, self-concept and motivation that can be measured and observed. Knowledge, skills and behavior are obvious, while self-concept and motivation are sometimes hidden. Specific competencies are required in every professional domain, including the teaching profession.

c. Concept of Teacher Competence

According to Undang Undang No 14 of 2005 concerning Teachers and Lecturers, there are four teacher competencies, namely: pedagogic, professional, personality and social. Based on the Regulation of the Minister of National Education No. 16 of 2007, *pedagogical competence* concerns the ability to understand students, design and implement learning, evaluate learning outcomes, and develop students to actualize their various potentials. Mastery of ICT literacy skills (digital literacy) is part of the pedagogical competence that teachers must have.

Meanwhile, according to Selvi (2010) in (Hoesny & Darmayanti, 2021) there are nine competencies that must be possessed by a teacher, namely: field competence, research competence, curriculum competence, lifelong learning competence, socio-cultural competence, emotional competence,

communication competence, information and communication technology (ICT) competence, environmental competence.

d. The Concept of ICT Literacy as Part of Teachers' Pedagogical Competence

According to Hasan and Akbar (2020) the meaning of literacy in general is the ability of individuals to read and write. According to UNESCO in Mahdi (2020) and Igwe et al., study (2020): *"Literacy is the ability to identify, understand, interpret, create, communicate, and count, print, and write materials related to various contexts, stated in addition to reading and writing."*

In this 21st century development, the notion of literacy includes: technological literacy, information literacy, creative media, responsibility and social competence (Reddy, P & Salma, 2020). Technological literacy is related to the ability to use internet media to access information and communicate effectively. ICT literacy competence is part of a teacher's pedagogical competence, which in Regulation of the Minister of Education and Culture Number 68 article (4) generally means that ICT teachers have the main tasks and functions to guide students and provide services to teachers and other education personnel in searching, processing, storing, presenting, disseminating data and information to support the smooth learning process; including developing an ICT-based school management system. (Fathahillah & Suhartono, 2017).

Hague and Payton (2010) state that there are eight components of ICT literacy or digital literacy that teachers need to understand, namely: (1) Function skills, the ability and confidence of teachers in using technology; (2) Creativity, as the ability of teachers to make creative products using digital technology; (3) Understanding cultural and social; (4) Collaboration with

digital technology to support the synergy of teachers and learners in developing digital technology strategies; (5) Communication, which allows teachers and learners to communicate online at any time; (6) Ability to find and select information in cyberspace responsibly; (7) Critical thinking and evaluation, providing opportunities for learners to ask questions and solve problems; (8) Electronic security guarantees for learners in using and improving their digital literacy skills. Qustholani in Nuryani & Handayani (2020) asserts that one form of ICT literacy competence is competence *for technological commercialization*; that is, the competence of educating learners to be able to utilize technology for commercial or entrepreneurial purposes.

Based on the above opinions, it can be concluded that what is meant by ICT literacy competence in this paper is: the ability of teachers to understand and use internet-based information and communication technology, which is needed in carrying out the task of mentoring and optimizing the potential of students and services to parties in need so that schools can achieve their goals in this 4.0 era. ICT literacy competencies are often also called *digital literacy competencies*.

DISCUSSION

a. Urgency of ICT Literacy Competence

With ICT literacy competencies, teacher and learner interactions in the learning process can be carried out using *cyber space* media, exploring various sources of knowledge widely via the internet, and utilizing social media networks positively to develop themselves.

With ICT teachers can improve data literacy in the form of the ability to read, analyze, and make thinking conclusions based on the data and information *(big data)* obtained. Teachers can also improve technological

literacy, namely the ability to understand how machines work, technology applications and can work based on technology products to get maximum results. With ICT, teachers can also improve human literacy related to communication, collaboration, critical thinking, creativity and innovation. In fact, with ICT literacy competencies, teachers can present learning that uses global applications; globally integrated, critical cultural understanding, and support intercultural cooperation for transformative action.

Schacter (1999) in Summak & ıoğSamancıoğlu (2011) states: *"Technology can accelerate, enrich, and deepen basic skills; motivate and engage student learning; helps relate academics to the practices of today's' workforce; strengthens teaching; increases the economic viability of tomorrow's' workers; contributes to school change; and connects schools to the real world."* Summak's opinion indicates the importance of ICT competency standards for vocational teachers. Still according to (Summak & ıoSamancıoğlu, 2011): *"An effective use of Information and Communication Technology (ICT) in schools can have an immediate positive impact on the schools' learning environments."* The positive influence can be in the form of more dynamic teacher - learner interaction, enhancing collaboration and teamwork in problem solving activities; stimulating teacher and learner creativity; and assisting learners in controlling and monitoring their learning. As Christensen and Knezek (2008) state that the use of technology in teaching practices can directly influence their students' attitudes and dispositions towards integrating technology in the classroom.

b. Measurement of ICT Literacy Skills

As mentioned above, ICT literacy competencies (digital literacy) in teaching include dimensions of *knowledge, skills* and *attitudes*. According to M.M, Asad, et. all (2020) in S. Saripudin. et. All (2021), *"Digital technology*

competence can be recognized from five aspects which are the ability to access, manage, integrate, evaluate, and create." Therefore, the implementation of ICT literacy in learning includes aspects of: *Technology Knowledge (TK), Pedagogical Knowledge (PK), and Content Knowledge (CK)* which are interconnected in forming overall digital literacy competencies (Martinovic, D.; and Zhang, Z, 2012 in S. Saripudin, et. all, 2021).

According to D. Vernanda, et. all (2018) in S. Saripudin, et. all. (2021) the level of ICT literacy competence can refer to the *theory of Personal-Capability Maturity Model (P-CMM) and ICT-Literacy*, as in the following table:

Table 1. ICT Literacy Level Based on P-CMM Theory

Level 0:	*If a person does not know and does not care about the importance of information and technology to everyday life.*
Level 1:	*If an individual has repeatedly used technology to help with daily activities and has a repetitive pattern in its use.*
Level 2:	*If a person has been able to substantially increase (can be stated quantitatively) the efficiency of his or her daily activities through the use of information technology.*
Level 3:	*If a person has a standard of expertise and comprehension of the information and technology that he or she requires, and regularly uses these standards as a guide for carrying out daily activities.*
Level 4:	*If a person has been able to substantially increase (can be stated quantitatively) the efficiency of his or her daily activities through the use of information technology*

Level 5:	*If a person has regarded information and technology as an inseparable part of his or her daily activities and has directly or indirectly shaped his or her actions and culture (part of an information society or a cultured human being).*

Meanwhile, if viewed from the character of the user, it can be categorized into 3 (three), namely: awareness, *praxis*, and *phronesis* (practical wisdom). *Phronesis* is the highest level that aims to develop policies for utilizing digital technology. At this level, a teacher will be able to answer the question, "Why should we use technology?" Awareness is the most basic level of literacy. At this level, teachers can answer the question "what can technology do or not do?" At the praxis level, teachers are required to be able to practice the wise use of digital technology and begin to civilize the use of digital technology in learning activities. After that, teachers are able to complete simple tasks. At this level, they can answer the question, "How do you use this technology?"

Measurement of ICT literacy can be done from the dimensions of knowledge, literacy experience, and other abilities, such as: the level of recognition, use, and purpose of using information and communication technology (ICT) and its derivations. (Syarifuddin, 2014). How is the ICT literacy competence of SMK teachers in Cimahi City if measured using a literacy scale or level based on the P-CMM theory?

c. Case Study of ICT Literacy Skills of SMK Teachers in Cimahi City

A study with the aim of analyzing the ICT literacy skills of SMK teachers in Cimahi City has been conducted by S. SSaripudin, Ida Bagus Budiyanto, Reni Listiana and A, Anna in 2020).*.* This research with a quantitative approach took the population of SMK teachers in Cimahi City with 371 respondents from 23 SMKs in Cimahi City as samples. The sampling

technique was carried out by *random sampling*. Data collection through research instruments in the form of a *google.form* questionnaire which contains a number of statements to measure the level or level of ICT literacy of teachers using a Likert Scale.

The study showed the following results:

1. ICT literacy competencies of SMK teachers in Cimahi City can be differentiated based on gender, age and work experience (length of teaching).

2. The level of ICT literacy competence of male teachers is higher than that of female teachers, although the difference is not significant (lk: 69%; pr: 63%). The assumption is that men are more attentive and challenged by new things compared to women who tend to do new things if asked as a demand or obligation.

3. Younger teachers' ICT literacy competency levels are higher than those of older teachers. The assumption is that people with younger ages tend to be faster and easier to master the technology that comes along with their time.

4. The level of ICT literacy competence of teachers with longer years of work or teaching experience is lower than that of teachers with shorter teaching experience. The assumption is that the length of teaching experience correlates with age; the longer the teaching experience, the older the teacher.

5. The average level of teachers' ICT literacy competence in using technology communication and information at 77% which is categorized as level 3 of the 6 competency levels based on the P-CMM theory. Most teachers own

a computer and often use it to print documents, store and transfer them via loose disks, use MS Word, Excel, Power Point applications and use search engines for learning.

6. The average level of teacher ICT literacy competence in making learning media

is at 72% which is categorized as level 3 of the 6 competency levels based on P-CMM theory. The highest presentation of skills shown is making presentation shows with the MS PowerPoin application.

CONCLUSION

The discussion above shows that the level of ICT competence of SMK teachers in Cimahi is at level 3 of 6 categories. This can be concluded as follows:

1. SMK teachers' ICT literacy skills are still inadequate to reach the optimal level in mastering ICT competencies.

2. Efforts are needed to improve the ICT literacy competencies of SMK teachers to meet the demands of the disruption era.

3. The implementation of ICT in learning that requires teacher competence is influenced by education policy, the availability of adequate infrastructure, ICT literacy skills (digital literacy) in teachers and learning situations and conditions.

4. Efforts that can be made to improve the ICT competence of SMK teachers are as follows:

- Increase teachers' knowledge about the urgency of ICT, its benefits for life and the development of a world in the future that cannot be separated from technology. With the right knowledge, it is expected to build teacher motivation to continue to improve their ICT literacy competencies.

- Build positive attitudes of teachers towards new developments in the world of technology, the development of learner interaction with technology, and the use of technology for the purposes of building social networks, publication or marketing of educational institutions and commercial interests.

- Provide teachers with extensive learning opportunities to receive education and training on new applications that are useful to support their teaching duties.

- Provide adequate infrastructure to access and use information through technology, such as: internet quota, cellular phones, computers, networks/modems/Wifi, lap tops.

- Building an internet-based school database that can be a means of learning to improve competencies independently, such as: e-library, e-document, e-form, etc.

- Build habits of technology-based school behavior, such as: meetings or meetings with Zoom, Goole Meet, Webex, etc; coordination through WhattsApp Group, Line or Telegram; using social media as a means of school publications involving teachers, students and parents.

- Building healthy interaction and mutual learning between teachers and learners in using ICT-based learning media. Learners as *digital natives* certainly have wider and higher ICT skills than teachers.

- Reinforce the role of teachers in building learners' social responsibility when interacting with ICT.

- Periodically challenge teachers to improve their competence and *reward* teachers who are able to reach a certain level of ICT literacy competence.

- The government must prepare regulations related to tiered ICT competency training, coaching programs and adequate budgets to improve teachers' ICT literacy competencies evenly, especially in areas far from the center of government.

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