

Elinvo (Electronics, Informatics, and Vocational Education)

Journal Title **ELINVO (Electronics, Informatics, and Vocational Education)**
 ISSN **2477-2399 (online) | 2580-6424 (print)**
 DOI Prefix **Prefix 10.21831 by Crossref**
 Editor in Chief **Handaru Jati**
 Publisher **Department of Electronic Engineering Education, Faculty of Engineering, Universitas Negeri Yogyakarta**
 Frequency **Two issues per year (May & November)**
 Citation Analysis **Sinta | Google Scholar | Garuda**

Elinvo (Electronics, Informatics and Vocational Education) is a peer-reviewed journal that publishes high-quality scientific articles in English in the form of research results (the main priority) and or review studies in the field of electronics and informatics both in terms of their technological and educational development.

Elinvo (Electronics, Informatics and Vocational Education) accepts the scientific articles in the field of electronics and informatics from national and international academicians and researchers.

Elinvo (Electronics, Informatics and Vocational Education) is published twice a year by the Department of Electronic Engineering Education, Faculty of Engineering, Universitas Negeri Yogyakarta. **Elinvo (Electronics, Informatics and Vocational Education)** Editorial Team consists of editors who have experience in writing articles both nationally and internationally (Scopus), this information is available in detail in the Editorial Team page. **Elinvo (Electronics, Informatics and Vocational Education)** has a house style consisting of Title, Author Identity, Abstract, Keyword, Introduction, Methods, Results, Conclusion and References. It can be accessed in the Author Guidelines page. The process of editing the article through the review process is conducted by at least two (2) reviewers who are competent in their fields. The accepted articles are decided by the editor-in-chief based on the editorial board's recommendation. Plagiarism screening is conducted through google scholar. This information is available in details in the Policies page.



SPECIAL LINKS

- ▶ Editorial Team
- ▶ Reviewers
- ▶ Journal Subscription
- ▶ Statistics
- ▶ Focus and Scope
- ▶ Publication Ethics
- ▶ Author Guidelines
- ▶ Peer Review Process
- ▶ Reviewer Guidelines
- ▶ History

USER

Username
 Password
 Remember me

JOURNAL TEMPLATE



NOTIFICATIONS

- ▶ View
- ▶ Subscribe

JOURNAL CONTENT



This journal has been ACCREDITED by National Journal Accreditation (ARJUNA) Managed by the Ministry of Research, Technology, and Higher Education, Republic Indonesia with Second Grade (Peringkat 2, Sinta 2).

OAI Address

ELINVO has OAI address: <https://journal.uny.ac.id/index.php/elinvo/oai>

Editorial Team

Editor in Chief

Handaru Jati, (Scopus ID: 25825016500) Department of Electronic Engineering Education, Faculty of Engineering, Universitas Negeri Yogyakarta, Indonesia

Editorial Board Members

Taufik Taufik, (Scopus ID: 23670809800) California Polytechnic State University, United States
 Abdul Jaleel Kehinde Shittu, (Scopus ID: 56026303600) Fountain University, Nigeria
 Abdul Zubar Hameed, (Scopus ID: 55531475400) King Abdulaziz University, Saudi Arabia
 Rao Faizan Ali, (Scopus ID: 57219471253) University of Management and Technology, Pakistan
 Dhanapal Durai Dominic, (Scopus ID: 25824958800) Universiti Teknologi Petronas, Malaysia
 Imam Much Ibnu Subroto, (Scopus ID: 56287856000) Universitas Islam Sultan Agung, Indonesia
 Juhriyansyah Dalle, (Scopus ID: 55010239500) Information Technology Department, Faculty of Engineering, Universitas Lambung Mangkurat, Indonesia
 Pipit Utami, (Scopus ID: 57205284958) Department of Electronic Engineering Education, Faculty of Engineering, Universitas Negeri Yogyakarta, Indonesia
 Bektu Wulandari, (Scopus ID: 57205288126) Universitas Negeri Yogyakarta, Indonesia
 Bonita Destiana, (Scopus ID: 57209466901) Universitas Negeri Yogyakarta, Indonesia
 Anggun Winursito, (Scopus ID: 57203099252) Universitas Negeri Yogyakarta, Indonesia
 Oktaf Agni Dhewa, (Scopus ID: 57190937294) Universitas Negeri Yogyakarta, Indonesia
 Gilang Nugraha Putu Pratama, (Scopus ID: 57195619352) Universitas Negeri Yogyakarta, Indonesia
 Vita Wahyu Insanigati, Department of Electronics and Informatics Engineering Education, Faculty of Engineering, Universitas Negeri Yogyakarta, Indonesia
 Akhsin Nurlayli, (Scopus ID: 57202782544) Faculty of Engineering, Universitas Negeri Yogyakarta

SPECIAL LINKS

- ▶ Editorial Team
- ▶ Reviewers
- ▶ Journal Subscription
- ▶ Statistics
- ▶ Focus and Scope
- ▶ Publication Ethics
- ▶ Author Guidelines
- ▶ Peer Review Process
- ▶ Reviewer Guidelines
- ▶ History

USER

Username
 Password
 Remember me

JOURNAL TEMPLATE

[Home](#) > [Vol 6, No 2 \(2021\)](#) > [Amin](#)

Vocational Teachers Readiness in Integration The Principles of Industrial Revolution 4.0 into The Learning Process

Muhammad Amin, Universitas Negeri Medan, Indonesia
Bima Mustaqim, Institut Teknologi Sepuluh Nopember, Indonesia

 [10.21831/elinvo.v6i2.44210](https://doi.org/10.21831/elinvo.v6i2.44210)

Abstract

The Indonesian government has started to fix the problem of industrial change with 'Making Indonesia 4.0' as a strategy to pave the way for Indonesia to become one of the new powers in Asia. One of the steps taken is to change the education system in Vocational High Schools in Indonesia where the education system has turned into competency-based and student-oriented education since April 2018. Teachers must be highly qualified in order to produce students capable of meeting the challenges of the industry revolution 4.0. In this article, we ask the following: "What is the level of teacher readiness in integrating the principles of the industrial revolution 4.0 in the learning process?". Furthermore, this research employs a quantitative technique because data collection this study uses research instruments and its presentation is related to numbers which aim to describe the phenomenon that occurs, including teacher readiness. According to our results, Vocational High School teachers are in the category of ready to integrate the principles of industrial revolution 4.0 in the learning process which is seen from several aspects, follows: (1) Education Competence (EC), (2) Competence for Technological Commercialization (CTC), (3) Competence in Globalization (CG), 4) Competence in Future Strategies (CFS), (5) Counselor Competence (CC). The rapid development of technology can make it easier for vocational teachers to dig up information about industrial revolution 4.0. Therefore that vocational teachers are in the ready category to integrate the principles of the industrial revolution 4.0 in the learning process.

SPECIAL LINKS

- ▶ [Editorial Team](#)
- ▶ [Reviewers](#)
- ▶ [Journal Subscription](#)
- ▶ [Statistics](#)
- ▶ [Focus and Scope](#)
- ▶ [Publication Ethics](#)
- ▶ [Author Guidelines](#)
- ▶ [Peer Review Process](#)
- ▶ [Reviewer Guidelines](#)
- ▶ [History](#)

USER

Username

Password

Remember me

Vocational Teachers Readiness in Integration The Principles of Industrial Revolution 4.0 into The Learning Process

Muhammad Amin¹, Bima Mustaqim²

¹Department of Electrical Engineering Education, Universitas Negeri Medan, Indonesia

²Department of Electrical Engineering, Institut Teknologi Sepuluh Nopember, Indonesia

E-mail: aminunimed@unimed.ac.id

ABSTRACT

The Indonesian government has started to fix the problem of industrial change with 'Making Indonesia 4.0' as a strategy to pave the way for Indonesia to become one of the new powers in Asia. One of the steps taken is to change the education system in Vocational High Schools in Indonesia where the education system has turned into competency-based and student-oriented education since April 2018. Teachers must be highly qualified in order to produce students capable of meeting the challenges of the industry revolution 4.0. In this article, we ask the following: "What is the level of teacher readiness in integrating the principles of the industrial revolution 4.0 in the learning process?". Furthermore, this research employs a quantitative technique because data collection this study uses research instruments and its presentation is related to numbers which aim to describe the phenomenon that occurs, including teacher readiness. According to our results, Vocational High School teachers are in the category of ready to integrate the principles of industrial revolution 4.0 in the learning process which is seen from several aspects, follows: (1) Education Competence (EC), (2) Competence for Technological Commercialization (CTC), (3) Competence in Globalization (CG), (4) Competence in Future Strategies (CFS), (5) Counselor Competence (CC). The rapid development of technology can make it easier for vocational teachers to dig up information about industrial revolution 4.0. Therefore that vocational teachers are in the ready category to integrate the principles of the industrial revolution 4.0 in the learning process.

Keywords: vocational teacher, teaching competence, industrial revolution 4.0, teacher readiness

INTRODUCTION

A. Industrial Revolution 4.0: The Role of Teachers and Education

Education 4.0 is a concept coined by educators to describe the integration of cyber technology into the classroom. Education 4.0 is a reaction to the needs of the fourth industrial revolution, in which machines and humans work together to develop solutions, solve issues, and discover new innovations. Education during the IR 4.0 should be viewed as a three-part competency development process that encompasses the ability to think, act, and live in the real world. [1]. The components of thinking include critical thinking, creative thinking, and problem-solving. Communication, collaboration, digital literacy, and technology literacy are all action components. Initiative, self-direction, global understanding, and social responsibility are all aspects of life in the world. [2].

Education practitioners in schools that rely on the transfer of knowledge from teachers to students are no longer effective in preparing students to enter the industry 4.0 ecosystem that prioritizes 21st Century competency development. Education 4.0 can only be implemented in the context of knowledge and innovation generation and application by referring to a new educational paradigm formed by students as connectors, creators and constructivists [3]. By integrating the views on the characteristics of Education 4.0, the following learning characteristics are obtained. (1) Student-centered learning. This gives students the opportunity to learn according to their interests and learning speed. (2) Learning develops students' ability to explore their knowledge from sources using the Internet as a means of lifelong learning (lifelong learning). (3) Leverage ICT infrastructure and virtual learning tools to give students the flexibility to

find quality learning resources, record data, analyze data, create reports and give presentations. (4) Learn the theoretical aspects of knowledge at home and focus on practical learning by a learning method called "flipped classroom" that is practiced in class. This method develops self-learning habits and skills while providing more time to study at school for capacity building. (5) Develop critical thinking, creativity, problem-solving, especially genuine extraordinary problem-solving soft skills. (6) Collaboration and social interaction as the main approach to skill development to introduce labor culture into the world of industry and labor in the 21st century. (7) Provides flexibility in the learning process through blended learning. This allows students to interact, collaborate, and learn remotely in class over the Internet [4].

The Industrial Revolution Era 4.0 focuses on digital economy, artificial intelligence, big data and robotics. This requires a world of creativity, critical thinking, technology acquisition, and education to develop digital literacy [5]. As a result, changes in the field of education and learning are unavoidable. Teachers must adapt their teaching perspectives, as well as their learning methods and educational concepts, to meet the demands of the IR 4.0 age. The world is evolving at a breakneck pace. The digitization of education has resulted in significant transformations. The classroom is no longer the sole place where students can study. A campus can exist in the virtual world. In this way, artificial intelligence has supplanted a number of vocations in the midst of the Fourth Industrial Revolution. With the quick pace of change, the teacher's duty must expand beyond teaching to include student learning management. For pupils, teachers must be more adaptable, creative, fascinating, and enjoyable. [6].

The national education system is faced with very complex but interesting challenges. This principle marks the beginning of the democratization of knowledge which creates opportunities for everyone to use technology productively [7]. Artificial Intelligence (AI) is a

type of machine that is programmed to perform specific tasks in order to assist people with their daily activities. Artificial intelligence, which can search for information and deliver it fast, precisely, and interactively, aids individual learning in the field of education. This is what the Fourth Industrial Revolution, particularly in the sphere of education, is all about. It has a significant impact on how people teach and learn. Digital learning patterns are becoming more common in classrooms, making learning more creative, participative, diverse, and thorough.

Teachers are crucial in putting material into context and directing students during dialogues. [8]. Teachers must alter their teaching methods to make it more enjoyable and engaging. Similarly, the teacher's function has evolved from that of an information transmitter to that of a facilitator, motivator, inspiration, mentor, and developer of imagination, creativity, character values, teamwork, and social empathy, because if not, technology will be able to replace the teacher's position. The role of teachers or instructors in the IR 4.0 era must be watched out for, educators should not only focus on their duties only in the transfer of knowledge, but more emphasis on character, moral and exemplary education. This is because the transfer of knowledge can be replaced by technology, however, the application of soft skills and hard skills cannot be replaced with any sophisticated tools and technology [9]. The IR 4.0 which is full of super-fast technology will bring significant changes, one of which is the education system in Indonesia. This condition demands the readiness of teachers in facing a new era in the learning process. On the other hand, there are concerns about the current low competence of teachers. Based on the results of the national teacher competency test by the Directorate General of Higher Education (Ditjen Dikti) in 2015 shows that the average national teacher competency is only 56.69, and teachers in North Sumatra only reach 53.43. The educational qualifications of Vocational High School teachers are currently still in the standard

category, where 95.1% are qualified bachelor and only 4.9% are qualified above bachelor, as well as teachers who have educator certifications who teach in Vocational High School only 36.1% while the rest 63.9% have not been certified (Directorate General of GTK, 2019). These facts encourage the need for efforts to increase teacher capacity in the face of the era of IR 4.0 which is unavoidable.

Teachers are said to be ready to face the era of the IR 4.0 if they have been able to apply the three new literacies born from the IR 4.0, namely data literacy needed by a teacher to improve skills in processing and analyzing big data for the benefit of improving learning. Technological literacy shows the ability to utilize digital technology to process data and information. Meanwhile, human literacy must be mastered because it shows elements of soft skills or individual character development to be able to collaborate, be adaptive and be wise in the information-rich IR 4.0 era. This is supported by research. [10], that vocational education must be able to equip graduates with all three literacies, namely digital literacy, technological literacy and human literacy through the revitalization of the chronosystem which includes the learning system, education units, students, and educators and education staff [11]. Teachers must also increase communication, cooperation, critical thinking, and problem solving abilities, as well as creativity and innovation, as 21st-century talents that must be learned in order to utilize the new literacy afforded by the IR 4.0.

B. Vocational Teachers Readiness in Integration The Principles of The Industrial Revolution 4.0 in Indonesia

The role of the teachers as educators is impacted by changes in the educational system. Teachers must be highly qualified in order to develop pupils who are prepared to meet the demands of the Industrial Revolution. 4.0.[12] Following are five abilities that instructors must acquire in the era of the IR 4.0: 1) As a fundamental skill, the ability to educate/learn using the internet of things. 2) the ability to teach

pupils an entrepreneurial mindset (entrepreneurship) based on technology and student creative efforts. 3) Globalization competence, a world without walls, not stuttering when discussing different cultures, hybrid competence, and problem-solving competence. 4) Future strategy competency; the world is quick to change and move, therefore they must be able to forecast exactly what will happen in the future as well as the plan. 5) The ability of the counselor. Teachers who can act as counselors/psychologists will be needed in the future, as children's problems will be more related to psychological problems, stress due to increasingly complicated and harsh circumstances, than to difficulty in understanding instructional materials. [13].

As a result, if we want to increase the quality of education, we must first improve the quality of instructors [14]. In the era of disruption, not only students, but teachers and lecturers must also have 21st century skills. Because it is impossible for teachers to train these skills to students if the teachers themselves haven't mastered it. Teachers must have strong competencies, have soft skills, includes critical, creative, communicative and collaborative thinking. The teacher's role is as a role model, spreading passion and inspiration. This is a role that technology cannot replace [15].

Teachers must be able to build an atmosphere that can meet the psychological needs of students [16]. Efforts to become a competent teacher during the IR 4.0 can be implemented in six different ways, including (1) a selective and standardized teacher recruiting method in response to technology advancements. (2) a bottom-up structure of teacher competency growth, with each problem and impediment faced by teachers in the areas being taken into account for a subsequent collective review. (3) Through the PKB program, the teaching profession is continually improved. (4) Lesson analysis to help teachers enhance their skills. (5) e-literacy [17].

To achieve 21st century skills, learning trends and best practices must also be adjusted,

one of which is through integrated learning or blended learning [18]. Blended learning is a way of integrating the use of technology in learning that enables appropriate learning for each student in the classroom [19]. Blended learning is the combination of instruction from two historically separate models of teaching and learning: Traditional learning systems and distributed learning systems. It emphasizes the central role of computer-based technologies in blended learning. Research conducted by [20] shows that the use of blended learning can improve learning and practicum chance in vocational high school.

The function of the teacher is essential because technology cannot be a facilitator, motivator, inspiration, mentor, or developer of imagination, creativity, character values, teamwork, and social empathy. Technology will never be able to take the place of the teacher as a character builder for pupils. Teachers, on the other hand, are expected to continue to improve their skills so that issues associated to Indonesia's poorer educational quality in comparison to other nations can be remedied quickly [15].

It is not easy to prepare ideal teachers as required in education in the era of the IR 4.0 in a short time [21]. It is necessary to change the teacher's thinking which was originally only tasked with teaching to become a teacher who is able to encourage students to be more active and creative. Apart from several existing obstacles, teacher readiness is the most important factor in integrating the principles of the IR 4.0 in the learning process. Teachers are at the forefront of implementing the principles of the IR 4.0 in the learning process because the teacher is a person who deals directly with students, thus providing a direct influence on the success of students in the learning process. The success of integrating the IR 4.0 in the learning process is largely determined by the readiness of teachers. Therefore, it is necessary to study how the readiness of vocational teachers is to integrate the principles of the industrial revolution 4.0 in the learning process.

This study is to find out how far the readiness of vocational teachers is, what aspects have been mastered, then what aspects have not been mastered. The results of this study will be useful for stakeholders and policy makers, especially in preparing teachers to integrate the principles of the IR 4.0 in the learning process and improve teacher education and training in the future [22][23].

Readiness to integrate the principles of the IR 4.0 in the learning process is not only seen from the level of understanding of the teacher about the ins and outs of the principles of the IR 4.0, but also seen from the level of the teacher's ability to integrate the principles of the IR 4.0 in learning which includes: planning, implementing, and assess learning. This shows that the readiness of teachers to integrate the principles of the IR 4.0 already contains two aspects of ability, both theoretical and applicable. With such teacher readiness, it can indicate the success or failure of teachers to integrate the principles of the IR 4.0 in learning [24].

The strategic objective of this research is to provide data and evidence that forms the basis for reforming the vocational education system in Indonesia. Vocational teachers as the most important human resources in the learning process must see the level of readiness in integrating the principles of the IR 4.0 in the learning process so that students can compete and be ready to face the industrial revolution. In accordance with the literature review, this study aims to measure the level of readiness of vocational teachers in integrating the principles of the IR 4.0 in the learning process.

METHODS

The population studied in this study consisted entirely of vocational high school teachers in North Sumatra. The population in this study were 1661 teachers who teach in vocational high schools. Determination of the sample size that is able to represent the population is done by non-random sampling

with purposive sampling type. Purposive sampling according to [25] is a sampling technique with certain considerations. The steps for taking the subject that became the sample were carried out in the following ways: (1) Determined from the distribution of Vocational High Schools in the North Sumatra region. The number of vocational schools in North Sumatra is 1014 schools which is divided into 33 districts in North Sumatra; (2) Determined from the status of the school, number of public schools is 25 and number of private schools is 744; (3) Determined from the vocational high school expertise program, namely the electricity expertise program. The number of vocational high schools for electricity expertise programs in North Sumatra is 34 Vocational High School; and (4) Determined by the gender of teacher, where the number of male teachers is 755 and the number of female teachers is 906. Based on the provisions of the purposive sampling technique, the sample used for this research are 330 teacher with electrical competence.

This study uses a quantitative approach, where data collection in this study uses research instruments and the study is related to numbers [25]. The instrument used is a questionnaire with a checklist filling format with a scale Likert measurement. The scale items are presented in a closed form by providing 4 alternatives according to table 1. The instrument was developed based on several indicators or aspects proposed by [12]. The instrument was distributed to vocational high school teachers by using the google form. This was done because of the Covid-19 pandemic that attacked Indonesia and caused several vocational high schools to apply online learning. In addition, the use of google forms can make it easier for researchers to analyze research data. The data from the research results obtained are classified as answer categories based on the indicators or aspects studied, then entered into the data tabulation table. The definition of tabulation in data processing here is an effort to present data in tabular form. The criteria for the readiness of vocational teachers in integrating the principles

of the IR 4.0 in the learning process are seen in the Table 1.

Table 1. Readiness Category

Interval	Category
3.26 – 4.00	Very Ready
2.51 – 3.25	Ready
1.76 – 2.50	Fairly Ready
1.00 – 1.75	Less Ready

The scales presented describe the level of readiness of vocational high school teachers in integrating the principles of the IR 4.0 in the learning process. Furthermore, the indicator or aspect that is used as a benchmark for assessing the readiness of vocational teachers is the competence used by [12], where the competencies are as follows:

A. Educational Competence

Internet-based learning competence of Thing (IoT) as a basic skill. In other words, the ability to understand and use various IoT tools for education and teaching must be mastered. IoT is a condition that allows humans or objects to connect with anyone, anywhere, and anytime. IoT is a relatively new technology that has emerged to facilitate the real. Vocational teachers must be able to integrate IoT in the learning process. For this indicator there are 10 questions to see the readiness of teachers to integrate the principles of the IR 4.0 in the learning process. These questions were developed from research conducted by [17][26].

B. Competence for Technological Commercialization

A teacher must have competencies that will bring students to have an entrepreneurial attitude with technology on the innovations of students. The commercialization of technology refers to a process that begins with a techno-market insight and ends with the continuous functioning of the product that the market requires. Vocational teachers are expected to have competence in commercializing technology outside of school and even abroad. For this indicator, there are 9 statements that are used to see the readiness of vocational teachers in integrating the principles of the IR 4.0 in the

learning process. These questions were developed from research conducted by [27][28].

C. Competence in Globalization

Teachers do not stutter to various cultures and are able to solve educational problems. There are seven global competencies that must be mastered by teachers, includes: 1) general competencies, 2) information system competencies, 3) information and communication technology competencies, 4) project management and leadership competencies, 5) management competencies and knowledge and collaboration, 6) communication competence and 7) cultural competence. Vocational teachers are expected to master this competency. To see the readiness of vocational teachers for competence in globalization, there are 10 statements used. These questions were developed from research conducted by [29][30].

D. Competence in Future Strategies

Competence to predict exactly what will happen in the future and its strategy by means of joint-lecture, joint-research, joint-resources, staff-mobility, and rotation. Vocational teachers must master these competencies so that students can compete in today's industrial 4.0 world. To see the teacher's readiness to master competence in future strategies, there are 6 statements used. These items were developed from research conducted by [31][26].

E. The Counselor Competence

The Counselor Competence is the competence of teachers to understand that in the future students' problems will not only be difficult to understand teaching materials but also related to psychological problems due to the times. Vocational teachers must be able to become counselors for their students in providing motivation, encouragement, and advice for the problems they face. To see the readiness of vocational teachers in mastering the competence of counselors, there are 8 statements used. These items were developed from research conducted by [32][33].

RESULT AND DISCUSSION

This study is intended to describe the level of readiness of vocational high school teachers in integrating the principles of the IR 4.0 in the learning process. The level of teacher readiness is measured by giving a questionnaire consisting of 43 statements with a score range of 1 - 4, where a score of 1 = Not Good, a score of 2 = Not Good, a score of 3 = Good, and a score of 4 = Very Good. The indicator used to see the readiness of vocational high school teachers in integrating the principles of the industrial revolution 4.0 in the learning process is to use competency indicators that must be mastered by a vocational high school teacher, including: Educational Competence, Competence for Technological Commercialization, Competence in Globalization, Competence in Future Strategies, and Counselor Competence. The following are the results of the research on the level of teacher readiness based on the competence of vocational teachers.

A. Educational Competence

In educational competence, vocational teachers are required to be able to master the Internet of Things as a basic skill where teachers have the ability to understand and use various Internet of Things equipment for education and teaching. The level of readiness in the education competence indicator is measured by giving a questionnaire consisting of 10 statements with a score range of 1-4. The average and elementary grades show in Table 2.

Table 2 shows the mean and standard deviation of each item questionnaire. The average value obtained on the questionnaire education competencies 2.943. The result of the analysis shows that vocational high school teachers on education competence were in the ready category.

Table 2. Education Competence

Item	Mean	SD
Using e-mail in learning	2.78	.800
Learning using the internet	3.15	.662
Students have the ability to access the internet and use it in the learning process	2.90	.709
Provide teaching materials handouts that can be accessed via the internet	2.88	.822
Using applications and or the internet to show simulations or videos needed to deliver learning materials	2.58	.712
Applying online learning	3.05	.714
Using the internet to submit assignments	2.93	.764
Students connected to e-learning	3.18	.781
Doing blended learning	2.98	.768
Providing internet access in the school environment	3.00	.934

Based on the results of the analysis of the ability of vocational teachers on education competence, it is still low in the delivery of learning materials. Vocational teachers are still not good enough in delivering theoretical learning materials. This is in line with research conducted by [34] and [35]. The study mentions the difficulties faced by vocational teachers in learning, one of which is still difficult in conveying the material. Factors that influence this is the presentation of material that is less attractive to students in theory learning, vocational students are only interested in practical learning. In table 2 it can also be seen that vocational teachers are very good at connecting or inviting students to learn using e-learning. This is because students are interested in learning by using their own smartphones. Coupled with the e-learning used is very suitable for learning where the material presented is

equipped with video displays, images and others. This is in line with research conducted by [36] which states that it appears that vocational students are interested in learning by using their own smartphones.

B. Competence for Technological Commercialization.

In Competence for Technological Commercialization, vocational teachers must have competencies that can bring students to understand and have an entrepreneurial attitude with technology for the innovative work of students. The level of readiness on the Competence for Technological Commercialization indicator is measured by providing a questionnaire consisting of 9 statements with a score range of 1-4. The average and elementary grades show in Table 3.

Table 3. Competence for Technological Commercialization

Item	Mean	SD
Ready to integrate technological developments	3.00	.555
Students are ready to accept any technological developments	2.75	.630
Teachers use information technology in delivering learning materials in class	2.98	.620
Teachers use information technology in providing teaching materials	3.08	.694
Teachers provide handouts (modules) on each learning material	3.13	.563
Teachers use teaching aids or multi-media in delivering learning materials in class	3.03	.577
Teachers direct/invite students to have an entrepreneurial attitude based on information technology and entrepreneurship on student innovation work	3.00	.599
Teacher directs/invites students to be able to communicate with digital media to support learning both individually and in groups	3.03	.620
The number of computers available at the school is sufficient to facilitate students according to the needs of students to learn	2.48	.716

Table 3 shows the mean and standard deviation of each questionnaire item. The average value obtained on the Competence for Technological Commercialization questionnaire is 2.948. The result of the analysis shows that the vocational high school teachers in Competence for Technological Commercialization were in the ready category. Based on the results of the analysis, vocational teachers have complaints about the lack of facilities provided by schools to students to meet learning needs. One of the facilities that are lacking and these facilities can support students' entrepreneurship interest is a computer. With the computer facilities provided by the school, it can make it easier for teachers to hone their competencies so that students can have an entrepreneurial attitude. This is in line with research conducted by [28] that the use of computers is one of the supports for students to be able to grow commercialization skills, one of which is the interest in entrepreneurship. In table 3 also can be seen that the Competence for Technological Commercialization of vocational teachers is very good at providing modules that can support the learning process, so that students can read and understand the contents of the modules provided anytime and anywhere, so that it can lead to an entrepreneurial attitude of students. This is in line with research conducted by [37] which states that the importance of the module is to grow one's interest or entrepreneurial attitude.

Table 4. Competence in Globalization

Item	Mean	SD
Conduct learning with student-centered	3.08	.616
Observe any differences potential possessed by students	3.33	.616
Doing learning style variations to the students during the learning process	3.05	.749
Carry out learning activities in accordance with the needs of the industrial revolution 4.0	2.75	.707
Integrate life skills with students by applying project-based learning or training models	3.00	.716
Directing / inviting students to be able to take advantage of various existing learning resources	3.40	.672
Facilitating and motivating students find and formulate their own problems during the learning process	3.13	.648
Develop students' social skills such as cooperation, tolerance, communication and responsiveness to other people's ideas	3.28	.554
Provide opportunities for students to discuss learning material and or complete assignments in groups	3.18	.549
Forming study groups taking into account students' learning abilities	3.08	.694

C. Competence in Globalization

Vocational teachers Competence in Globalization is competence owned by teachers that no longer stutter about the various existing technological cultures and are able to solve educational problems related to technology. The level of readiness on the Competence in Globalization indicator is measured by giving a questionnaire consisting of 10 statements with a score range of 1-4. The average and elementary grades show in Table 4.

Table 4 shows the average value and standard deviation of each questionnaire item. The average value obtained on the Competence in globalization questionnaire is 3,128. The result of the analysis shows that vocational high school teachers in Competence in globalization are in the ready category.

Based on the analysis, it was found that vocational teachers are still less able to integrate the life skills of students by applying a project-based learning model. This is because there seems to be a lack of skills possessed by students, so it is difficult for vocational teachers to determine the life skills of the students themselves. This is in line with research conducted by [38] that vocational teachers must be able to see and help participants find skills that participants have and are interested in, so that teachers can apply project-based learning in the learning process.

Table 4 also shows that vocational teachers can invite students to be able to take advantage of existing learning resources. By utilizing existing learning resources, learning will not stop because of the problem of lacking learning resources. This is in line with research conducted by [39] that the use of existing learning resources can facilitate the learning process so that students have a broad source of information.

D. Competence in Future Strategies

Competence in Future Strategies vocational teachers are required to be able to predict what will happen in the future and strategies to deal with it. Vocational teachers must master this competency because it is to prepare students who are able to compete in today's industrial 4.0 world. The level of readiness on the Competence in Future Strategies indicator is measured by giving a questionnaire consisting of 6 statements with a score range of 1-4. The average and elementary grades show in Table 5.

Table 5 shows the average value and standard deviation of each questionnaire item. The average value obtained on the Competence in future strategies questionnaire is 3.118. The result of the analysis shows that the vocational high school teachers on Competence in future strategies were in the ready category. Based on the analysis conducted, it was found that vocational teachers were still unable to motivate students to be able to adapt to changes in the 4.0 industrial revolution. This is because there is still a lack of information obtained by students about

the rapid development of the industrial revolution 4.0. This is in line with research conducted by [40] that the industrial revolution 4.0 is very rapidly developing, if there is a lack of information it will be left behind. In table 5 it can also be seen that vocational teachers can direct students to be able to express opinions about the learning material presented. This is done to train students to think critically and dare to have an opinion. So that students will be able to compete with the era of the industrial revolution 4.0. This is in line with research conducted by [41] who revealed that critical thinking and daring to express opinions are one of the skills that must be possessed in the era of the industrial revolution.

E. Counselor Competence

In Counselor Competence, vocational teachers are required to be able to understand the problems that are being faced by students, both problems in learning and psychological problems of students as a result of the times. The level of readiness on the Counselor Competence indicator is measured by giving a questionnaire consisting of 8 statements with a score range of 1-4. The average and elementary grades show in Table 6.

Table 6 shows the average value of d and standard deviation of each questionnaire item. The average score obtained on the Counselor Competence questionnaire is 2.936. The result of the analysis shows that the vocational high school teachers at Counselor Competence were in the ready category.

Table 5. Competence in Future Strategies

Item	Mean	SD
Motivating students to take learning anywhere and anytime bythe applying principles contained in the industrial revolution 4.0	3.08	.694
Motivating the students to always be able to adapt against changes in the era of the industrial revolution 4.0	2.92	.693
Provide opportunities for students to discuss problems found in the learning process	3.17	.635
Invite students to always think critically in responding and solving problems related to learning material	3.17	.500
Directing/ inviting students to be courageous and active in expressing their opinion (what they think) about the learning material presented	3.25	.588

Table 6. Counselor Competence

Item	Mean	SD
Always provide motivation to learn before learning begins	3.40	.708
Make jokes to be able to refresh the atmosphere in the classroom	2.97	.659
Applying different learning models according to students' materials or learning needs	2.57	.747
Facilitating students through various media in learning (both online) in accordance with the principles of the industrial revolution 4.0	2.50	.679
Motivate students on how to describe the challenges that students will face in the world of work in the era of industrial revolution 4.0	3.00	.640
Motivating students to be able to take advantage of the opportunities that can be in the era of the industrial revolution 4.0 today	3.10	.671
Give students the opportunity to study groups in turn	2.90	.590
Motivate students to be flexible and always compromise with other members in achieving group goals	3.05	.503

Based on the analysis of vocational teachers on this competency, it is still difficult to provide the facilities needed by students. This is because there is still a lack of cooperation between the school and the teacher to complete the facilities needed by students. Complete facilities will make it easier to convey learning to students. This is in line with research conducted by [42] which revealed that learning facilities greatly affect the achievement of learning objectives. Table 6 also shows that vocational teachers always encourage students before learning begins. This is done to make students more focused on learning.

Competencies that are used as a reference for teacher readiness are competencies that have been widely used and tested by several previous studies. The novelty of this research lies in the development of a questionnaire adapted to the principles of the industrial revolution 4.0, so that the instrument used can measure the level of readiness of vocational teachers. From the results of the study, it was found that vocational teachers were in the category of being ready to integrate the principles of the industrial revolution 4.0 in the learning process with an average level of readiness of 3.014. Based on this value, it can be stated that vocational teachers in Indonesia are in the category of ready to integrate the principles of the industrial revolution 4.0 in the learning process.

Readiness integration of vocational teachers on the principles of the Industrial Revolution 4.0 into the learning process will

make learners more able to adapt to the development of the industrial revolution 4.0 in modern times. Based on the results of the research conducted, it was found that the vocational teachers as a whole were in the ready category. The industrial revolution 4.0 can still be well known by vocational teachers, so teachers can integrate the principles of the industrial revolution 4.0 in the learning process, where vocational teachers are able to use the internet in the learning process and teachers have an entrepreneurial attitude based on technology and are able to motivate students to produce innovative work through the expertise of each. In addition, vocational teachers also train students' thinking in solving problems found by students in learning excellence. However, vocational teachers always upgrade existing technology and information in accordance with the times and teachers are able to convey any opportunities that exist in the industrial revolution 4.0, where the task of a teacher is to be able to facilitate students as counselors to understand what students need. related to psychological problems, stress due to pressure from increasingly complex circumstances and teachers must be ready to motivate students to take advantage of what are the strengths and weaknesses of these students [43][44].

CONCLUSION

The level of readiness of vocational teachers with electrical competence at North Sumatra in integrating the principles of the industrial revolution 4.0 into the learning process is in the ready category. The indicator used to see the readiness of vocational high school teachers

in integrating the principles of the industrial revolution 4.0 in the learning process is to use competency indicators that must be mastered by a vocational high school teacher, including: Educational Competence, Competence for Technological Commercialization, Competence in Globalization, Competence in Future Strategies, and Counselor Competence.

In Education Competence, vocational teachers are still in the ready category, this is due to the lack of mastery of the Internet of Things as a basic teacher skill. If vocational teachers are provided with facilities and training on the Internet of Things, then vocational teachers will be categorized as very ready for this competency. Competence for Technological Commercialization of vocational teachers is still in the ready category, this is due to the lack of facilities provided by teachers to hone competence. If the facilities provided are fulfilled, it will be possible that in this competency the vocational teacher is in the very ready category. Competence in Globalization vocational teachers are in the ready category. This is because vocational teachers are still lacking in knowledge about the life skills of students. If this is fulfilled, it will be possible for vocational teachers in this competency to be in the very ready category. In Competence in Future Strategies, vocational teachers are in the ready category, this is because vocational teachers do not get the latest information about the development of industry 4.0. If vocational teachers can continue to seek information about industry 4.0, it will be possible that vocational teachers will fall into the very ready category. In Counselor Competence, vocational teachers are in the ready category, this is because there is still a lack of teachers in providing motivations that can inspire students to face the industrial revolution 4.0. If vocational teachers continue to hone their abilities to stimulate the enthusiasm of students, it will be possible that vocational teachers in this competency will fall into the very ready category.

Researchers assume that if these suggestions can be carried out or applied, there

will be no difference in the readiness of vocational teachers in integrating the principles of the industrial revolution 4.0 in the learning process and vocational teachers fall into the category of being very ready to integrate the principles of the industrial revolution 4.0 in the learning process. Therefore, this research is expected to be a material consideration for office holders or the government to be able to pay attention to the readiness and competence of vocational teachers in accordance with the principles of the industrial revolution 4.0 so that vocational teachers can integrate these competencies into the learning process, then students who graduate from vocational high schools can compete in the digital world and have creativity that can advance the Indonesian nation.

REFERENCES

- [1] A. J. Rotherham and D. Willingham, "21st Century Skills: The Challenges Ahead What Will It Take?," *Educational Leadership*, 2009. <http://www.ascd.org/publications/educational-leadership/sept09/vol67/num01/21st-Century-Skills@-The-Challenges-Ahead.aspx>.
- [2] J. L. McBrien, R. Cheng, and P. Jones, "International Review of Research in Open and Distributed Learning Virtual Spaces: Employing a Synchronous Online Classroom to Facilitate Student Engagement in Online Learning," 2009.
- [3] A. H. Anaelka, "Education 4.0 Made Simple: Ideas For Teaching," *Int. J. Educ. Lit. Stud.*, vol. 6, no. 3, p. 92, 2018, doi: <http://dx.doi.org/10.7575/aiac.ijels.v.6n.3p.92>.
- [4] G. B. Cotet, N. L. Carutasu, and F. Chiscop, "Industry 4.0 Diagnosis from an iMillennial Educational Perspective," *Educ. Sci.*, vol. 10, 2020, doi: [10.3390/educsci10010021](https://doi.org/10.3390/educsci10010021).
- [5] A. A. Shahroom and N. Hussin, "Industrial Revolution 4.0 and Education," *Int. J. Acad. Res. Bus. Soc. Sci.*, vol. 8, no. 9, pp. 314–319, 2018, doi:

- 10.6007/ijarbss/v8-i9/4593.
- [6] M. Baygin, H. Yetis, M. Karakose, and E. Akin, "An Effect Analysis of Industry 4.0 to Higher Education," 2016, doi: 10.1109/ITHET.2016.7760744.
- [7] T. N. Gorbunova, E. V. Papchenko, R. I. Bazhenov, and L. V. Putkina, "Professional Standards in Engineering Education and Industry 4.0," *Proc. 2018 Int. Conf. 'Quality Manag. Transp. Inf. Secur. Inf. Technol. IT QM IS 2018*, pp. 638–642, 2018, doi: 10.1109/ITMQIS.2018.8524922.
- [8] Y. Mulyadi, "Vocational Teacher Perception on Industry 4.0 and Society 5.0," *Glob. Conf. Ser. Sci. Technol. (GCSST), Vol. 2, 2019 1st Int. Conf. Educ. Sci. Technol.*, vol. 2, pp. 62–68, 2019.
- [9] B. Destiana and P. Utami, "Urgensi Kompetensi Pedagogik Guru Vokasional pada Pembelajaran Abad 21," *Elinvo (Electronics, Informatics, Vocat. Educ.*, vol. 2, no. 2, pp. 211–222, 2017.
- [10] H. Muhammad Yahya, "ERA INDUSTRI 4.0: TANTANGAN DAN PELUANG PERKEMBANGAN PENDIDIKAN KEJURUAN INDONESIA Disampaikan pada Sidang Terbuka Luar Biasa Senat Universitas Negeri Makassar Tanggal 14 Maret 2018," 2018, [Online]. Available: <https://core.ac.uk/download/pdf/154762984.pdf>.
- [11] V. A. Tandirerung and D. Vitalocca, "Pemetaan Kompetensi Lulusan SMK Bidang Keahlian Teknologi Informasi dan Komunikasi di Kota Makassar," *Elinvo (Electronics, Informatics, Vocat. Educ.*, vol. 2, no. 2, pp. 150–155, 2017.
- [12] Qusthalani, "Pengembangan Revolusi Industri 4.0 dalam Berbagai Bidang," 2018. .
- [13] D. Nuryani and I. Handayani, "Kompetensi Guru Di Era 4.0 Dalam Meningkatkan Mutu Pendidikan," in *Prosiding seminar nasional pendidikan program pascasarjana universitas PGRI Palembang 10 januari 2020*, 2020, pp. 224–237, [Online]. Available: <https://jurnal.univpgri-palembang.ac.id/index.php/Prosidingpps/article/view/3805/3573>.
- [14] T. Murwaningsih, H. Sawiji, W. Murtini, and N. R. Akbarini, "Teacher 's Need in the Continuing Professional Development Program for Teachers of Vocational High School throughout Surakarta Residency," vol. 6, no. 1, pp. 71–77, 2021, doi: 10.21831/elinvo.v6i1.39802.
- [15] V. Puncreobutr, "Education 4.0: New Challenge of Learning," *J. Humanit. Soc. Sci.*, vol. 2, no. 2, pp. 92–97, 2016, [Online]. Available: <http://scopusu.com/scopus/index.php/hum-se-sc/article/view/188>.
- [16] Z. Zainuddin and C. J. Perera, "Exploring students' competence, autonomy and relatedness in the flipped classroom pedagogical model," *J. Furth. High. Educ.*, vol. 43, no. 1, pp. 115–126, 2019, doi: 10.1080/0309877X.2017.1356916.
- [17] M. S. Panggabean and K. K. Himawan, "The Development of Indonesian Teacher Competence Questionnaire," *J. Educ. Heal. Community Psychol.*, vol. 5, no. 2, p. 1, 2016, doi: 10.12928/jehcp.v5i2.5134.
- [18] S. N. Hidayah, "Hybrid Model-Based Learning In Welcoming Era Industrial Revolution 4.0.," *Innov. Soc. Stud. J.*, vol. 1, no. 1, p. 55, 2019, [Online]. Available: <https://ppjp.ulm.ac.id/journals/index.php/iis>.
- [19] C. J. Bonk and C. R. Graham, *The handbook of blended learning: Global perspectives, local designs*. San Francisco: CA: Pfeiffer Publishing, 2006.
- [20] V. T. Irawan, E. Sutadji, and Widiyanti, "Blended learning based on schoology: Effort of improvement learning outcome and practicum chance in vocational high school," *Cogent Educ.*, vol. 4, no. 1, 2017, doi: 10.1080/2331186X.2017.1282031.
- [21] R. S. Termit Kaur and C. Samli, "Teacher Readiness on Ict Integration in Teaching-Learning : a Malaysian Case Study," *Int. J. Asian Soc. Sci.*, vol. 4, no. 7, pp. 874–885, 2014, doi: 2224-4441.
- [22] E. N. Faulinda and 'Abdu Aghni Rizqi Ni'mal, "Kesiapan Pendidikan Indonesia Menghadapi era society 5.0," *Edcomtech J. Kaji. Teknol. Pendidik.*, vol. 5, no. 1, pp. 61–66, 2020.
- [23] M. A. A. Wibowo, N. Purwaningsih, and

- S. Munadi, "Industrial Revolution 4.0 : Critical Thinking Skills in Vocational Education," in *PGSD UST International Conference on Education*, 2018, vol. 1, pp. 81–84, doi: 26550687.
- [24] Y. P. Yuara, F. Rizal, and I. Kusumaningrum, "Kesiapan Guru Vokasi Smkn 1 Sumatera Barat Dalam Menghadapi Era Revolusi Industri 4.0," *J. Imiah Pendidik. dan Pembelajaran*, vol. 3, no. 3, pp. 280–288, 2019, doi: 1858-4543.
- [25] Sugiyono, *Metode Penelitian Pendidikan (Pendekatan Kuantitatif, Kualitatif, dan R&D)*. Bandung: Alfabeta, 2015.
- [26] A. L. Mirzagitova and L. G. Akhmetov, "Self-development of pedagogical competence of future teacher," *Int. Educ. Stud.*, vol. 8, no. 3, pp. 114–121, 2015, doi: 10.5539/ies.v8n3p114.
- [27] A. Datta, D. Mukherjee, and L. Jessup, "Understanding commercialization of technological innovation: Taking stock and moving forward," *R D Manag.*, vol. 45, no. 3, pp. 215–249, 2015, doi: 10.1111/radm.12068.
- [28] S. A. Gbadegeshin, *Commercialization skills: Necessity for high technology entrepreneurs in digital era*, vol. 881. Springer International Publishing, 2019.
- [29] J. M. Pawlowski, P. Holtkamp, and H. Kalb, "Globalization Competences in Information Systems and E-Learning," in *ICSOB 2010 Proceedings, Workshop on Competencies for the Globalization of Information Systems in Knowledge-Intensive Settings, 1st International Conference on Software Business*, 2010, no. January, pp. 1–9, [Online]. Available: https://www.researchgate.net/publication/210076446_Globalization_Competencies_in_Information_Systems_and_E-Learning.
- [30] A. Auzuña, "Teacher Competences for Facing Challenges of Globalisation in Education," *J. Educ. Cult. Soc.*, vol. 9, no. 2, pp. 24–37, 2018, doi: 10.15503/jecs20182.24.37.
- [31] G. Chryssolouris, D. Mavrikios, and D. Mourtzis, "Manufacturing systems: Skills & competencies for the future," *Procedia CIRP*, vol. 7, pp. 17–24, 2013, doi: 10.1016/j.procir.2013.05.004.
- [32] S. Mustaffa, Z. Nasir, R. Aziz, and M. N. Mahmood, "Emotional Intelligence, Skills Competency and Personal Development among Counseling Teachers," *Procedia - Soc. Behav. Sci.*, vol. 93, no. 1995, pp. 2219–2223, 2013, doi: 10.1016/j.sbspro.2013.10.191.
- [33] J. M. Swank and A. Houseknecht, "Teaching Competencies in Counselor Education: A Delphi Study," *Couns. Educ. Superv.*, vol. 58, no. 3, pp. 162–176, 2019, doi: 10.1002/ceas.12148.
- [34] J. Yunos, L. Chee, S. Ph, T. Tze, K. Ph, and H. H. M. Ed, "The Issues and Challenges of Vocational Teacher Education Program," in *Annual International Seminar on Transformative Education and Educational Leadership*, 2016, vol. 2025, pp. 7–14, doi: 2548-4613.
- [35] E. Boldrini, V. Sappa, and C. Aprea, "Which difficulties and resources do vocational teachers perceive? An exploratory study setting the stage for investigating teachers' resilience in Switzerland," *Teach. Teach. Theory Pract.*, vol. 25, no. 1, pp. 125–141, 2019, doi: 10.1080/13540602.2018.1520086.
- [36] C. D. Handaru and Pujiriyanto, "Analysis of Vocational High School Students Interest on Interactive Learning Multimedia of Product Creative and Entrepreneurship (PKK) Subjects Based on Android," *Int. Technol. Educ. J.*, vol. 4, no. 2, pp. 43–51, 2020.
- [37] M. L. Hörnqvist and E. Leffler, "Fostering an entrepreneurial attitude – challenging in principal leadership," *Educ. Train.*, vol. 56, no. 6, pp. 551–561, 2014, doi: 10.1108/ET-05-2013-0064.
- [38] T. Hadinugrahaningsih, Y. Rahmawati, and A. Ridwan, "Developing 21st century skills in chemistry classrooms : Opportunities and challenges of STEAM integration Developing 21st Century Skills in Chemistry Classrooms : Opportunities and Challenges of STEAM Integration," vol. 030008, no. August, 2017, doi: 10.1063/1.4995107.
- [39] D. B. O. Lawal, "A Comparative Study of Students' Access to and Utilization of Learning Resources in Selected Public and Private Universities in Southwest, Nigeria," *J. Educ. Pract.*, vol. 8, no. 3, pp. 71–77, 2017, [Online]. Available:

- www.iiste.org.
- [40] M. M. K. Man, "Human Resource Development Requirements in Industrial Revolution 4.0," *Contemp. Glob. Issues Hum. Resour. Manag.*, pp. 129–139, Jan. 2020, doi: 10.1108/978-1-80043-392-220201011.
- [41] S. Sulistiani and S. Y. Sudikan, "Deconstruction-Critical Thinking: Alternative Learning Model of Literature Appreciation in Industrial Revolution 4.0," vol. 461, no. Icllae 2019, pp. 318–324, 2020, doi: 10.2991/assehr.k.200804.063.
- [42] E. Purnomo, R. Fajrin, and R. Ana, "The Effect Of Learning Facilities Towards Learning Motivation Of Grade III Students At SD Negeri Notorejo, Kecamatan Gondang Kabupaten Tulungagung," vol. 9, pp. 600–606, 2020.
- [43] P. Andersson and S. Köpsén, "Continuing professional development of vocational teachers: Participation in a Swedish National Initiative," *Empir. Res. Vocat. Educ. Train.*, vol. 7, no. 1, 2015, doi: 10.1186/s40461-015-0019-3.
- [44] Y. Mulyadi, "Vocational Teacher Perception on Industry 4.0 and Society 5.0," in *Global Conferences Series: Sciences and Technology (GCSST), Volume 2, 2019 The 1st International Conference on Education, Sciences and Technology*, 2019, vol. 2, pp. 62–68, doi: doi.org/10.32698//tech1315126.