

Teacher Competency of Vocational High School (SMK) in the Era of Industrial Revolution 4.0

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Abstract—The world is currently in the industrial revolution 4.0 era, which is marked by new technological advances that are physically, digitally, and biologically integrated. According to several studies, technology is likely to replace the role of teachers assuming their function is limited to the transfer of knowledge to students or teaching in the classroom. In addition, the demands of industrial revolution 4.0 can affect teachers' competencies, such as their set of knowledge, skills, and behaviours in carrying out their professional duties. These competencies are pedagogic, personal, professional, and social, therefore, teachers need to follow the development of education to improve the quality of learning. In the industrial revolution 4.0, teachers need to possess new literacy skills, namely digital, technological, human literacy, critical thinking, collaboration, communication, and creativity.

Keywords—teacher competence, industrial revolution 4.0

I. INTRODUCTION

The term Industrial Revolution 4.0 was officially coined in Germany at the 2011 Hannover Fair [1]. This led to the implementation of a development policy known as the High-Tech Strategy 2020, which aims to keep Germany at the forefront of manufacturing [2]. Industrial Revolution 4.0 has a wide-scale, scope, and complexity with technological advances that are physically, digitally, and biologically integrated. Furthermore, it is influenced by various government disciplines, economics, and industries, with the fields of (1) artificial intelligence and robotic, (2) nanotechnology, (3) biotechnology, (4) quantum computer technology, (5) block chain (such as bitcoin), (6) internet-based technology, and (7) 3D printers experiencing breakthroughs [3].

The opportunities and challenges associated with this era, provide a boost to vocational education innovation. Therefore, the Government needs to review the relevance of vocational education and employment to respond to the changes, challenges, and opportunities of industrial era 4.0 in accordance with human aspects. Vocational education is used to increase one's maturity and skills, therefore, it cannot only be borne by a group rather it is a collective responsibility [4]. This training and skill acquisition greatly influence a person's

work development-related ability [5]. Furthermore, it is directed at increasing self-reliance in entrepreneurship according to their competencies [6].

Teachers' success in facing the industrial revolution 4.0 is determined by their ability to master competence, expertise, and adapt to technological and global challenges. Educational institutions need to prepare new orientation and literacy in the field of education. In addition, the old literacy that relies on reading, writing, and mathematics needs to be strengthened by data, technology, and human resources. Data literacy is the ability to read, analyse, and use information from data in the digital world, while technological literacy refers to the act of understanding technological systems in the working world. Meanwhile, human resource literacy is the ability to interact properly, with good character [7].

II. METHODS

This is a content analysis research, which obtained data from several books, journals, magazines, newspapers, and all types of communication-related to research problems and objectives [8]. This technique is used to express various theories that are relevant to the problem studied [9].

III. RESULTS AND DISCUSSION

A. Competencies of Vocational High School Graduates in the Industrial Revolution 4.0 Era

The industrial revolution 4.0 is marked by an increase in manufacturing digitization, which is driven by four factors, namely 1) an increase in data volume, computing power, and connectivity, 2) the emergence of business analysis, skills, and intelligence, 3) the occurrence of new interactions between humans and machines, and 4) the improvement of digital transfer instructions such as robotics and 3D printing to the physical world [10]. The industrial revolution 4.0 is associated with the integration of Cyber-Physical Systems (CPS) and the Internet of Things and Services (IoT and IoS) into manufacturing, logistics, and other processes. Furthermore,

CPS is a technology used to combine the real and virtual world [11].

The Ministry of Industry has established four strategic steps in dealing with Industry 4.0. The **First** is promoting the Indonesian workforce to continuously improve their capabilities and skills, especially in using the internet of things technology (IoT) or integrating internet capabilities with production lines in the industry. The **Second** is the utilization of digital technology to spur productivity and competitiveness for small and medium industries (IKM) to be able to enter the export market through the IKM E-smart program. The **Third** is the utilization of digital technology that is more optimal in national industries such as Big Data, Autonomous Robots, Cybersecurity, Cloud, and Augmented Reality. And the **Fourth** is promoting technological innovation through the development of start-ups by facilitating business incubation to produce more technology-based entrepreneurs in Indonesia [12].

In 2015, the world economic forum announced a possible change to the 21st-century skill structures namely 1) solving complex problems, 2) cooperation, 3) management, 4) critical thinking, 5) negotiation, 6) quality control, 7) service orientation, 8) assessment and decision making, 9) active listening, and 10) creativity. These work structures changed to 1) solving complex problems, 2) critical thinking, 3) creativity, 4) people management, 5) cooperation, 6) emotional intelligence, 7) assessment and decision making, 8) service orientation, 9) negotiation, and 10) cognitive flexibility in 2020 [13].

A survey conducted by the World Economic Forum's Global Agenda Council on the Future of Software and Society indicated that people expect artificial intelligence machines to be part of corporate boards by 2026. However, active listening, which is considered a core skill today, is likely to disappear completely from the top 10, with a significant increase in emotional intelligence [14].

B. Learning in Vocational High Schools in the Industrial Revolution 4.0 Era

The Industrial Revolution 4.0 has brought changes and influenced various aspects of human life, including the field of education. The inception of digital technology tends to affect the current education system with the provision of an effective, efficient, and attractive learning system. In the 1980s, artificial concrete objects were widely used to visualize abstract concepts. However, this has been replaced with the digital technology-based visualization tool, which is more effective, efficient, interactive, and attractive [15].

The 21st century is oriented towards a digital learning lifestyle, with the development of thinking tools, capable of functioning the way knowledge works. Three out of the four 21st century learning orientations are closely related to vocational education, namely the way knowledge works, thinking tool strengthening, and digital lifestyle. The way knowledge works are the ability to collaborate in teams with

different locations and tools, while the thinking tool strengthening is the ability to use technology, digital tools, and services. Furthermore, the digital lifestyle is the ability to use and adapt to the digital era [16].

Life-based learning emphasizes the development of knowledge to contribute to the welfare and happiness of society in a balanced and harmonious manner, to become reliable human resources. Indonesia also needs to prepare reliable (quality) and sufficient (quantity) human resources in STEM (Science, Technology, Engineering, and Mathematics) disciplines to face the global competitive era [17]. Therefore, it is time for the curriculum to be reviewed and gradually developed to direct, shape, and prepare students for the industrial revolution era with an emphasis on the STEM field [18].

STEM education connects the four fields of Science, Technology, Engineering, and Mathematics to offer dynamic career opportunities. The eight standards and characteristics of learning that develop STEM education are (1) asking questions (for science), (2) developing and using models, (3) planning and carrying out investigations, (4) analysing and interpreting data, (5) using mathematics and thinking computationally, (6) constructing explanations (for science), (7) arguing from evidence, as well as (8) obtaining, evaluating, and communicating information [19].

STEM education has many potential benefits for individuals and society, such as the provision of scientific and technological literacy that can be determined from reading, writing, observing, and conducting science [20]. Therefore, when involved in the community, it tends to develop their competencies in dealing with problems in everyday life related to STEM science [21].

The current educational curriculum needs to mandate learning in information technology, the internet of things, big data, and computerization, as well as entrepreneurship and internship to produce skilled graduates in terms of data, technological and human literacy.

C. Competence of Vocational School Teachers in the Industrial Revolution 4.0 Era

The 2015 Teacher Competency Test showed unsatisfactory results, namely 53.05 national average score with professional competency score of 54.77 and pedagogical competence 48.94. In particular, the Vocational High School Teacher Competency Test scores below the standards set by the government. This value indicates that there are still many Vocational High School teachers who have not reached the ideal score so that it must be done to increase the pedagogical and professional competence of Vocational High School teachers [22]. Efforts made by the government through Teacher Professional Education and Competency Certification Programs in collaboration with industry.

Teachers tend to experience the direct impact of industrial revolution 4.0 in the world of education, with the use of smart

devices, modern learning media, and cloud storage created for efficiency and effectiveness. Furthermore, the term 'teacher 4.0' is used to describe teachers that apply technology 4.0 in learning [23]. They are required to have high competence to produce students that can provide solutions to the challenges of the Industrial Revolution 4.0.

Teacher professional development for curriculum implementation needs to be informed to determine the best practice knowledge that exists in STEM education and the nature of problem-based learning [24]. Furthermore, they need to increase the capabilities and skills of the young generation of prospective workers in the education world [25]. STEM education provides opportunities for teachers to illustrate the concepts, principles, and techniques of science, technology, engineering, and mathematics used in an integrated manner for the development of products, processes, and systems to students [17].

The challenges faced by teachers in the industrial revolution 4.0, are as follows: 1) Teaching in societies that have diverse cultures with multilingual competence, 2) Teaching to construct meanings (concepts), 3) Teaching for active learning, 4) Teaching and technology, 5) Teaching with a new view on abilities, 6) Teaching and choice, as well as 7) Teaching and accountability [26].

There are several competencies required by teachers before entering the Industrial Revolution 4.0 era. The first is educational competence, such as internet-based learning as a basic skill. The second is technological commercialization, which is associated with the need for teachers to have competencies that will bring students to have an entrepreneurial attitude with technology due to their innovative work. The third is globalization, which does not allow teachers to stutter towards various cultures with the ability to solve educational problems. The fourth is competence in future strategies, which is associated with the ability to predict future outcomes and its strategies, using joint-lectures, joint-research, joint-resources, staff mobility, and rotation. The fifth is counsellor competence, such as teachers' ability to understand that the problems of students in the future are not only difficulties in understanding teaching materials, rather they are also psychological problems due to the times [27].

In the industrial revolution 4.0, education is no longer teacher-centred, rather it has changed to be student-centred where the teacher becomes a facilitator for providing the learning needs. This is further carried out to implement 'how to learn' by preparing learning resources and media, which are intended for students, irrespective of their time and location.

IV. CONCLUSION

In conclusion, the various forms of skills and abilities in the 21st century and industrial 4.0 era that need to be integrated into the elements of vocational education, comprised of the learning system, education units, students, educators, and education personnel. Therefore, teachers improve their skills in accordance with the development of education to improve the

quality of learning. In the industrial revolution 4.0 era, teachers need to have new literacy skills, namely digital, technological, and human literacy as well as other competencies such as critical thinking, collaboration, communication, and creativity.

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