Systematic Literature Review: Work readiness of vocational high school graduates in facing the industrial 4.0 era

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ABSTRACT

The Industrial Era 4.0 requires Vocational High School (VHS) graduates to have high capabilities and competitiveness in facing global job competition. Every graduate is expected to have Work Readiness relevant to the demands of the industry and the world of work. Many studies examine aspects of Work Readiness that graduates must possess in the industry 4.0 era. So, it is necessary to review journal papers that discuss the Work Readiness of VHS graduates facing the Industrial 4.0 era. The method used in this study is a Systematic Literature Review of journal papers published from 2016-2021. The findings of this study show that 13 research articles resulted from interrelated mapping journals. Those findings cover topics about graduates, students, dimensions, industry, curriculum, factors, experience, training, workers, skills, employers, employability, and soft skills. Secondly, 10 Work Readiness that must be possessed by graduates, namely readiness to adopt technology, communication skills, collaboration skills, adaptability, analytical and problem-solving skills, critical thinking skills, innovativeness, independence, creativity, and curiosity. Third, the readiness to adopt technology in digitalisation is the most priority aspect of Work Readiness needed for VHS graduates in the Industrial Revolution 4.0 era. The findings of this study are expected to be the basic reference for developing the VHS Curriculum to face the Industrial 4.0 era. Therefore, VHS graduates will have good work readiness that fulfils the demands of the industry.

Keywords: Industry 4.0, Systematic Literature Review, vocational education, Work Readiness

INTRODUCTION

In the Industry 4.0 era, Vocational High School (VHS) graduates are the generation and human resources who are prepared to have high capability and competitiveness in facing the challenges of the times and global job competition (Darmawan, 2021). In this regard, each individual is expected to have Work Readiness to adapt to the industry's revolutionary changes (Hadayani et al., 2020). To achieve this target, schools, through their curriculum, must be able to produce graduates who master various aspects of Work Readiness in the 21st century (Delipiter, 2019). Work Readiness includes knowledge, practical work skills, personal characteristics and behavioural skills (Kinnane et al., 2021). The four domains of Work Readiness have work competencies; unique work characteristics, organisational acumen; and social intelligence

(Rogers et al., 2021). Work readiness is the overall condition of an individual that includes physical, mental, and experience maturity that encourages a person to want to cooperate with others, be critical, accept responsibility, and have the ambition to advance and adapt to the work environment (A. Wibowo & 2016).

Various studies on Work Readiness in the context of Industry 4.0 in several countries have been carried out. A survey conducted to investigate Industry 4.0 applications in Turkish companies found that the lack of technical skills and expertise is one of the most important challenges in the transformation of Industry 4.0 companies (Yüksel, 2020). A case study in the United States that examines the method of evaluating the readiness of graduates of a higher education institution reveals that it is important to evaluate the readiness of graduates according to industry expectations. Efforts are made to align education's strategic objectives to meet the industrial world's new global and competitive challenges (Chida & Brown, 2011). Several studies in Indonesia related to Work Readiness illustrate that Vocational Schools are not optimal to prepare postgraduate work readiness for their students (A. Wibowo, 2016). Therefore, schools through their curriculum must be able to produce graduates who master various aspects of Work Readiness in the 21st century (Delipiter, 2019). Smart Innovation is needed from VHSin preparing graduates who are skilled and ready to work (Setiawaty & Tjahjono, 2019). In addition, the world of education and industry must also formulate industrial transformation strategies by considering the human resource sector competent in its field (Muktiarni et al., 2019).

Currently, many studies examine aspects of Work Readiness that graduates must possess in the industry 4.0 era. So, it is necessary to review journal papers that discuss the Work Readiness of VHS graduates facing the Industrial 4.0 age. This kind of research needs to be done because it can be the basis of research for developing a vocational school curriculum following the context of Industry 4.0 so that graduates who have Work Readiness are produced according to the demands of Industry and the World of Work. Therefore, the purpose of this study is to find out the research pattern of several journals related to the importance of Worker Readiness in the context of Industry 4.0 owned by VHS graduates, analyse the uniformity of Worker Readiness aspects that VHS graduates must possess in the context of the Industrial Revolution 4.0.

METHOD

The method used in this paper is a systematic literature review related to the work readiness profile VHS graduates must possess in the Industry 4.0. The stages in this research are divided into 4 (four) main parts as used by Buettner (Buettner & Buettner, 2016), namely: 1). Identification of the database, 2). Identification by title, 3). Look for the suitability of the abstract content and keywords, 4)—deletion of inappropriate articles and determine the papers to be reviewed. The research questions in this study are how the research patterns of several journals

related to the importance of Worker Readiness in the context of Industry 4.0 are owned by VHS graduates, how is the uniformity of Worker Readiness aspects that VHS graduates must have in the context of the Industrial Revolution 4.0. The solution used to answer this research question is the Systematic Literature Review (SLR) method by conducting a process of selecting papers that match the selected criteria. The importance of the SLR method in this study is that researchers can identify and analyse journals systematically according to the recommended stages related to journals about the Work Readiness profile that VHS graduates must have in the context of IR 4.0.

The first step is to select a database source. The databases used in this systematic literature review include Springer, Google Scholar, Taylor & Francis Online, Sage Journal, Emerald Insight and Science Direct. Generally, articles published from international journals and the results of proceedings are in the 2016-2021 range. The literature search is carried out using keywords relevant to Work Readiness Industry 4.0, namely: work readiness, graduate, career readiness, employability, Industry 4.0 and digitalisation. The literature search strategy is based on meta-analysis of the database with the help of Harzing's Publish or Perish software, then selected, articles that match the next keyword will be retrieved (qualified), while those that do not match will be ignored (excluded). Articles that match the keywords are articles that are selected (included), then reviewed to get a summary of each article. At this stage, the number of articles obtained from the search results was 2862 articles. The number of selected articles is 91 articles published in the 2016-2021 range.

The article selection process is based on the following stages:

1) Stage 1: Identification of the source database based on search criteria, at this stage the number of articles that can be identified is 2862 articles

2) Stage 2: identify the articles selected in the first stage based on the title of the article that is relevant to the research topic, at this stage 1055 articles can be identified

3) Stage 3: article selection based on the suitability of the abstract content and keywords, resulting in 194 articles

4) Stage 4: is the last stage of removing a number of articles that do not meet the requirements based on the search criteria, at this stage 91 articles can be identified. The distribution of the number of articles from 2016 to 2021 can be shown in Figure 1
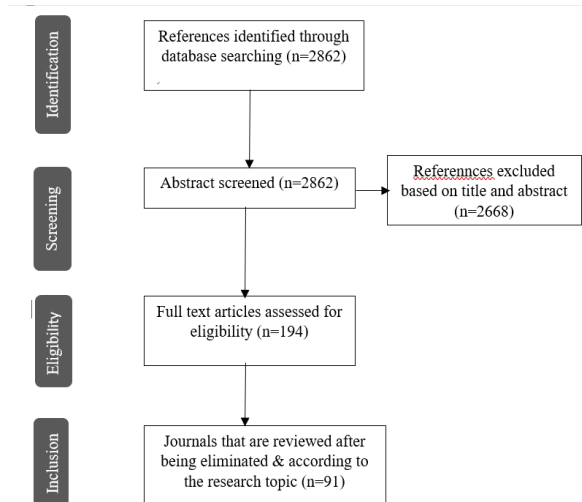
Figure 1. Prisma flow diagram of systematic review

Ninety-one papers are selected regarding the focus of this literature review which the author presents in Table 1. The articles are sourced from the google scholar database (30 articles), sage journals (4 articles), science direct (8 articles), Taylor and Francis (14 articles), emerald (20 articles), and Springer (14 articles).

Table 1. Number of Publications by Database in the 2016-2021 Range

No	Source	Stage 1 (papers)	Stage 2 (Title)	Stage 3 (Abstract & keywords)	Stage 4 (Final review)
1.	Google Scholar	716	482	59	30
2.	Sage Journals	380	110	15	4
3.	Science Direct	319	145	12	8
4.	Taylor and Francis	496	129	28	14
5.	Emerald	390	125	43	20
6.	Springer	561	64	37	14
	Total	2862	1055	194	91

The articles reviewed are articles sourced from research results published in international journals and international proceedings. At the final selection stage, the researcher summarises the solutions and results from the articles reviewed. The details of the number of selected articles based on the 2016-2021 publication year are presented in Figure 2 below:
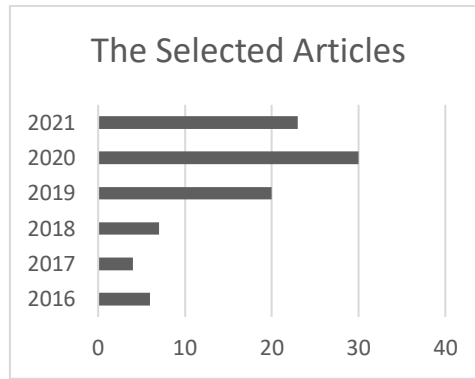
Figure 2. Number of Selected Articles of Work Readiness Industry 4.0

Researchers also mapped journals related to Work Readiness published in the range of 2016 – 2021 to find out the aspects of Work Readiness required by graduates in the context of Industry 4.0. More than 2000 articles taken from various databases related to the topic were inputted into the Mendeley application then the collected data was stored in a RIS file, the researchers continued to analyse the data using VOS viewer software based on the title and abstract of the article.

RESULTS AND DISCUSSION

Based on a review of 91 articles reviewed by researchers related to the job readiness profile that VHS graduates must have in the context of IR 4.0, then in this section the researchers divide into three main parts, namely knowing the research patterns of some journals related to the importance of Worker Readiness in the context of Industry 4.0 owned by VHS graduates, analyse the uniformity of Worker Readiness aspects that VHS graduates must have in the context of the Industrial Revolution 4.0, and analyse the most priority Worker Readiness aspects needed for VHS graduates in the Industrial Revolution 4.0 era.

The pattern of research on the importance of Work Readiness in the context of Industry 4.0 is owned by graduates.

Researchers mapped journals related to Work Readiness to identify the research focus of several journals related to Work Readiness in the context of Industry 4.0. Researchers found 13 research focuses that were examined by a number of articles published in the 2016-2021 period. The focus of the research that has been carried out is in the following areas: 1). Graduates 2). Students 3). Dimensions 4). Industry 5). Curriculum 6). Factor 7). Experience 8). Training 9). Workers 10). Skills 11). Employers 12). Employability and 13). soft skills. The thirteen aspects are known to be interrelated. This is in line with the author's Identification of the results of the Systematic Literature Review results, which showed that the thirteen research areas were covered

entirely in 90 selected articles. The results of journal mapping are shown in Figure 3. An overview of the distribution of the identified research focus is presented in Figure 4.
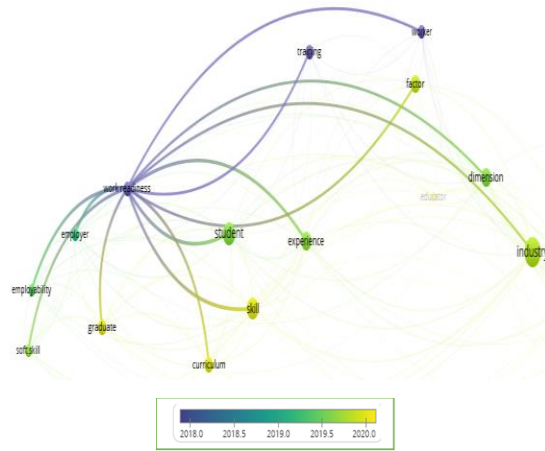

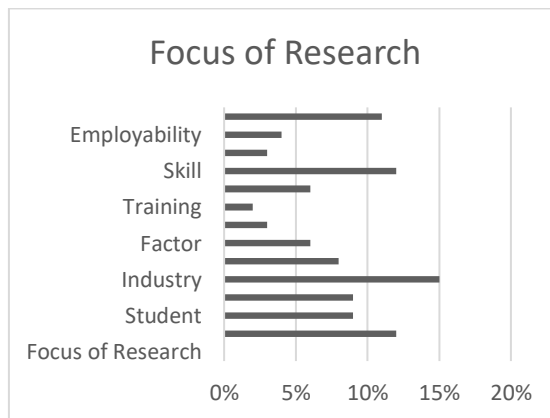Figure 3. Visualisation of Work Readiness Research Data for 2016-2021

Figure 4. Research Focus on Work Readiness 2016-2021

Work Readiness is important in understanding graduate transitions from education to employment (Prikshat et al., 2020). Various studies in several countries have been carried out highlighting the importance of Work Readiness graduates in the context of Industry 4.0. A survey conducted to investigate Industry 4.0 applications in Turkish companies stated that the lack of technical skills and expertise is one of vital challenges in the transformation of Industry 4.0 companies (Yüksel, 2020). An integrative review investigating the strategies used to support the graduate transition in Australia concluded that there are two important considerations for postgraduate nursing programs. First, a combination of strategies is needed to address the four domains of job readiness. Second, there is a need to adapt strategy, and its implementation, to the context of the organisation and the workplace (Rogers et al., 2021). The study aimed to explore on-the-job training in India revealed that training to encourage worker retention is basic job readiness skills consisting of self-presentation, interpersonal communication, segregation of work

life, and independence needed to survive in the workplace (Ranganathan, 2018). A survey of student readiness in two post-Soviet countries for digital work provides the practical implication that the global digitalisation of jobs requires students, educators, human resources professionals, and business leaders to rethink workforce readiness assessments and readjust training programs (Prikshat et al., 2020). A case study in the United States that examines the method of evaluating the readiness of graduates of a higher education institution reveals that it is important to evaluate the readiness of graduates according to industry expectations. Efforts are made to align education's strategic goals to meet the industrial world's new global and competitive challenges(Chida & Brown, 2011).

Several studies in Indonesia related to Work Readiness in the context of Industry 4.0 illustrate that Vocational High Schools are not optimal in preparing postgraduate work readiness for their students (A. Wibowo, 2016). Some of the causes are the imbalance of the material obtained at school with what is needed in the world of work (Tisnawati et al., 2021), there is still a gap between the competencies taught in schools and the work competencies needed by the industrial/business world (Lanuihsan, 2019). In addition, the curriculum offered to vocational students does not develop according to technology or industry (Baihaqi et al., 2021), even though sustainable education and curriculum should exist to face the world of work (Suharti & Faidin, 2021). This is a challenge for the world of education and industry in preparing the quality of human resources in order to adapt to industry 4.0. Therefore, the education system needs to follow developments in the knowledge space of the industrial revolution 4.0 era (Lee et al., 2018). Schools through their curriculum must be able to produce graduates who master various aspects of Work Readiness in the 21st century (Delipiter, 2019), smart Innovation is needed from VHSin preparing graduates who are skilled and ready to work (Setiawaty & Tjahjono, 2019). In addition, the world of education and industry must also formulate industrial transformation strategies by considering the human resource sector competent in their field (Muktiarni et al., 2019).

Aspects of Work Readiness in the context of Industry 4.0

The author has conducted a systematic literature review and found the top 10 Work Readiness graduates must possess. It includes s to adopt technology, communication skills, collaboration ability, analytical and problem-solving skills, critical thinking

Technology Adoption

One of the dimensions of People and culture IR 4.0 is digital skills(Wagire et al., 2021)The Industrial Revolution 4.0 is inseparable from technology that is all virtual and sophisticated, the acceleration of digital transformation is the driving force for the emergence of new jobs, various innovations and the importance of digital competencies. Vocational High School graduates must be able always to be dynamic and even have to be adaptive to any technological developments and changes that occur (Indarta et al., 2021).

Communication Ability

VHS graduates besides being required to have competence in the skill program taught in schools, they are also required to have competence in the form of good interpersonal skills (Lanuihsan, 2019). This ability can be achieved by habituation of the nature and attitude of students to always communicate in the learning process actively at school (Y. E. Wibowo & Syamwil, 2019). Studies identifying job skills employers need in career fields show that job skills concerning future job demands include communication, teamwork, problem-solving, and technology skills. Implementing these work skills is essential to integrate into the classroom learning processor all subjects (Fajaryati et al., 2020).

Ability to Cooperate

One of the general competencies of the twentieth century is the ability to work together or collaborate (Coşkun & Deniz, 2021). Some call it interpersonal skills (Lanuihsan, 2019). The results of research on 178 class XII students of the Mechanical Engineering Expertise Package in Jember Regency found that collaboration skills in 21st-century skills being a sub variable as the largest contribution to student capabilities. The development of student capabilities in the fourth industrial revolution era can be focused on developing collaboration skills (Kurniawan et al., 2019).

Adaptability

Research on mapping the need for graduate capabilities in vocational students in the Industrial 4.0 era finds the need for the ability to adapt to all working environmental conditions (Mukhadis et al., 2019), readiness to change (Caliskan & Isik, 2016), and adaptation to change (Borg & Scott-Young, 2020).

Analysis and Problem-Solving Ability

Research on vocational students' readiness training participants facing the Industrial Revolution 4.0 at Global Mulia Cikarang Vocational School show that problem-solving and communication skills are the most important aspects that must be considered in the Industrial Revolution 4.0 era (Rezasyah, 2019). Competence includes knowledge, skills, and attitudes to solve problems in variable situations (Tittel & Terzidis, 2020).

Critical Thinking Ability

A study confirmed that one of the top six skills and competencies that employer's rate most important is: critical thinking/problem-solving skills (Baird & Parayitam, 2019). Research that aims to determine the application of Problem-Based Learning and its effect on critical thinking skills in high school students finds that students' critical thinking skills are shown by their ability to argue, solve problems, and draw conclusions (Narmaditya et al., 2018).

Creative and Innovative

Creativity and Innovation are twenty-first-century general competencies needed (Coşkun & Deniz, 2021). Innovation is one of the conceptual models of entrepreneurial competencies needed to take advantage of Industry 4.0 technology (Kruger & Steyn, 2021). An entrepreneur can think creatively and innovatively in solving problems to create opportunities for success (Harnani, 2020). Innovation readiness is one of the five dimensions of work readiness that needs to be prepared to work in Industry 4.0 (Blayone & Van Oostveen, 2021).

Independence

Research on work readiness among 316 Students of XII Class in the Multimedia Expertise Program at State Vocational High School I Jombang provides suggestions for future researchers to add the independence variable as a factor that affects work readiness. When someone is not independent when faced with difficult or unattractive situations, they will need other's help to complete it (A. Wibowo, 2016).

Curiosity/Learner

In this era of digitalisation, technology enthusiasm, interest in learning, personality and digital skills are needed as factors that shape successful interactions between humans and computers (Blayone et al., 2020).

The most priority aspect of Work Readiness is for VHS graduates in the Industrial Revolution 4.0 era.

Regarding Work Readiness graduates in the context of Industry 4.0, most articles discuss the readiness to adopt technology in the face of digitalisation. As a consequence of the Industry 4.0 era, industry is required to adopt 4.0 technology (Ismail et al., 2019) (Damerji & Salimi, 2021)Industry is required to have digital readiness which includes (a) digital agents and skills, (b) digital tools and applications, (c) digital systems and infrastructure, and (d) digital ecosystem and culture. Industry is required to carry out technology development as well as workforce development to handle and understand the new technology they plan to implement in their workplace (Nathan et al., 2020). In the adoption of new technology industry 4.0(Falah et al., 2020), flexible and adaptive digital readiness is demanded (Ottesjö et al., 2020) Use of digital technology (Švarc et al., 2020) and digitalisation readiness(Lentes et al., 2019)also supported by strategy, leadership and culture within a company as key elements in the transformation journey I4.0 (Narula et al., 2020).

Several studies also emphasise the importance of digital competence (Wang & Ha-Brookshire, 2018). Educational institutions must cultivate the readiness of their students to study and work (Mykhailenko et al., 2020) within digitalisation and robotic era (Vrchota et al., 2019). Technology literacy required (Hidayat & Yunus, 2019), graduates must be digitally literate, resilient, adaptable, and able to collaborate and communicate with others from various

backgrounds in virtual and face-to-face settings (Jackson et al., 2020), have practical expertise in the adoption and integration of digital technologies (Ifenthaler & Egloffstein, 2020). In addition, adaptive, cognitive and computational thinking skills, especially in information technology, data analysis (Mian et al., 2020). The importance of improving teachers' digital skills (Alda et al., 2020) because schools are required to teach technology related to Industry 4.0 (Yoshino et al., 2020).

CONCLUSION

Based on the results of mapping journals that examine Work Readiness in 2016-2021, the researcher identified 13 research focuses that were reviewed by several articles. The research has been done in the following areas: 1) graduates, 2) students, 3) dimensions, 4) industry, 5) curriculum, 6) factor, 7) experience, 8) training, 9) workers, 10) skills, 11) employers, 12) employability, and 13) soft skills. The thirteen aspects studied are related to each other. Based on a systematic review of the literature, the author found the top 10 Work Readiness to face Industry 4.0 in sequence, namely readiness to adopt digital technology, communication skills, ability to work together, adaptability, analytical and problem-solving skills, critical thinking skills, Innovative, independent, creative, and curious/learner. Most articles from a systematic review discuss the readiness to adopt technology in the face of digitalisation in Era 4.0. This shows that the ability to embrace technology is the most priority aspect of Work Readiness needed for vocational graduates in the Industrial Revolution 4.0 era.

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