Defining Vocational Teacher Competencies in Industry 4.0 from the Perspective of Policymakers

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Abstract: This study aims to analyze the competence of vocational school teachers needed in Industry 4.0 based on the opinions of policymakers using a quantitative method (13 education policymakers). Identifying the priority competencies of vocational school teachers is an important issue because low teacher competence is a problem for vocational education in Indonesia. The results of the study indicated the priority of pedagogical competence, social competence, personality competence, and professional competence of vocational teachers. Vocational teacher pedagogic competencies that are very much needed are the ability to actualize potential as part of student development, the ability to understand students in-depth, and the ability to understand the character of students in physical, social, cultural, emotional, and intellectual aspects. In addition, vocational school teachers are expected to have the ability to design and evaluate learning. The needed social competencies for vocational school teachers are the ability to communicate efficiently, emphatically, and respectfully both oral and written communication skills, and the ability to communicate and improve themselves using ICT.

Keywords: Competence, Industry 4.0, Policymaker, Teacher competency, Vocational school teacher.

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1. Introduction

In the Fourth Industrial Revolution (Industry 4.0), the skills required are evolving and are progressively connected to the use of technology. Therefore, to be successful in global competition, Indonesia must improve human capital through quality education by taking advantage of the demographic bonus. Education is the core of this change. Vocational school is existing as an attempt to enhance the quality of Indonesia's human capital which is followed by a policy that includes curriculum improvement, creativity in learning, teachers' and educators' professionalism, collaboration with the industrial world, standardization of infrastructure, and institutional arrangements. In this circumstance, teachers are at the forefront of improving the quality of education. The quality of the education system cannot surpass the quality of the teacher (Barber, Morshed, M., and Whelan, 2007).

In the Great Dictionary of the Bahasa Indonesia (KBBI), competency is defined as the authority or power to determine something. Competency is a collection of intelligent acts, full of responsibility, which a person must have and is considered as a prerequisite for performing the tasks within a specific professional field. The nature of intelligence requires integrity, precision, and effectiveness in performance. Competency is the mental and physical ability to perform tasks or skills obtained through practice and training. Teacher competency can be defined as the growth and development of knowledge, skills, and attitudes in the context of intellectual and responsible acts in the performance of duties as an educator. Teacher competency is essential in achieving educational objectives. Teacher competency includes the areas of personal character, general

knowledge, practical knowledge, and pedagogical knowledge. The attitude of a teacher has a big influence on students' development. Ideally, all teachers should be a model of learning for students (Vansteelandt, Mol, Caelen, Landuyt, and Mommaerts 2017).

There have been many types of research on teacher competency. One of the studies shows that teacher competency plays an important role in shaping students' characters. Competency is not only knowledge or skills. Competency requires the willingness to fulfill the complexity of the demands. Nowadays, teachers experience much greater challenges than in past decades. Teachers are encountered with a much more varied range of clients, subject matter that is more complex and challenging, the learning standard, and also the demand for higher thinking skills of students. Teachers' past and present experiences determine the day-to-day learning practices in the classroom (Handayani, Ali, Wahyudin, and Mukhidin, 2020). Teachers are indeed an integral part of the educational organizational subsystem as a whole. Teacher competencies cover four important aspects which include (1) knowledge of the subject matter, pedagogy, and curriculum; (2) value and development of children; (3) self-assessment and professional development; and (4) understanding and contributing to the development of the education system.

Teachers in Industry 4.0 are required to be able to incorporate the learning process. Technological Pedagogical Content Knowledge (TPACK) framework which is the development of the Pedagogical Content Knowledge (PCK) concept initiated by Lee S. Shulman needs to be understood by teachers. TPACK framework describes the scientific insights of a teacher in the fields of technology, pedagogy, subjects, and their use in learning. Figure 1 shows a substantial part of the three components that lead to technology integration in education.

Fig. 1: TPACK Model [6]

Indonesia has teacher and lecturer competencies standards established under the mandate of Law No. 14 of 2005. It states that teachers and lecturers must have educational competency, personality competency, social competency, and professional competency. The four

competencies are holistic and form a unity that characterizes professional teachers. In the context of vocational education, the starting point for vocational teacher skills is based on skills descriptions that must involve a continuous process and development in order to be able to see those competencies holistically. Research on teacher competency has been conducted quite often because it is still a fundamental issue in education. However, the competence of the vocational school teachers is different from those of teachers in general because of the specific characteristics of vocational education. Therefore, the aim of this study is to define vocational teacher competencies included pedagogical competence, social competence, personality competence, and professional competence in Industry 4.0 from the perspective of policymakers. The results of the research are expected to become a reference for the development of vocational teacher competencies in order to improve the quality of education.

2. Theoretical Framework

Several competency formulations are important for vocational school teachers to have and develop (Ana, 2020). The demands for specific dimensions and indicators of vocational teacher competence differ from country to country. In a global context, the formulation of vocational teacher competencies is generally a combination of aspects of occupational expertise, instructional expertise, and the ability to act as educators. The general competencies of vocational school teachers are presented in Table 1.

Cognitive competencies, concerned with individual conceptual knowledge. While functional competencies include competencies related to individual work or technical skills. Social competence is related to the underlying behavior or attitudes in interacting and communicating with others. Meta competence is personal competence in dealing with various situations. Globally, vocational teacher competency development can be seen in Table 2.
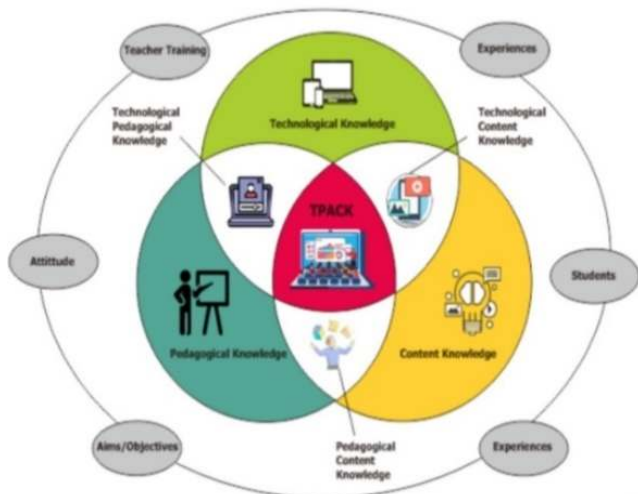
Table 1: General competence of vocational school teachers [10]

	Occupational	Personal
Conceptual	Cognitive Competencies (Knowledge)	Meta Competencies (Motives and Traits)
Operational	Functional Competencies (Skills)	Social Competencies (Attitudes and Behaviors)

Table 2: Vocational teacher competency development

Domain of Expertise	Theory	Practice
Professional domain	Subject specific technical/ expert knowledge	Subject-specific teaching methods
TVET pedagogy	example VET psychology; teaching and learning methods; assessment theory	example teaching skills; assessment skills and techniques; (integrative) use of digital media
TVET management	example knowledge on school organization and links to external stakeholders; ability to reflect on own	example skills to collaborate/network with key stakeholders (esp. companies); motivation and commitment for continuous improvement of school environment

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Domain of Expertise	Theory	Practice
	practice (reflective practitioner)	

Competency standards for vocational school teachers in ASEAN in a recent study were reported, reviewing at least three categories, three domains, and 15 indicators. The three competency categories include: 1) planning and preparation; 2) implementation and 3) evaluation. The three competency domains include 1) knowledge; 2) skills and 3) attitude. Meanwhile, fifteen indicators include the ability to: 1) identify students' backgrounds; 2) designing lesson plans; 3) prepare, design, and select learning content; 4) designing strategies and methods of continuous learning; 5) selecting and preparing materials and learning media on an ongoing basis; 6) designing strategies and assessment instruments; 7) motivating students in the learning process; 8) managing class activities; 9) communicate with students, colleagues, and stakeholders; 10) implementing strategies and teaching methods; 11) connecting students with the world of work or industry; 12) using learning tools and media relevant to the world of work; 13) assess student learning outcomes; 14) serving, giving or receiving feedback to/from students; and 15) conduct an evaluation process (Al Hinai, Bhuiyan, and Husin, 2020).

In line with that, in Finland, seven general competencies are important for vocational teachers. The seven competencies are: 1) pedagogical competency; 2) guidance and counseling competency; 3) interaction competency; 4) competency in pedagogical leadership; 5) partnership competency; 6) innovator competency; 7) assessment competency. Not much different from Finland, comparative studies in Germany and Ukraine also mention important competencies for vocational teachers, including 1) professional competency; 2) management orient personality; 3) autonomy; 4) stability; 5) service; 6) challenge; 7) integration of lifestyles, and 8) entrepreneurship. Particularly for the competence of vocational school teachers in Indonesia itself, among others, emphasizes several aspects, such as positive psychological conditions, the ability to interpret education positively, nationalism, teacher performance, and leadership (Idrianti and Wahid, 2020).

Several laws and regulations related to teacher competence in Indonesia, Law Number 14 of 2005 concerning Teachers and Lecturers, Article 1 paragraph 10, Law Number 14 of 2005 concerning Teachers and Lecturers, Article 10 paragraph 1, Regulation of the Minister of National Education Number 16 of 2007 concerning Academic Qualification Standards and Teacher Competencies, and Government Regulation Number 19 of 2005 Article 28 Paragraph 3. The Indonesian government has set teacher competency standards into four competencies that a teacher and prospective teacher must have, namely 1) pedagogical competence which includes: understanding of the foundation of education, understanding of students, preparing curriculum and syllabus, planning lessons, educational learning applications, utilizing learning technology, evaluating learning outcomes, and developing the potential of various students, 2) Personality competencies include: good character, wise, dignified, stable emotions and thoughts, mature, honest, exemplary, able to develop themselves independently, and able to evaluate their own performance, 3) social competence, including communication skills, using technology according to functions and needs, interacting effectively with students, fellow educators, leaders and parents, and applying the principles of brotherhood and a spirit of togetherness, 4) professional competence, including: broad and in-depth knowledge, understand the material, structure, concepts, and scientific mindsets that support the subjects being taught, understand the competency standards and basic competencies of the subjects, develop creative learning materials, and develop professionalism in a sustainable manner by taking reflective action.

3. Method

The method used in this research is a survey. The survey is intended to record the competency of vocational school teachers that is urgently needed based on the perceptions of policymakers. The research method flow chart is shown in Figure 2.
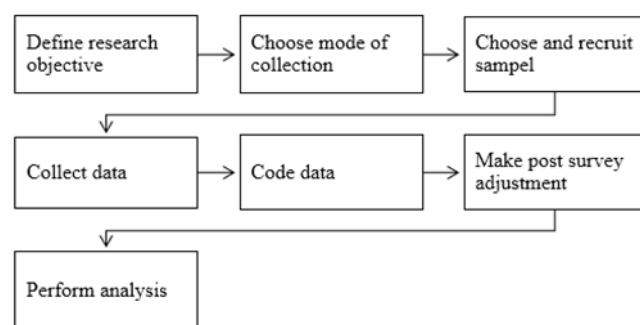
Fig. 2: The research method flow chart

This research survey consists of several stages, namely determining research objectives and compiling research instruments, considering data collection techniques so that research objectives can be achieved, determining research samples, collecting data, coding to facilitate data analysis, make post-survey adjustment, and perform data analysis. The research instrument consists of indicators that define the competencies of vocational school teachers based on the results of the Focus Group Discussion (FGD). FGD is intended to collect qualitative of vocational teacher competency instruments. FGD is conducted prior to previous research. Data collection is obtained by distributing questionnaires to 13 policymakers. Respondents give statements on the competency measures found in the instrument. The measurement criteria for each indicator categories as extremely needed, needed, sufficiently needed, not needed, and extremely not needed. The competency indicators for vocational school teachers are shown in Table 3.

No	Teacher Competencies	Competencies Indicators
		g. The ability to address the psychological challenges of students due to current development (counselor competence)

4. Results and Discussion

4.1 Pedagogic Competency Analysis

Teacher's pedagogical skill consists, at the very least, of understanding the knowledge or educational foundation, understanding the characteristics of learners from the physical, moral, spiritual, social, cultural, emotional, and intellectual aspects, proficiency of learning theory and learning principles, curriculum development or syllabus related to the subject being dealt with, learning design, implementing educational and dialogical learning, utilizing information and communication technology for the benefit of learning, developing students to actualize their various potentials, communicating effectively, empathically and politely with students, assessment and evaluation of learning outcomes, the use of assessment and evaluation results for the benefit of learning, and reflective action to improve the quality of learning. The results of research on the pedagogical competencies needed by vocational school teachers according to policymakers are shown in Figure 3.

From Figure 3, we could find that all indicators of pedagogic competence in this study are mostly in the extremely needed category. No policymaker considers the competencies offered to be unnecessary. Sequentially, the priority of the pedagogical competencies needed by vocational school teachers from the highest percentage is 1) ability to develop students to actualize their various potentials, 2) ability to understand students in-depth, 3) understand the characteristics of students from physical, social, cultural, emotional, and intellectual aspects, 4) ability to design and implement the learning evaluation, 5) ability to design learning, ability to conduct learning, 6) ability to understand student learning styles and learning difficulties, 7) ability to understand learning theories and principles, and 8) ability to develop curriculum that encourages student involvement in learning.

According to policymakers, the pedagogical expertise required by vocational school teachers is the ability to help students to realize different potentials in improving them are 92%. The realization of these different potentials is part of the developmental aspects of students. Vocational school teachers must be able to play a vital role as educators, teachers, school managers, personal and psychological teachers as well. Professional teachers must have intellectual, professional, social, moral, and spiritual responsibilities (Darmadi, 2016). Teachers have a significant part to play in achieving the objectives of national education with all their contributions and responsibilities.

85% of policymakers stated that the pedagogic competency that is extremely needed by vocational school teachers is the ability to understand students in-depth. Teachers as an educated workforce are one of the key factors in the achievement of educational objectives since teachers

Table 3: Vocational teacher competencies indicators

No	Teacher Competencies	Competencies Indicators
1	Pedagogic competencies	a. The ability to understand the student in-depth b. Has student characteristics from physical, social, cultural, emotional, and intellectual aspects c. The ability to design learning d. The ability to conduct learning e. The ability to design and implement the learning evaluations f. The ability to develop students to actualize their various potentials g. The ability to understand student learning styles and learning difficulties h. The ability to master the theory and principles of learning and educational learning i. The ability to develop a curriculum that encourages student involvement in learning
2	Social competencies	a. The ability to be inclusive, to act objectively, and not to discriminate. b. The ability to communicate effectively, empathically, and politely with fellow educators, education staff, parents, and the community c. The ability to adapt on the job in all areas of the Republic of Indonesia which have socio-cultural diversity d. The ability to communicate orally and in writing e. The ability to use ICT to communicate and develop themselves
3	Personality competencies	a. Ability to act in accordance with social norms b. The pride of becoming a teacher c. Consistency in behaving in line with norms d. The ability to act independently e. High work ethic f. Authoritative behavior (giving a positive influence on students) g. The ability to evaluate one's own performance h. The ability to develop continuously
4	Professional competencies	a. Have technology-based learning competencies (*educational competence*) b. Have competencies that can shape students into entrepreneurship by integrating technology (*competence of technological commercialization*) c. The ability to adapt to global changes and be able to solve educational problems (*competence in globalization*) d. The ability to predict exactly what will happen in the future and the strategy (*competence in future strategies*) e. Experience in conducting joint lectures, joint research, joint-resource, staff mobility, and deployment f. The ability to understand students' problems

engage directly with students to guide future graduates. Teachers are human resources that serve as planners, actors, and determinants of the achievement of educational objectives. One of the teacher's pedagogical competencies in applying the management of the learning process is that the teacher must start to comprehend students deeply.

Vocational school teachers must also have the ability to understand the characteristics of students from physical, social, cultural, emotional, and intellectual aspects. As many as 85% of policymakers stated that this competency is very much needed. There are four aspects that teachers need to consider contributing to students' comprehension, including the level of intellect, imagination, physical disabilities, and cognitive development. Also, vocational school teachers must be able to plan and conduct the learning evaluation. Vocational teacher qualification requirements include the preparation, execution, and evaluation of learning; providing a work-related learning environment, materials and media; assessment; student guidance; and curriculum development and evaluation.
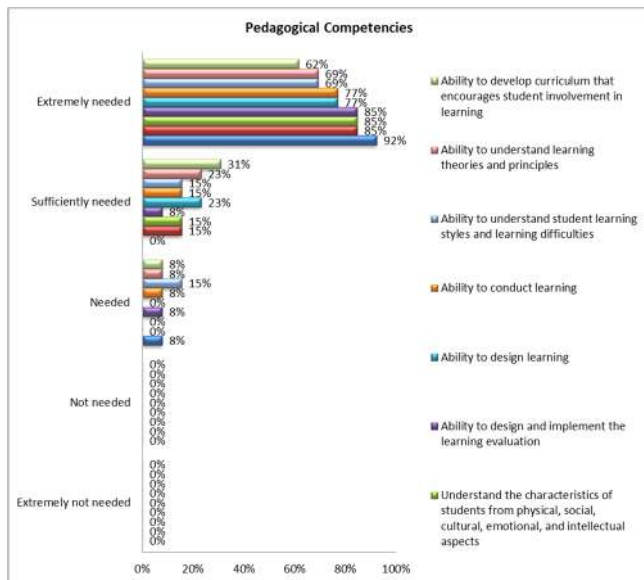
Fig. 3: Pedagogical competencies of vocational school teachers from the perspective of policymakers

77% of policymakers stated that vocational school teachers must be able to design learning and implement learning. One of the teaching skills that teachers must achieve is the ability to plan and execute learning as part of the process of understanding the different potentials that they have. 69% of policymakers stated that vocational school teachers must be able to understand the learning styles and learning difficulties of students, be able to master the theory and principles of learning and educational learning, following the statement that a professional teacher must be able to diagnose students learning difficulties. To implement the diagnose, teachers, are expected to be able to assess the learning challenges of students. In general, elementary school teachers do not understand various learning theories and learning principles, do not apply various approaches,

strategies, methods, and creative learning techniques, do not understand the principles of assessment and evaluation of learning processes and outcomes following the characteristics of the field of study, and lack of reflection on the learning that has been implemented. All of these issues also occur in the pedagogical capacity continuum.

62% of policymakers stated that vocational school teachers must be able to develop a curriculum that encourages student involvement in learning. One of the advantages of certified teachers is their ability to develop curricula related to subjects or areas of development that can encourage students to develop various potentials within themselves (Suhandani and Julia, 2014). The demands of teachers to develop adequate learning planning are relatively high, considering the importance of efficient learning and the preparation of lesson plans as part of curriculum development.

4.2 Pedagogic Competency Analysis

The required social competencies of vocational school teachers from the perspective of policymakers can be seen in Figure 4. From Figure 4, we could find that all indicators of social competence in this study are mostly in the extremely needed category. No policymaker considers the competencies offered to be unnecessary. Sequentially, the priority of the social competencies needed by vocational school teachers from the highest percentage is 1) ability to communicate effectively, empathically, and politely with fellow educators, education staff, parents, and the community, 2) ability to communicate orally and in writing, 3) ability to be inclusive, act objectively, and not discriminate, 4) ability to use ICT to communicate and develop themselves, 5) ability to adapt on the job in all areas of Indonesia which have socio-cultural diversity.

The results of the research show the priority of the social competencies that vocational school teachers must have is the ability to interact efficiently, empathically, and respectfully with students, other teachers, parents, and the community. This is in line with previous research which has shown the value of effective communication (Ghaferi and Dimick, 2016). Then for the next competency, 92% is the ability to communicate orally and in writing. Social skills are best served by effective communication skills, both oral and written.
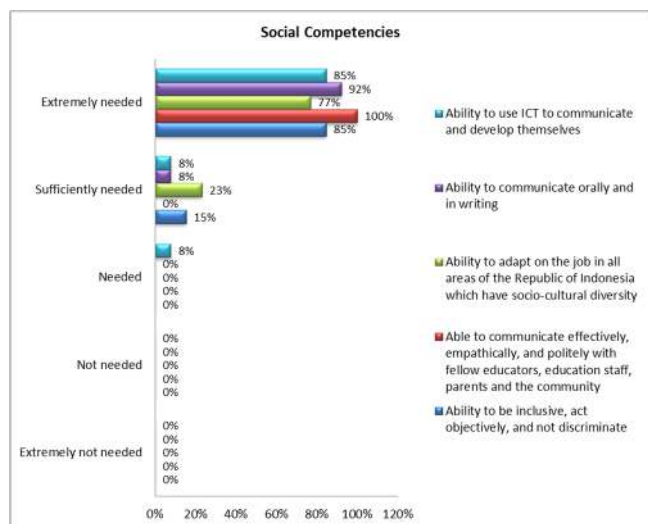
Fig. 4: Social competencies of vocational school teachers from the perspective of policymakers

Fig. 5: Personality competencies of vocational school teachers from the perspective of policymakers

There are many changes, shifts, and challenges that vocational school teachers have to face. One of them is the use of Information Communication Technology (ICT). 85% of policymakers stated that the ability to use ICT to communicate and develop themselves is needed by vocational teachers. The indicator of the ability to use ICT to communicate and improve is in line with the principle of lifelong learning (Taylor, 2009), where teachers must be able to develop themselves with a variety of competencies following the changes and demands of the times.

Demands and developments that exist in the Indonesian National Work Competency Standards (SKKNI) No. 234 the year 2020 concerning the Basic Class Education soft skills category. One of which is the ability to be inclusive, not discriminative to teachers. In the indicator of the ability to be inclusive, act objectively, and not discriminative, vocational teachers, 85% of policymakers stated that it is needed. Another indicator of social ability is that vocational school teachers are required to have high adaptability. 77% of vocational school teachers must have the ability to adapt to the job in all areas in Indonesia which have socio-cultural diversity. Vocational school teachers need to have these adaptation abilities followed by a willingness and desire to work and learn.

4.3 Personality Competency Analysis

Personality is used to define the psychological characteristics that affect the actions, emotions, and feelings of individuals that move through certain circumstances and times. There are a variety of personality competencies that are important to prepare, strengthen, and build when someone chooses a profession to become a vocational teacher. Figure 5 presents the personality competencies of the vocational school teachers from the perspective of policymakers.
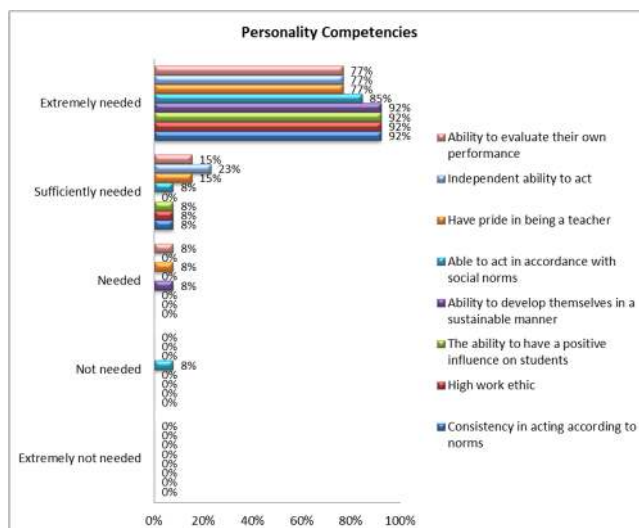
From Figure 5, we could find that all indicators of personality competence in this study are mostly in the extremely needed category. No policymaker considers the competencies offered to be unnecessary. The priority of the personality competencies needed by vocational school teachers from the highest percentage is 1) consistency in acting according to norms, 2) high work ethic, 3) the ability to have a positive influence on students, 4) ability to develop themselves sustainably, 5) able to act following social norms, 6) have pride in being a teacher, 7) independent ability to act, and 8) ability to evaluate their performance. Four competencies categorized as extremely needed (92%). Those are the ability to develop continuously, having authoritative behavior, having a high work ethic, and consistent in behaving in line with norms in the society. Followed by the willingness to behave by social standards (85%). Three other competency indicators which are the ability to the ability to evaluate one's performance, the ability to act independently, the pride of becoming a teacher are 77%.

The ideal vocational teacher is one who has emotional intelligence or in other words, is competent in the aspect of personality. The teacher's job is not merely to transfer knowledge. Teachers also have an important role in achieving effective education so students can become independent learners. The personality competencies of the teacher make a valuable contribution to students' character development. Generally, the elements of the student's competencies are obtained through a paradigm that is frequently illustrated by a teacher (Lolo and Sudira, 2019). A vocational teacher will be confronted with a variety of individual characters, particularly students who are peculiar and appear to be destructive. Therefore, under these circumstances, teacher personality competencies play an essential role in handling the complexity of characters to ensure that learning tasks occur in an efficient manner.

Indeed, the role of teachers nowadays has been much influenced by technology, including in terms of personal

modeling. However, this should not lead teachers to ignore their responsibilities as educators in instilling educational values for students. Besides, the main role of teachers in improving students' potential cannot be replaced by technology. It is, therefore, extremely important to improve teacher personality competencies (Triyono, 2017). Teachers who actively improve their personality competencies are likely to be more confident in learning both theoretically and practically. Through effective self-development, teachers will become experts in their fields of expertise and actively contribute to numerous developments in their work and working environment (Triyono, 2017). There are five major domains of teacher personality competencies that are important to develop today. The five domains are 1) openness; 2) accuracy; 3) extraversion; 4) friendliness, and 5) emotional stability (Kim et al, 2019). Meanwhile, in other literature it is stated that the five major personality traits that are important for teachers to develop are: 1) agreeableness; 2) conscientiousness; 3) extraversion; 4) neuroticism; 5) openness to experience (Kell, 2019). Each of these personality traits can be explained as follows:

a. Agreeableness is an adjective that describes a pleasant person, including a warm, kind, and cooperative person. The agreement is positively connected to the tendency to use negotiation to resolve conflicts. Agreeableness often defines the capacity of an individual to handle stress efficiently, support others in need, and be driven to establish harmonious relationships with others.

b. Conscientiousness is an adjective describing a person who is conscientious, hard-working, and responsible; a conscientious person appears to obey social norms, accepts remorse when he is guilty, and makes a good impression when encounters others.

c. Extraversion, describes a very extraverted personal image, including talkative, courageous, and energetic; extroverted personalities often appear to provide a positive stimulus to the environment.

d. Neuroticism, correlated with the essence of being comfortable, relaxed, calm, optimistic, and not acting impulsively when agitated.

e. Openness to experience. Describes an open personality, including innovative, creative, and curious. Openness is strongly associated with art appreciation, divergent thinking, and political liberalism. An open person tends to pursue novelty and originality, is competent to recognize the emotions of others, and is very interested in learning from other experiences.

The importance of developing teacher personality competence in other studies is said to have a significant effect on four teacher performance items, are: 1) professional knowledge; 2) paradigm formation; 3) enthusiasm in teaching; and 4) instructional quality of teachers (Baier et al., 2019)

4.4 Professional Competency Analysis

There are a number of professional competencies needed by Industry 4.0 from the perspective of policymakers. The professional competencies of vocational school teachers can be seen in Figure 6.
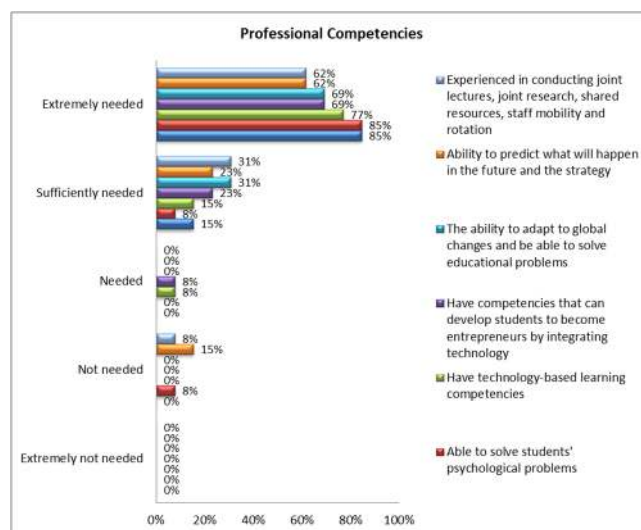

Fig. 6: Professional competencies of vocational school teachers from the perspective of policymakers

From Figure 6, we could find that all indicators of professional competence in this study are mostly in the extremely needed category. No policymaker considers the competencies offered to be unnecessary. The priority of the professional competencies needed by vocational school teachers from the highest percentage are 1) the ability in solving students' psychological problems as a result of current development (counselor competencies), 2), the ability in understanding students 'problems, 3) having technology-based learning competencies (educational competencies), 4) having competencies that can shape students into entrepreneurship by integrating technology (competencies of technological commercialization), 5) the ability to adapt to global changes and be able to solve educational problems (competencies in globalization), 6) the ability to predict precisely what will happen in the future and its strategy (competencies in future strategies), and 7) experience in conducting joint lectures, joint research, joint-resource, staff mobility, and deployment.

Based on the above findings, ideally, vocational teachers' competencies in Industry 4.0 are that the ability in solving students' psychological problems as a result of current development (counselor competencies) as well as the ability in understanding students 'problems. Additionally, the teacher also needs to understand the dynamics of the class and use technology to educate students. Technology will make teachers more confident and easier to teach students so that they can turn classrooms into creative, innovative, and fun learning spaces (Utomo and Setiastuti, 2019). Also, teachers can assist students.

Vocational school teachers are also expected to be skilled in making learning methods or strategies that can improve the students' skills. The model developed by the teacher can affect improving students' problem-solving abilities. Also, the new concept of vocational learning leads to the formation of the ability or competence of graduates to solve problems

by thinking critically according to competencies and self-development, creative thinking, working effectively. and collaboratively. Therefore, 21st-century vocational learning requires the development of the ability to work together in solving problems. Being based on the aforementioned, it is time to note that individual learning has been reduced. Activities involve many forms of collaborative assignments that require high-level thinking so that students' collaborative skills in solving problems are needed to deal with changes that occur in 21st-century learning. Working in the 21st century is no longer a solitary job, apart from other people and systems, but working in the 21st century is working in systems and teams (Ana, 2020).

Furthermore, vocational school teachers in Industry 4.0 must also have technology-based learning competencies (educational competence). The challenge of teachers in this era is to have strong competency and have soft skills, equip students with 21st-century skills. The education and training program must also be designed in such a way as to adapt to developments in Industry 4.0 so that teachers become competent and professional. Teachers at the same time can train these skills to students when the teachers have obtained the skills. Teachers must have strong competencies, one of which has soft skills, namely critical, creative, communicative, and collaborative thinking. Also, teachers must be able to adapt to advanced technology. The application of technology can accelerate the readiness of students to meet the millennium. In Industry 4.0, education is marked by the use of digital technology in the learning process or known as the cyber system. This system can make the learning process take place periodically without the limitation of space and time. Teachers are required to be innovative and be able to learn to adapt their knowledge and abilities in Industry 4.0. This is due to the changing times followed by rapid technological changes. Rapid changes must be matched by appropriate and reliable technology skills. Technology will make teachers more confident and easier to teach their students so they can turn classrooms into creative, innovative, and fun learning spaces.

The findings of the study showed that 69% of the vocational teachers' competencies needed in Industry 4.0 is having competencies that can shape students into entrepreneurship by integrating technology (competencies of technological commercialization). As role models, teachers also have an entrepreneurial attitude (Utomo and Setiastuti, 2019). This is a role that technology cannot replace. Teachers must be able to meet the psychological needs of students, which include the needs for competencies and that every student needs to feel that they can. It means that those interactions in learning can make students feel they have the capacities to implement it.

The five competencies that must be possessed by teachers in the Industry 4.0 are 1) educational competency, internet-based educational competency of things as basic skills, 2) competency for technological commercialization, having the competency to educate students to have entrepreneurial attitudes (entrepreneurship) technology-based and innovative work of students, 3) competency in

globalization, a world without borders, not stuttering against various cultures, hybrid competence, and problem solver competence, 4) competency in future strategies, the world is easy to change and walk fast so that they have the competence to predict exactly what will happen in the future along with the strategy, 5) counselor competency. Given that in the future student's problems are not in understanding the teaching material, but are more related to psychological problems and stress due to increasingly complex and heavy pressures. Therefore, teachers must act as counselors.

The ability to adapt to global changes and be able to solve educational problems (competency in globalization), that the development of cyber systems in the world of education will allow teachers to provide up-to-date teaching materials according to the current development because they can directly display the material in classrooms online. In other words, the development or provision of cyber network facilities as part of the integration with information technology networks in educational institutions will create various conveniences, both in academic and non-academic administration, and the learning process of teaching, which leads to improvements of quality.

The ability to predict exactly what will happen in the future and the strategy (competency in future strategies). The ability of vocational school teachers is that they must have the ability to predict specifically what will happen in the future and the strategies (competency in future strategies) that the world is easily changed and moves fast, therefore, students may have the competency to predict specifically what that will happen in the future. Then, vocational teachers' competency has begun to adapt to the current global changes in the world. The impact will be visible in certain sectors but will develop rapidly and shortly, and it will also demand new forms of knowledge, skills, and competencies. In the scenarios that arise, some jobs will perish and others will appear in newer forms. The ability of vocational school teachers to predict global change must be obtained as well as having new skills, otherwise what happens will be perished by the times (Mehta and Awasthi, 2019).

Furthermore, having the experience in carrying out joint lectures, joint research, joint-resources, staff mobility, and deployment is an ideal vocational teacher preparation model where vocational education teachers must be able to produce graduates who have comparative and competitive competencies so they can compete with professionals from other countries. Therefore, we need a teacher preparation model for vocational education which is expected to be able to meet the ideal competency demands for vocational teachers. The model for preparing vocational education teachers that are offered is divided into three stages, namely: 1) taking a higher education level, 2) apprenticeship in industry, 3) teaching practice. In the first stage, prospective teachers will be equipped with the knowledge, skills, and attitudes required for vocational education. The second stage, apprenticeship in industry, is intended to provide an industrial experience so that teachers can provide an overview of the actual industrial conditions and can carry out

learning that is more oriented towards the industry. While the third stage, teaching practice, is intended to provide opportunities for prospective teachers to get real experience in teaching students in vocational education. If these three stages can be completed, the prospective teacher can be then declared as a professional vocational education teacher. This is also in line with the studies that (industrial apprenticeship is to increase the relevance of productive teacher professional competency.

5. Conclusion

Identification of the competencies needed by vocational school teachers according to the demands of Industry 4.0 is important because it makes it easier to determine development approaches and strategies. Pedagogy competencies of vocational school teachers based on the level of their needs according to the opinion of policymakers are the ability to develop students to actualize their various potentials. Social competencies for vocational school teachers that are extremely needed are the ability to communicate effectively, empathically, and politely with fellow educators, education personnel, parents, and the community. Vocational school teachers' personality competencies that are extremely needed are consistency in behaving in line with norms and high work ethic. The professional competencies of vocational school teachers that are extremely needed are the ability to understand students' problems and the ability to solve students' psychological problems. Vocational teacher competency that is relevant to Industry 4.0 is an asset to develop the quality of human resources through quality education. Approaches and strategies for developing vocational teacher competencies in the future need to be further analyzed.

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