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Training effect on teacher ability to implement the 21st century skills in learning

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Abstract:

This study aims to evaluate the effect of training on the ability of teachers to implement 21st-century skills learning at the Construction Engineering Vocational School in Yogyakarta. According to the training objectives, descriptive and inference statistics methods measure teacher learning achievement in developing 4C skills. A total of 42 Vocational High School teachers were taken as samples, representing three groups of subjects, basic subjects of expertise (C1), basic skill programs (C2), and competency skills (C3). Data analysis was carried out using descriptive analysis techniques and Manova analysis. Content validation of the research instrument was carried out through expert judgment involving three experts, and the instrument was declared valid, with the Aiken V coefficient of 0.60. The results showed: (1) the level of implementation of learning to develop 4C skills (critical thinking, creativity, collaboration, and communication) at the Construction Engineering Vocational School in Yogyakarta in the good category; (2) obstacles to the implementation of 4C learning are related to teachers' understanding of low 4C learning, overloaded teacher workloads, and the academic abilities of Vocational High School students who are at medium and low levels; and (3) the level of implementation of 4C learning between subject groups is significantly different, while that based on teacher participation in 4C learning training is not significant.

Keywords: teacher ability; vocational high school; 21st-century skill; training effect.

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Introduction

Vocational High school aims to prepare graduates to work and develop careers according to the field of expertise they are studying. Rupert & Evans (Pendidikan, 1997)states that vocational education is part of the national education system that prepares a person to be better able to work in certain occupations than in other occupations. However, the mismatch between vocational high school graduates and the needs of the world of work in Indonesia still occurs today. Statistics Indonesia 2020 released the open unemployment rate in August 2020, which was 7.07%, an increase of 1.84% compared to August 2019. The highest open unemployment rate (9.71%) came from vocational high school graduates (Badan Pusat Statistik, 2020). The high unemployment rate for vocational high school graduates indicates a mismatch problem between supply and demand, namely between the number of vocational high school graduates and the number of job candidates needed, or a mismatch between the competencies of vocational high school graduates and the competencies required by the world of work(Firmansyah et al., 2020).

In addition, the big challenge facing the Indonesian nation in the future is the presence of the Industrial Revolution 4.0 era, which is marked by the application of a cyber-physical system that will radically change how humans live, work, and communicate. Jobs originally done manually by relying solely on skills and human labor will be replaced by machines, automation (robots), and information technology. The World Economic Forum (WEF, 2020) estimates that by 2025, 85 million jobs will be replaced by machines, and even more jobs – 97 million – will have to match the new division of labor between humans, machines, and algorithms. This change will tremendously impact the need for education, especially the learning process in vocational high schools. They must prepare graduates with relevant abilities and develop and adapt to changes that will continue to occur. Currently, the education system is not adapting quickly enough to respond to the demands of the future workforce that needs to be influenced by the industrial revolution 4.0. If not addressed, this problem can result in a mismatch between the skills taught in education and the skills needed in the world of work, resulting in a gap between the supply and demand for labor, which can cause the unemployment rate to increase (Flynn et al., 2017).

The era of 4.0 is marked by the rapid development of information technology and the development of automation in various fields. In this era, the most important job is “brain work” to analyze every situation logically and creatively and take advantage of current opportunities. In this kind of global condition, interdependence between countries with each other is no longer unavoidable (Firmansyah et al., 2021; Rose, 1997). The problems above will undoubtedly require the prerequisite abilities of every competitive individual. Each individual must have the ability to learn faster. He must push himself to pursue quality and excellence constantly. Therefore, as educational institutions that assist students in growing their potential and competencies, schools must be able to carry out the learning process to assess appropriately. The learning process must be able to optimize the development of student competencies and ensure that students in the future can live, work, and participate in 21st-century society, knowledge society, and the global economic community (Helmawati & SE, 2019).

This is in line with what is stipulated in Permendikbud Number 34 of 2018, concerning National Education Standards for Vocational High Schools, that the learning process in Vocational High Schools must provide space for the development of 21st-century skills, namely creative, innovative, critical thinking, problem-solving, collaborative, and communicative to meet the era of the industrial revolution 4.0 and the era to come. This era is also the disruptive innovation phenomenon that emphasizes the digital economy, artificial intelligence, big data, and robotics. The implementation of 21st-century learning, which prioritizes the development of 4C skills (critical thinking and problem solving, collaboration, communication, creativity, and innovation) in vocational high school, needs to be evaluated—considering

that several research results show that students' skills in critical thinking, communication, collaboration, and creativity are still very low. Less must continue to be improved (Pratiwi & Muslim, 2016; Saputri et al., 2018; Zubaidah, 2016). Likewise, field facts show that the evaluation of the implementation of the 4C skills learning has never been carried out. The evaluation of the learning program that has been carried out is only related to the learning process in general, not specifically regarding the learning of 4C skills, so the process and results of learning 4C skills cannot be measured.

Literature Review

Learning in vocational high schools applies the specific principles of the learning process in vocational high schools as follows: (1) emphasizes applied knowledge and skills; creates a learning climate as a simulation of the work environment in the world of work/industry; (2) basing on real, authentic work, and inculcating a work culture through teaching factories to get accustomed to thinking and working with quality standards that apply in the workplace; (3) adjust to market demand; (4) takes place at home, at school, and in the world of work/industry; (5) involving expert practitioners who are experienced in their fields to strengthen learning through mentoring during industrial internships; and (6) implementing "the Multi Entry Multi Exit" program and past learning recognition. Meanwhile, the learning process in Vocational High Schools is also differentiated into the theoretical learning process in the classroom, practical/practical learning in the workshop/video/laboratory, block learning, and learning in dual system education. The 21st-century skills are abilities that must be prepared to meet future needs that continue to grow (Dede, 2010). 21st-century skills are needed to help everyone learn to work and live in a rapidly changing society (Trilling & Fadel, 2009). The education system is not readily adaptable to these changes. This is mainly due to difficulties in curriculum changes, teacher reluctance to innovate learning, low motivation of teachers to improve their knowledge, scarcity of new learning strategies resulting from research, and bureaucratic rules that prevent teachers from bringing new ideas to school (Symonds et al., 2011).

Much literature has discussed educational reform and curriculum development oriented to 21st-century skills needs and their integration into learning ((Boholano, 2017; Cox, 2014; Savu et al., 2014). Cox (2014) points out that the concept of 21st-century skills has yet to find agreement among experts. There is an overlap between this concept and other parameters, such as transferability and soft skills. For example, the 21st-century skills instrument developed in Malaysia (M-21CSI) classifies 21st-century skills into five specific elements, namely (1) digital literacy; (2) inventive thinking; (3) effective communication; (4) high productivity; and (5) spiritual values (Soh et al. 2012). However, many experts agree that 21st-century skills are described as 4C abilities, namely critical thinking, creativity, communication, and collaboration (Bialik et al., 2015; Mathis, 2013; Saleh, 2019; Uehara, 2016).

2.1. Critical Thinking

NEA (2012) states that the first learning skill in the 21st century is the ability to think critically. Critical thinking is the skill of identifying, assessing, interpreting, analyzing, debating, evaluating, and concluding using various information (Brown, 2015). Critical thinking skills as skills to carry out various analyses, assessments, evaluations, reconstructions, and decision-making that lead to rational and logical actions. Critical thinking is one of the life skills that need to be developed through the learning process in schools, at every level of education, because in the era of the industrial revolution 4.0, critical thinking skills are essential skills needed to face and find solutions to all the problems faced.

2.2. Creativity

Creativity is an essential skill in the human life span and is directly related to mastery of knowledge and skills (Egan et al., 2017). According to Santrock (2014), creativity is a form of the ability to think about things in new and unusual ways and produce unique solutions to problems.

2.3. Communication Skills

Partnership for 21st Century Learning (2015) defines communication as a skill that involves listening, observing, speaking, asking questions, analyzing, and evaluating to convey messages or information to others through various media. Here, understanding the information given and the ability to express ideas or concepts effectively heard are two important things in communication.

2.4. Collaboration Ability

Collaboration is one of the arts in building practical cooperation with anyone while respecting diversity to achieve a common goal. Brown (2015) defines collaboration as a skill that aims to develop collective intelligence in helping, suggesting, accepting, and negotiating through interactions with others mediated by technology. Meanwhile, (Kivunja, 2014) formulated four essential skills in collaborative learning; 1) collaborating with others to achieve specific goals, 2) respecting different opinions, 3) being able to work effectively and flexibly in diverse teams, and 4) being able to compromise with other members of the team for the sake of achievement of the goals that have been set.

Method

Research Design

This study is an evaluation study that aims to determine the level of implementation and the effect of training on the ability to implement 21st-century skills learning by teachers at Construction Engineering Vocational Schools in the Special Region of Yogyakarta by referring to the standard of the learning process set out in Permendikbud Number 34 of 2018.

Sample and Data Collection

A total of 42 state vocational high school teachers in the Construction Engineering expertise program at D.I. Yogyakarta have been selected as the research sample, using a quota sampling technique, namely three teachers for each skill competency. The research sample consisted of basic subject group teachers in the field of expertise (C1 group), as many as 13 teachers; teachers of the basic subject group of expertise programs (group C2), as many as 13 teachers; and teachers of the skill competency subject group (C3 group), as many as 16 teachers.

Data on teacher understanding of 4C learning was carried out using a closed questionnaire using a numerical rating scale with four categories of answers, namely: Very Appropriate (SS), Appropriate (S), Less Appropriate (KS), and Not Appropriate (TS). Meanwhile, data on the implementation of learning to develop 4C skills were collected using the same instrument, with four categories of answers: not yet implemented (BT), a small part implemented (SKT), mostly implemented (SBT), and fully implemented (SPT).

The research instrument was validated based on content validity, which was carried out through expert judgment involving three experts. The determination of content validity is based on Aiken's V coefficient, which reflects the level of expert agreement regarding the research instrument that has been developed. The results of the content validity analysis show that the research instrument designed for all aspects measured is valid because it has Aiken's V coefficient of 0.60 (Retnawati, 2014). Estimating instrument reliability based on inter-rater reliability shows that the reliability coefficient of all instruments used is > 0.70 (Firmansyah et al., 2022). This means that the research instrument used in the study is reliable.

Analyzing of Data

Research data analysis used descriptive statistics to determine the mean score and standard deviation and multivariate analysis of variance (Manova) to compare the level of implementation of 4C learning based on subject groups and the effect of training on the ability to implement 4C knowledge.

Result

Data on teacher participation in 4C learning training shows as many as 60.98% of teachers have attended 4C learning training. However, according to the teacher, there are two main obstacles in implementing 4C learning: the academic ability of vocational students, who are generally at the lower middle level, and the carrying capacity of learning facilities and infrastructure in vocational high school is lacking. Regarding the desire of teachers to apply 4C learning after completing the training, as many as 56.10% of teachers stated they wanted to and tried to use it according to their abilities. In comparison, as many as 4.88% of teachers wanted to apply but had not implemented it because they did not understand. The teacher's level of understanding regarding learning 4C skills was collected using a closed questionnaire of 10 items. The results of measuring teachers' level of understanding obtained an average score of 2.90 on a scale of 1 - 4, with an understanding level of 72.50% or in the good category.

The level of implementation of learning to develop student's critical thinking skills was explored using a closed questionnaire consisting of 8 items. The measurement results show that the level of implementation of learning to develop necessary thinking skills is in the medium category, with an average score of 1.77 on a scale of 0-3, or the percentage of implementation level of 58.84%. In this case, there are three aspects of learning to develop critical thinking skills that have been carried out well, namely: (1) developing students' openness in giving opinions, (2) developing students' abilities to synthesize subject matter, and (3) teacher openness in accepting criticism.

The level of implementation of learning to develop students' creativity was explored using a closed questionnaire consisting of 10 questions. The measurement results show that the level of implementation of learning to develop critical thinking skills is in a good category, with an average score of 1.80 on a scale of 0-3, or a percentage of implementation of 60.00%. However, there are two aspects of learning in the moderate category, namely: (a) the teacher has not been able to explore students' creative ideas, and (b) the teacher's low ability to develop higher-order thinking skills (HOTS). The level of implementation of learning to develop students' cooperative skills was explored using a closed questionnaire consisting of 10 items. The measurement results show that the level of implementation of learning to develop cooperative skills is in a good category, with an average score of 1.92 on a scale of 0 – 3, or the percentage of implementation level of 64.15%. In this case, one aspect of learning in the medium category is the low ability of teachers to apply cooperative learning models.

The level of implementation of learning to develop students' communication skills was explored using a closed questionnaire consisting of 8 items. The measurement results show that the level of implementation of learning to develop communication skills is in a good category, with an average score of 1.86 on a scale of 0-3, or the percentage of implementation level is 61.99%. However, there are four aspects of learning that are categorized as moderate, namely: (1) teachers do not encourage students to express opinions, (2) teachers rarely give assignments to compose written papers/papers to be presented, (3) teachers rarely encourage students to ask questions/ opinions when discussing, and (4) the teacher does not explore students' opinions less. The four aspects of learning indicate that the ability of teachers to involve all students in learning is still in the moderate category and needs improvement.

Furthermore, a description of the level of learning implementation to develop 4C skills is presented in Table 1.

Table 1. The level of learning implementation to develop 4Cs skills

No	Learning Implementation of 4Cs Skills	Mean	Level of Implementation	Category
1.	Learning process to develop critical thinking skills	1.77	58.84%	fairly good
2.	Learning process to develop student's creativity	1.80	60.00%	Good
3.	Learning process to develop collaboration skills	1.92	64.15%	Good
4.	Learning process to develop communication skills	1.86	62.00%	Good
	TOTAL	**1.84**	**61.33%**	**Good**

Of the 42 teachers who were the study's sample, 13 teachers taught the basic subject group in the field of expertise (C1), and 13 teachers taught the basic subject group for the skill program (C2). As many as 16 teachers taught the skill competency subject group (C3). The results of Manova's analysis regarding the level of implementation of 4C learning in each subject group are presented in Table 2.

Table 2. Implementation of 4C learning per subject group

Multivariate Tests

Statistics	Value	F	Hypothesis df	Error df	Sig.
Pillai's Trace	.625	2.544	10.000	56.000	.013
Wilks' Lambda	.460	2.566	10.000	54.000	.013
Hotelling's Trace	.993	2.581	10.000	52.000	.013
Roy's Largest Root	.747	4.184	5.000	28.000	.006

The data in Table 2 shows that the level of implementation of learning 4C skills in each subject group (C1, C2, and C3) in all 4C skills is significantly different, with all F statistical values significant ($p < 0.05$). This shows that the level of implementation of 21st-century learning for all 4C skills (critical thinking, creativity, collaboration, and communication) for each subject group (basic areas of expertise, basic skill programs, and competency skills) is different, with an average score. The highest average is in the basic subject group of expertise programs (C2), 20.59, followed by the skill competency group (C3), with an average of 19.12. The lowest is the basic subject group in the field of expertise (C1), with an average of 17.83. Differences influence this difference in subject characteristics between the three subject groups and the level of teacher understanding of 4C learning. Most of the C1 subject teachers sampled in this study were junior teachers with inadequate teaching experience.

Data regarding participation in training shows that 26 (60.98%) teachers have attended 4C learning training, while 16 teachers (39.02%) have never participated in 4C learning training. The results of

Manova's analysis regarding the level of implementation of 4C learning based on their participation in 4C learning training are presented in Table 3.

Table 3. Implementation of 4Cs learning based on training participation

Multivariate Tests					
Statistics	**Value**	**F**	**Hypothesis df**	**Error df**	**Sig.**
Pillai's Trace	.045	.255	5.000	27.000	.933
Wilks' Lambda	.955	.255	5.000	27.000	.933
Hotelling's Trace	.047	.255	5.000	27.000	.933
Roy's Largest Root	.047	.255	5.000	27.000	.933

The results of the Manova analysis in Table 5 show that the level of implementation of 21st-century skills learning by teachers who have attended training and have not attended training on all 4C skills (critical thinking, creativity, collaboration, and communication) are not significantly different, with all F statistical values. not significant ($p > 0.05$). This shows that the learning training attended by teachers had no significant effect on their ability to carry out learning in the 4C century. This result is thought to be since information can be obtained from various sources, not only through education or training. In addition, young teachers who have never attended training generally have better ICT literacy than senior teachers.

Discussion

The results showed that more than 60% of teachers had attended learning training to develop 4C skills. This data is in line with the level of understanding of the teacher regarding 4C learning and the level of implementation of 4C knowledge that the teacher has carried out. This illustrates that the socialization and learning training to develop 4C skills that have been carried out so far are effective. In addition, the socialization and learning training that has been carried out has also motivated teachers to implement 4C learning in schools. In addition, from about 60% of teachers who have received training in 4C learning, more than 50% of teachers have understood 4C learning, and most of the teachers who have attended the training are willing to apply 4C learning. Therefore, we need to be optimistic that all teachers will implement 4C learning if they have received training and can understand 4C knowledge. Or in other words, socialization efforts and learning training to develop 4C skills in the future have good prospects.

The results also show that the level of implementation of learning to develop 4C skills by teachers at Construction Engineering Vocational High School in Yogyakarta is in a good category. These results align with the research results of Rusdin et al. (2018), which found that elementary school teachers in Malaysia were very prepared to implement 21st-century learning. However, to measure teacher readiness, Rusdin is only based on the teacher's perception, level of academic education, and teaching experience. Similarly, Ningsih et al. (2021) found differences in teacher readiness to teach 21st-century skills between data based on teacher perceptions and classroom observations. In this case, the teachers felt they understood the concept of 21st-century skills well, but classroom observations showed they could not incorporate 21st-century skills into their lesson plans. The teachers think they have taught almost all 21st-century

skills, but the results of classroom observations show that the 21st-century skills taught by teachers are far less.

Likewise, the implementation of learning to develop 21st-century skills (critical thinking, creativity, collaboration, and communication) of students by teachers at Construction Engineering Vocational High School in Yogyakarta is also still facing obstacles, so the level of implementation is not optimal. These constraints are broadly related to the low understanding of teachers regarding 21st-century learning, the overload of teacher workloads, and most vocational students' academic abilities at medium and low levels. The low knowledge of teachers regarding 21st-century learning is shown by: (1) there are still 44% of teachers who have never attended 21st-century learning training; (2) as many as 37% of teachers do not understand 21st-century learning; and (3) 29% of teachers stated that the school did not provide facilitation and assistance to implement 21st-century learning. Meanwhile, another obstacle was that 54% of teachers had an overloaded task load. As many as 44% of teachers stated that the academic ability of vocational students was generally at the medium and low levels.

The obstacles faced by teachers in implementing learning to develop student's critical thinking skills can be grouped into two main problems, namely: (1) developing students' open attitudes, both when receiving criticism, giving criticism, and giving opinions based on data; (2) give assignments to students for problem-solving. To develop creativity, teachers also face problems that are related to (a) teachers finding it difficult to explore students' creative ideas and (b) teachers have not been able to apply learning to develop higher-order thinking skills (HOTS). Meanwhile, teachers face obstacles in implementing cooperative learning to develop the ability to collaborate. Meanwhile, in developing communication skills, teachers face problems because the teacher's ability to involve all students in learning is still in the moderate category and needs improvement. This result is also in line with the level of implementation of the 21st century, which is still in the medium category and has low aspects.

In addition, another factor that also has a negative effect on the implementation of 21st-century learning is the emergence of the Covid-19 pandemic, which forces learning to be held online, making it difficult for teachers to implement the lesson plans that have been prepared. On the other hand, organizing online learning also positively affects increasing mastery of digital technology literacy to welcome the era of the industrial revolution 4.0. The ability of digital technology literacy is one of the 16 important skills that need to be given to students so that they can survive and succeed in the era of R.I. 4.0. These competencies are categorized as skills in mastering tools to develop skills in the RI 4.0 era, which includes technology, media, and information literacy (P-21, 2007). Meanwhile, the World Economic Forum (WEF, 2018) classifies this skill as one of the foundational literacies related to students' ability to apply core skills in daily tasks. These skills are in the form of basic literacy consisting of (1) literacy, (2) numeracy, (3) scientific literacy, (4) ICT literacy, (5) financial literacy, and (6) cultural and civic literacy. However, due to the unprepared readiness of human resources and educational infrastructure in Indonesia, the online learning system makes learning chaotic and less effective (Damayanti, 2020).

As described in the research results above, implementing learning to develop 21st-century skills is still limited to implementing learning in schools. Permendikbud number 34 of 2018 has determined that learning in vocational schools includes the learning process in the classroom (theory), practical learning in workshops/workshops/videos/laboratory, block system learning, and learning through factory teaching as a form of learning that takes place in schools and learning through a dual system education (DSE) model which is a learning process outside of school (in the world of work).

DSE learning model is a form of providing vocational skills education that combines systematically and synchronously with educational programs in vocational schools with mastery of skills programs obtained through working directly on real jobs in the world of work, directed to achieve a certain level of professional expertise (MONE, 1997). . Djojonegoro (1998), stated that the implementation of education

with the DSE approach aims to: (a) produce a workforce that has professional skills; (b) improve and strengthen the link and match between vocational education and training institutions and the world of work; (c) improve the efficiency of providing professional quality education and training for workers; (d) recognize and reward work experience as part of education; (e) so that education and training carried out in schools are the same as the demands of competencies that must be possessed in the world of work.

The results of Manova's analysis show that the level of implementation of 21st-century skills learning in each subject group (C1, C2, and C3) in all 21st-century skills is significantly different. This can be interpreted that the level of implementation of learning in all 21st-century skills (critical thinking, creativity, collaboration, and communication) for groups of basic subjects of expertise, basic skill programs, and competency skills is different. The highest average score is in the basic subject group of expertise programs (C2), followed by the skill competency subject group (C3), and the lowest is in the basic subject group in the field of expertise (C1). These differences are thought to be influenced by differences in the characteristics of subjects between subjects in the basic group of areas of expertise, basic skill programs, and competency skills.

The basic group subject of expertise (C1) for the Construction Engineering Vocational School is a basic ability subject that is taught to students in all skill programs, and expertise competencies that are in the Technology and Engineering expertise group to provide basic skills for Vocational High School students who take the area of expertise in Technology and Engineering. The subjects in this group consist of 3 subjects: Physics, Chemistry, and Simulation and Digital Communication. The issues of the C1 group, especially Physics and Chemistry, are included in the science group subjects, which have low applied values in the vocational fields studied by students. Therefore, it is suspected that many teachers have difficulty giving tasks that involve the vocational area, let alone giving assignments at a higher level, such as analysis, evaluation, synthesis, and creation. It also shows that one of the obstacles teachers face in implementing 21st century learning is that teachers have not been able to apply learning to develop higher order thinking skills (HOTS).

The three basic subjects of vocational technology and engineering expertise are science and technology subjects that are very important to equip graduates to live, work, develop, and compete in the era of the industrial revolution 4.0 as it is today. (Fives et al., 2014) stated that science education trends in the 21st century should emphasize the importance of scientific literacy as a transferable outcome. Scientific literacy focuses on building students' knowledge to use science concepts meaningfully, think critically and make smart decisions on life-related problems (Rahayu, 2017)

In this case, learning with the STEM approach (Science, Technology, Engineering, and Mathematics) is considered a thematic approach in science education, designed to produce new comprehensive knowledge constructions from various disciplines (Sanders, 2009). Learning with the STEM approach is an important component of 21st-century education, and it is highly recommended to be implemented in the current education system (Becker & Park, 2011). But unfortunately, many research results reveal that the application of the STEM learning model to science group subjects in schools in Indonesia is still low (Ismayani, 2016; Pujiati, 2019. This is presumably because many teachers cannot understand and apply the STEM learning model.

The demands of 21st-century skills have prompted educational reforms in many countries. Integrating 21st-century skills into the curriculum is important in equipping students with the skills needed to live, work, and thrive today and in the future (Dede, 2009). Likewise, the development of the Vocational High School curriculum must be oriented to the competencies needed in the world of work, both now and in the future. Mouzakitis (2010) stated that the Vocational High School curriculum should be designed based on identifying and analyzing labor market needs. The Future of Work (WEF, 2018) emphasizes that to face the future, it is necessary to take steps to predict the skill needs to be needed in that era, namely:

(1) identifying student skills and skills gaps needed in the future; (2) strengthening the ability of graduates with innovation, creativity, empathy, and skills; (3) guiding students with the ability to adapt to the needs of the labor market in new ways of working, studying, and having a career; and (4) redesigning programs and policies to realize learning models, new skills development, and career paths.

Similarly, (Joo, 2018) states that four factors contribute to increasing the employability of vocational education graduates: competent teachers, relevant curriculum, effective leadership, and good school-industry relations. In addition, other factors can also influence our vocational education policies, labor market conditions, social demands, and time. If one of these factors is not met, then the implementation of education will not be optimal and successful in realizing competent graduates. This is in line with the mission that vocational education is held to realize the goal of strengthening professional education and serving economic and social development so that the increase in the employment of vocational education graduates can run optimally (Rahdiyanta et al., 2019).

The four components of 21st century skills need to be integrated into the curriculum to equip students to welcome the RI 4.0 era. First is a way of thinking, including being creative, innovating, critical, solving problems, making decisions, and learning proactively. The second component is learning/work and innovation skills, which include creativity, critical thinking, problem-solving, communication, collaborating, and working in teams. The third component is life skills and adaptability as citizens and global citizens, such as self-direction, adaptability, productivity, and adapting to environmental and work demands. The fourth component is mastering tools to develop skills in the RI 4.0 era, which includes technology, media, and information literacy.

In addition to curriculum development, the quality of the learning process is a very influential factor in student learning outcomes. Coe et al. (2014) stated that an effective learning process could improve student competency achievement, supporting future student success. Meanwhile, Hughes & Acedo (2016) formulated learning principles to develop 21st-century skills, namely: (1) starting learning by providing open-ended and ill-structured problems; (2) assigning students to solve problems collaboratively; (3) guiding students to generate investigative questions and formulate hypotheses (if needed); (4) assign students to collect information from various sources; (5) assign students to analyze the information or data that has been collected; (6) assign students to communicate the results of problem-solving in writing and orally; (7) apply blended learning; (8) carry out a 21st-century skills assessment, which is an authentic assessment.

Meanwhile, in the standard learning process, it has been determined that learning in Vocational High School must emphasize the implementation of discovery/inquiry, problem-based, and project-based learning models depending on the characteristics of each subject and program of expertise. In vocational education emphasizing the integration of various disciplines and practical abilities based on industry needs, project-based learning (PjBL) is the most appropriate model (Yudiono et al., 2019). Various studies have shown that PjBL can improve the quality of vocational education (Sukamta et al., 2018). This PjBL model can increase students' involvement, motivation, and attitudes in engineering learning (Viswambaran & Shafeek, 2019). In addition, PjBL can also improve important skills, such as collaboration, communication, and critical and creative thinking (Allison, 2018; Larmer & Mergendoller, 2010; Samsudi et al., 2019).

Conclusion

Based on the research results above, it can be concluded: First, the level of implementation of learning to develop 21st-century skills (critical thinking, creativity, collaboration, and communication) at the Construction Engineering Vocational School in Yogyakarta is generally in the good category. This is

indicated by the research results, which illustrate that more than 60% of teachers have implemented learning to develop 21st century skills.

Second, the obstacles teachers face in implementing 21st century learning are related to their low understanding of 21st century learning. This is because there are still teachers who (1) have never attended 21st-century learning training, (2) do not understand 21st-century learning; and (3) schools do not provide facilitation and assistance to implement 21st-century learning. Another obstacle that Vocational High School teachers also complain about in implementing 21st-century learning is that teachers have an overloaded task load, and the academic abilities of Vocational High School students are, on average, at the middle and low level.

Third, the level of implementation of 21st century learning between subject groups is significantly different, while that based on participation in 21st century learning training is not significantly different. This shows that the training attended by teachers does not affect their ability to implement learning to develop 21st-century skills.

Recommendation

Based on the results of this study, it is recommended: (1) schools need to have clear policies and programs regarding the implementation of 21st-century learning so that schools can provide facilitation and assistance to teachers in implementing 21st-century learning; (2) it is necessary to carry out further research with a more comprehensive scope, which not only concerns aspects of 21st-century skills, but also concerns foundational literacies, and character qualities; (3) this research is still limited to only revealing the level of implementation of learning based on what the teacher has done to develop 21st-century skills, it is necessary to do research using other data sources to validate the data about the teacher's statement; and (4) the government and stakeholders need to encourage teachers to implement various learning innovations, by providing adequate facilitation, including issuing legal products and incentives that encourage the growth of innovation by teachers.

Limitation

This study was conducted to measure the level of implementation of learning to develop 21st-century skills, namely critical thinking, creativity, collaboration, and communication, based on the statements of Vocational High School teachers at D.I. Yogyakarta about what they have done. Related to this, the limitations of this research include: (1) the scope of this research is only carried out on teachers in the Construction Engineering Skills Vocational School in D.I. Yogyakarta; (2) the need to use other data sources to validate the data about the teacher's statement; (3) this research is still limited to only revealing the level of implementation of learning to develop 21st-century skills, and has not measured learning outcomes in the form of 21st-century skills possessed by students; (4) this research is limited to measuring the level of implementation of the 21st-century competency component learning, which includes the 4Cs and does not yet involve the other two components, namely foundational literacy, and character qualities.

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