JOURNAL OF RESEARCH IN SCIENCE, MATHEMATICS AND TECHNOLOGY EDUCATION
DOI: 10.31756/jrsmte.224

http://www.estej.com/

Indonesia Vocational High School Science Teachers' Priorities Regarding 21st Century Learning Skills in Their Science Classrooms

Esty Haryani

William W. Cobern

Brandy A-S. Pleasants

Western Michigan University, USA

Abstract: The purpose of this study was to examine vocational high school science teachers' instructional prioritizing the 21st Century Skills mandated in the Indonesian National Curriculum 2013 revision. The Indonesian government implemented this curriculum in 2017 to support students' career readiness, which was inadequately addressed in previous curriculum documents. Survey data was obtained from the population of vocational high school science teachers in the city of Pontianak, West Kalimantan province, Indonesia. The study contrasted the prioritizing of 21st Century Skills objectives with previous curriculum objectives, in order to determine if teachers give priority to current curriculum requirements or are still focusing on previous requirements. The study furthermore examined whether teacher demographic data are associated with their teaching priorities. Results indicate teachers do prioritize the 21st Century Learning Skills over previous curriculum objectives. Novice teachers report higher priority on communication skills and male teachers give higher priority to problem solving. Future research includes determining how these priorities translate into classroom practice.
Keywords: *21st Century Learning Skills; Science content; Scientific process; Teaching priority; Quantitative study.*

Introduction

Historically, curriculum change aims to improve student learning outcomes, to develop educational approaches, and to meet a society's need for skilled citizens. Previous studies with regard to education reform report that teacher beliefs and attitudes, their understanding of the reform, and their motivation to implement the curriculum reform are important indicators for change (Czerniak & Lumpe, 1996; Haney, Czerniak & Lumpe, 1996; Skourdoumbis, 2016). The Ministry of Education and Culture (MoEC) in Indonesia recently (2017) revised the 2013 National Curriculum to include skills for the 21st century, such as *problem solving* and *critical thinking*. There is some question, however, as to whether or not science teachers prioritize the various 21st century skills differently, and whether they are prioritizing the reformed skills over more traditional curriculum objectives, such as content knowledge.

Two main frameworks guide this research. The first is provided by the Indonesian national curriculum policy documents (School-Based Curriculum 2006, Curriculum 2013), including the Curriculum 2013 revision (see MoEC regulation number 21, 2016). These policy documents define what pieces of information and knowledge *should* be most salient for Indonesian teachers. These "pieces of information and knowledge" become important in the second framework based on Schoenfeld (2015, p. 233). Beginning in 2006, Indonesia used the School-Based

Curriculum (SBC), which focused on developing *content knowledge* through exploration, elaboration, and confirmation. In 2013, Indonesia adopted a new curriculum, the Curriculum 2013 (C13), which included *science process skills*, such as observing, alongside science content learning. In 2017, the C13 curriculum was revised to include 21st Century Learning Skills, adopted from the Partnership for 21st Century Skills framework. These skills include *creativity and innovation*, *critical thinking and problem solving*, *collaboration*, and *communication* (P21, 2009).

Schoenfeld's (2015) Teacher Decision-Making Model provides the second framework. Schoenfeld asks, "suppose a person is engaged in a complex activity, such as teaching. What determines what that person does, on a moment-by-moment basis, as he or she engages in that activity?" His model addresses this question in light of resources and "teacher's knowledge, goals, and beliefs" (p. 229). His model further implies that teacher priorities are grounded in teacher knowledge resources, goals, and orientations (including beliefs, values, and preferences). We assumed that teachers in this study are given the resources and goals for their teaching, via the mandated national curriculum. Given these resources and goals, the teachers go into and orient to their classrooms, which is the second aspect of Schoenfeld's model (2015, p. 233). As per the third aspect of his model, this orientation involves either reinforcing the teacher's priorities or a revision of those priorities. The focus of our research is on the priorities teachers claim to have in the classroom.

Literature Review

The 2013 Indonesia curriculum reform responded to both internal and external challenges inherent in the older SBC. Internally, Indonesia was challenged to prepare its young citizens for the workplace by providing them with important skills and competencies. Externally, Indonesia was challenged by globalization involving economics, environmental issues, fast-growing STEM information, and international education development (Machali, 2014). The SBC curriculum focusing merely on content no longer fitted the need to develop students' character, practices, and critical thinking abilities. The C13 applied scientific approaches and active learning, which was not inherent in the SBC. Additionally, SBC assessed students primarily on content knowledge, while C13 emphasized authentic assessments on students' characters, skills, and knowledge comprehensively in both learning process and outcomes. The C13 learning activities include memorizing (mengingat), understanding (memahami), observing (mengamati), questioning (menanya), collecting data and information (mengumpulkan informasi), experimenting (mencoba), reasoning and data analyzing (menalar), communicating (mengkomunikasikan), creating (mencipta), evaluating (mengevaluasi), and implementing (menerapkan) (MoEC regulation number 22, 2016).

When the C13 was established in 2013, the MoEC with the local Department of Education and the Educational Quality Assurance Agencies organized workshops and trainings for introducing and guiding teachers to implement the new curriculum. The C13 has also been revised to accommodate suggested improvements based on the result of monitoring and

evaluation of the C13 implementation and to address global educational issues.

However, in 2017 there was a further revision of C13. The Indonesian MoEC noted that the World Bank Human Development Department for the East Asia and Pacific regions found in Indonesia that a lack of skills for employability, productivity, and competitiveness caused on-going high youth unemployment in Indonesia (di Gropello, Kruse, & Tandon, 2011). The report suggested the need to develop a firm understanding of individuals' competitiveness and productivity for career readiness in the 21st century. The report recommended building academic skills, generic skills, and technical skills. The Indonesian education sector has the responsibility for developing student competencies such as the 21st Century Learning Skills so that students are prepared for the workplace.

The Indonesian MoEC has noted that in the last few decades, the world has fundamentally changed. The fast-growing global economy and population demands that societies be adaptive. These demands call for changing the role of education because "education is the key to the economic survival in the 21st century" (Trilling & Fadel, 2009, p. 5). Educators and education stakeholders should consider preparing students to be ready for college, the workplace, and to live in the 21st century global society. The skills for 21st century include problem solving, critical thinking, communication, collaboration, adaptability, and independence (National Research Council [NRC], 2011). Rotherham & Willingham (2009) suggest that it is important for students to acquire knowledge and skills together because both knowledge and skills are intertwined. They suggest integrating 21st century skills into curriculum help students develop the ability to deal with complex problems. Students will have brighter futures if they are able to wisely use both key skills and content knowledge (Trilling& Fadel, 2009; Wiggins & McTighe, 2005). Indonesia, therefore, revised their C13 curriculum in 2017 to include 21st Century Learning Skills.

The development of "21st Century Skills" was initiated by the Partnership for 21st Century Learning (P21). The P21 was founded in 2002 as a partnership between U.S. business communities, education leaders, and policy makers that initially served to place 21st century skills in the center of the U.S. K-12 education (P21, 2009). P21 established a framework of 21st century skills that includes: "1) Core subject and 21st century themes; 2) Learning and innovation skills; 3) Information, media, and technology skills; and 4) Life and Career Skills" (p.121). P21 calls for the integration of core curriculum subjects with interdisciplinary themes including global awareness, financial, economic, business, and entrepreneurial, civic, health, and environmental literacies. P21 suggests that learning and innovation skills —including creativity and innovation, critical thinking and problem solving, communication, and collaboration—will prepare students for multifaceted life in the 21st century. The information, media, and technology skills —including information literacy, media literacy, and ICT literacy—help students to develop technological skills and to be able to filter information. Finally, life and career skills —including flexibility and adaptability, initiative and self-direction, social and cross-cultural skills, productivity and accountability, and leadership and responsibility— develop students' thinking skills, mastery content knowledge, and generic skills to

traverse the workplace (the P21, 2009 as cited in Larson & Miller, 2011). The P21 framework has not only been adopted in 21 U. S. states but also in other countries as well. It is this P21 framework that Indonesia has now adopted as an official reform to the C13 documents.

Implementing this revision, as is always the case with curriculum revision, requires teacher support, commitment, and persistent effort (Fullan, 2007). Teachers as the agent of change, have to implement the curriculum reform and be willing to initiate changes in their teaching practices (Badley, 1986). Thus, teachers are critical if the gap between the goal of the curriculum and student learning in the classrooms is to be bridged. Understanding factors that drive teachers' inclination to implement curriculum reform therefore, is necessary if Indonesia is to achieve its education reform goals. In Indonesia, however there is very little knowledge of such indicators with respect to the recently adopted 21st Century Learning Skills.

Many studies indicate that science teachers are one of the keys to success for any curriculum change, and so that reformation must start from science classrooms (Kirk & MacDonald, 2001; Spillane, 1999). For example**,** Skourdoumbis (2016) found that teachers' beliefs, teachers' capabilities, and understanding the curriculum reform influenced their implementation of a new Australian curriculum. Teachers consistently adopt new curriculum standards, if these factors are positively met. Czerniak & Lumpe (1996) noted that teachers' beliefs can predict their thinking, motivation, intention, and behavior with regards to implementing reform. Haney, Czerniak, & Lumpe (1996) investigated teachers' beliefs regarding their intentions to change their teaching behavior in response to an Ohio science curriculum reform. They found that with respect to changing behavior, teachers' beliefs were critical. In addition, teachers' attitudes toward the targeted behavior were critical with respect to the implementation of the science reform.

Teachers' beliefs shape teachers' decisions on teaching practices (Aikenhead, 1985; Mansour, 2009; Schoenfeld, 2011). Teacher's beliefs are an essential component that influences their teaching practices prioritization because beliefs are one predictor of individual decision making (Bandura, 1986, Dewey, 1933 as cited in Pajares, 1992). Teachers who believe that reform objectives are important and beneficial for students will prioritize those objectives. According to Banner, Ryder & Donnelly (2009), the way teachers prioritize curriculum reform influences teachers' response and implementation of the reform. Hence, identifying teacher priorities is important for understanding teacher inclination toward curriculum reform implementation. However, although some studies have examined Indonesian teachers' beliefs and attitudes regarding education reform, few have investigated science teachers' beliefs or their priorities with regard to the 21st Century Learning Skills. The studies on Indonesian educational reform were mostly focused on studying English as a Foreign Language (EFL) teachers and curriculum content reform studies in general (Ahmad, 2014; Darsih, 2014). In addition, there are limited studies that have been conducted to examine vocational high school science teachers' priority of the curriculum reform.

In the absence of published research, and based on Schoenfeld's Teacher Decision-Making Model, this study aims to first assess how teachers prioritize

teaching 21st Century Learning Skills over other curriculum objectives. The goal is to establish which pieces of knowledge teachers activate or prioritize, so future studies can examine if these priorities lead to actual enactment in the classroom. We have three research questions:

1. How do teachers prioritize the teaching of 21st Century Learning Skills with respect to historical curriculum (science content and science process) objectives?
2. How are the 21st Century Learning Skills objectives prioritized with respect to each other?
3. Are there any differences in prioritizing to teach 21st Century Learning Skills among teachers from different types of schools, teaching subjects, teaching experiences, gender, teaching professional certifications, and educational backgrounds?

Methodology

This quantitative study used a cross-sectional design in which data was gathered from vocational high school science teachers in the city of Pontianak, West Kalimantan province, Indonesia. Cross-sectional study designs are descriptive in nature, provide quantitative estimations of an important problem, and making inferences of the association between variables (Babbie, 1990; Friis & Sellers, 2009; Satten & Strawn, 2014). A survey was chosen to obtain information about teachers' descriptions of their priorities regarding mandated curriculum reform (Babbie, 1990). Several surveys have been previously developed to measure teachers' *perspectives* on teaching the 21st Century Skills (e.g., David, 2018; DiBenedetto, 2015; Happ, 2013). However, to our knowledge, there are no surveys addressing teachers' *priorities* specific to teaching the 21st Century Learning Skills.

For this study, we developed an instrument to assess the priorities that teachers have for learning objectives as mandated by the government. The development of this instrument was primarily informed by Dillman, Smyth, & Christian's (2014). Data was collected at a single time using a paper-based survey regarding teacher prioritization of the 21st Century Learning Skills. Data was also collected on school type, years of teaching experiences, gender, science teaching subject, professional certification status, and teachers' educational background to address to what extent, if any, teachers differ in their priorities with respect to those aforementioned demographics. Data collected from this study provides baseline information in an area where very little empirical study has been reported.

Data Collection

Participants and Sampling

The subjects for this study were the population of vocational high school science teachers at both public (n=10) and private (n=12) schools in the city of Pontianak, West Kalimantan province, Indonesia. A survey was sent to the entire population, which consisted of 55 science teachers, 53 of whom responded with completed surveys. Of these 53, about 72% were from public schools and about 28% from private schools.

Among the teachers, 23% were teaching physics, 38% teaching chemistry, 24% teaching natural science, and 15% were teaching combinations (i.e., teaching physics and natural science; chemistry and natural science; physics and chemistry; or teaching physics and math). Teaching experience varied from 1 to 30 years, with the average being 11 years. The age of the teachers ranged from 23 to 57 years old. Of the sample, 38% were male teachers and 62% were female

teachers, with 51% having a professional certificate in their teaching subject and 49% having not yet obtained their professional certification. Of the teachers, 53% held a bachelor's degree in science education, 32% held a bachelor's degree but not in science education, and 15% of the teachers held a master's degree.

Instrument

Data was collected using a paper-based survey (see appendix). The survey consists of two parts. The first part is composed of closed-ended items constructed using two statements of curriculum objectives separated by four points. In developing the instrument, we did not construct a conventional questionnaire listing all the objectives coupled with a typical Likert response scale (low priority to high priority). Given that the 21st Century Learning Skills are mandated by the government, we were concerned that teachers would rate them all high if asked to assign a priority individually to each skill. For example, DiBenedetto (2015) found that teachers who were required to teach the 21st century skills identified all the skills as equally important.

To address this issue, we created an instrument design that would discriminate teachers' priorities on the curriculum objectives. Subjects record the extent to which they prioritize one objective over another by circling a point closer to their priority. In other words, teachers had to give a priority for an objective in contrast to another objective. For example, in the following item, the respondent strongly prioritized collaboration skill over history of science.

Collaboration skills ⦿ • • • *History of Science*

Using the language of the P21 framework and language that appears in the Indonesian curriculum, the 21st Century Learning Skills of creativity and innovation, critical thinking, problem solving, collaboration, and communication skills were placed into oppositional items against each other and against the traditional learning objective of science content. By "oppositional" we simply mean that two objectives are placed at the opposite sides of a Likert format. The participant selects a dot between the two different curriculum objectives to represent how close their priority is to either pole. In this way, the 21st Century Learning Skills, that are relatively new to teachers, are placed in the context of content, which has long been in the curriculum.

The 21st Century Learning Skills objectives are also compared to science process which is newer to the curriculum than content but still much more established than the 21st Century Learning Skills. In the Indonesian curriculum, science process skill refers to students' ability to apply scientific methods to develop their understanding of science knowledge (Dahar, 1996). In responding to an item, the teacher is prioritizing one over another; that is, a 21st Century Learning Skill over science process or vice versa.

Indonesia uses a national curriculum for its K-12 education system and all teachers have the same opportunity to become acquainted with new curricula; thus, we can assume that all teachers have the same general knowledge regarding the new curriculum revision. Though all of the teachers in this study can be expected to know about the C13 revision, we included items using history of science and writing skill learning objectives that are not in C13 or in the 21st Century Learning Skills, to help insure that the teachers recognized the 21st Century Learning Skills as appropriate to the C13. We can expect that

Indonesian teachers will discriminate between objectives that are included in the national curriculum and those that are not. To test this, we set a criterion value at 2.5 on a five-point scale. The expectation is that distractor objectives compared against curriculum objectives will get no more than a 2.5 priority and that all curriculum objectives tested against the distractors will consistently return priorities above 2.5. The teachers should indicate less priority for these distractors if they know that the 21st Century Learning Skills are part of C13. The instrument model is as follows:

Table 1

Priority of C13 objectives with respect to Distractor Objectives

The C13 Curriculum	Outcome
Historical C13 content	Science Content
Previous C13 content	Science Process
21st-Century Learning Skill	Creativity and Innovation
21st-Century Learning Skill	Critical Thinking
21st-Century Learning Skill	Problem Solving
21st-Century Learning Skill	Collaboration
21st-Century Learning Skill	Communication Skills
Irrelevant for Learning C13	History of Science
Irrelevant for Learning C13	Writing Skills

The content validity process began by examining the Indonesian curriculum focusing on the terms used for the objectives of interest for the study and used this in developing a model. The model represents the curriculum areas of interest and provides a basis for item development. The model was reviewed by our research group, which confirmed that the model met the purposes of the study. Items representing the model (including the distractors) were then drafted. These were also reviewed by the research group and revised. The revised items were then translated in to the Indonesian language, and the translation was checked by persons fluent in both Indonesian language and English. For expert review (Dillman et al., 2014), the Indonesian items were shared with teachers and administrators who work with the Indonesian curricula. They were asked to response to the items and to comment on whether they understood the intent of the survey, and if they had any concerns about the survey. No problems or issues were reported.

The next step was conducting a pilot study to establish reliability and to evaluate the instrument (Dillman et al., 2014). The pilot study involved 12 science teachers at both public and private schools in the city of Surakarta, Central Java province, Indonesia. According to various authorities, 12 is a sufficient number for this type of reliability test (Hertzog, 2008; Hill, 1998; and Isaac & Michael, 1995). Though from a different province from the actual study, these 12 teachers in the pilot study were vocational high school science teachers and can be assumed to be similar to the actual study population in their understanding of the new Indonesia curriculum revision. Reliability was

estimated using a ten-day, test-retest procedure that yielded a test-retest Cronbach alpha reliability coefficient of 0.802. The pilot study also asked the respondents three open-ended questions to get information on whether they understood what the survey was about. The responses suggested that they did. In addition, the distractor responses were tested against the value of 2.5. The test results were statistically significant. The instrument was thus found to have an acceptable reliability coefficient, its meaning understandable and showing statistically significant discrimination.

Demographic items formed the second part of the survey. Subjects were asked at which type of school they currently teach, for their current teaching subject, teaching experience, and age. They were asked their professional certification status and whether their professional certificate is aligned with their teaching subject. They were also asked for their highest level of education.

Data Analysis

For data analysis purpose, the Likert scale responses were converted to numbers (1 – 4) to indicate one curriculum objective prioritized over another. The four-point range is within the range suggested by Lozano, García-Cueto, and Muñiz (2008) as important for scale reliability and validity. The item Likert scale responses of each respondent were grouped based on the curriculum objectives (science process, science content, history of science, writing skill, creativity and innovation, critical thinking, problem solving, collaboration, and communication skills). From this data, the individual priority average for each objective was calculated. We then calculated the average priority for the total group. Data was then used to analyze teachers' prioritization amongst curriculum objectives using SPSS Statistics paired t-test. In addition, we examined whether there is an association on prioritizing the above curriculum objectives by type of school, teaching subject, gender, years of teaching, teachers' age, professional certification status, and teachers' education background using Pearson Chi square test.

Results

The survey instrument includes two distractor objectives: history of science and writing skill. The mean difference of the two distractors was analyzed using SPSS one sample t-test to examine whether the means are lower than a priority score of 2.5. Table 2 below reports mean difference between the distractors and test value.

Table 2

The Mean Difference between the Distractors Objectives and Test Value

	One-Sample Test							
	Test value = 2.5							
	M	SD	*t*	*df*	p	Mean difference	95% Confidence Interval of the Difference	
							Lower	Upper
History of science	1.58	.57	-11.697	52	< .001	-.915	-1.07	-.76
Writing skill	1.91	-56	-7.675	52	< .001	-.594	-.75	-.44

Table 3

Response Distribution of Teachers' Priority between Science Content, Science Process, and 21st Century Learning Skills

Pair	Priority level	N	%	Mean	Pair	Priority level	N	%	Mean
SC-SP	(1)	18	34	2.08	SP-SC	(1)	5	9.4	2.92
	(2)	18	34			(2)	12	22.6	
	(3)	12	22.6			(3)	18	34	
	(4)	5	9.4			(4)	18	34	
SC-CI	(1)	22	41.5	1.81	CI-SP	(1)	1	1.9	3.19
	(2)	20	37.7			(2)	10	18.9	
	(3)	10	18.9			(3)	20	37.7	
	(4)	1	1.9			(4)	22	41.5	
SC-CT	(1)	18	34	1.98	CT-SC	(1)	4	7.5	3.02
	(2)	22	41.5			(2)	9	17	
	(3)	9	17			(3)	22	41.5	
	(4)	4	7.5			(4)	18	34	
SC-PS	(1)	26	49.1	1.81	PS-SC	(1)	4	7.5	3.19
	(2)	15	28.3			(2)	8	28.3	
	(3)	8	15.1			(3)	15	28.3	
	(4)	4	7.5			(4)	26	49.1	
SC-Col	(1)	17	32.1	2.02	Col-SC	(1)	2	3.8	2.96
	(2)	20	37.7			(2)	14	26.4	
	(3)	14	26.4			(3)	20	37.7	
	(4)	2	3.8			(4)	17	32.1	
SC-Com	(1)	15	28.3	2.19	Com-SP	(1)	6	11.3	2.79
	(2)	19	35.8			(2)	13	24.5	
	(3)	13	24.5			(3)	19	35.8	
	(4)	6	11.3			(4)	15	28.3	

SC=science content; SP=science process; CI=creativity &innovation; CT=critical thinking; PS=problem solving; Col=collaboration skill; and Com=communication skill; priority level:(1) =least priority; (2) =less priority; (3) = priority; and (4) =high priority

The calculation of mean total group of history of science objective priority score was 1.58 ± 0.57 and the mean of writing skill objective priority score was 1.91 ± 0.56. We then calculated the difference between mean total group and the priority score value of 2.5. Analysis shows a significant difference between means of both history of science and writing skill and the test value of 2.5. These results indicate that teachers could distinguish between the C13 curriculum objectives and non-curriculum objectives by giving the non-curriculum objectives low priorities (< 2.5). Teacher differences in prioritizing science

content, science process, creativity and innovation, critical thinking, problem solving, collaboration, and communication skills vis-a-vis the history of science and writing skills was also analyzed using SPSS Statistics paired t-test. The analysis of distractors indicates that teachers prioritized all of the legitimate C13 curriculum objectives over the two distractors. The results suggest that the teachers recognized the legitimacy of the reform objectives (creativity and innovation, critical thinking, problem solving, collaboration, and communication skills) as well as the more traditional objectives (science content and science process).

To address the first research question on teachers' prioritization of the 21st Century Learning Skills with respect to typical science content and process objectives, we analyzed response distribution for teacher prioritizing of 21st Century Learning Skills objectives vis-à-vis the more established objectives of science content and science process (Table 3).

Teachers consistently prioritize science process, creativity and innovation, critical thinking, problem solving, collaboration, and communication skills over science content.

Table 4 gives the paired-tests for statistical significance. For all six pairs, the difference against science content is significant.

Table 4

The Priority Differences between Science Content, Science Process, and 21st Century Learning Skills

		M	SD	95% CI for Mean Difference		*r*	*t*	*df*	*p*
				lower	upper				
Pair 1	SC-SP	-.849	1.955	-1.388	-.310	0.43	-3.161	52	0.003
Pair 2	SC-CI	-1.377	1.620	-1.824	-.931	0.85	-6.190	52	< 0.001
Pair 3	SC-CT	-1.038	1.808	-1.536	-.539	0.57	-4.179	52	< 0.001
Pair 4	SC-PS	-1.377	1.924	-1.908	-.847	0.72	-5.212	52	< 0.001
Pair 5	SC-Col	-.943	1.714	-1.416	-.471	0.55	-4.006	52	< 0.001
Pair 6	SC-Com	-.604	1.945	-1.140	-.068	0.31	-2.260	52	0.028

SC=science content; SP=science process; CI=creativity &innovation; CT=critical thinking; PS=problem solving; Col=collaboration skill; and Com=communication skill

Similarly, we analyzed teachers' prioritizing of 21st Century Learning Skills with respect to science process that were previously documented in C13 (Table 5).

Statistically, the mean differences between creativity and innovation, critical thinking, problem solving, and science process are significant at $\alpha = 0.05$. However, the mean difference between scientific process and collaboration, as well as scientific process and communication skills, is not significant. Taken together, Table 4 and 5 suggest three priority tiers:

- First tier (creativity and innovation, critical thinking, problem solving)
- Second tier (science process, collaboration, and communication skills)

- Third tier (science content)

The results indicate that teachers strongly prioritized creativity and innovation, critical thinking, and problem solving, and less so for science process, collaboration, and communication skills. However, the teachers prioritize all these objectives over science content.

The second research question asks about teacher priorities amongst the 21st Century Learning Skills (Table 6). For this analysis, we dropped the comparisons with science content and science process.

Table 5

The Priority Differences between Science Process and 21st Century Learning Skills

		M	SD	95% CI for Mean Difference		r	t	*df*	*p*
				lower	upper				
Pair 1	SP-CI	-.906	1.983	-1.452	.359	0.46	-3.325	52	0.020
Pair 2	SP-CT	-.566	1.956	-1.105	-.027	0.29	-2.106	52	0.040
Pair 3	SP-PS	-.717	1.955	-1.256	-.178	0.37	-2.670	52	0.010
Pair 4	SP-Col	-.283	2.043	-.846	-.280	0.14	-1.009	52	0.318
Pair 5	SP-Com	-.396	1.945	-.932	.140	0.20	-1.483	52	0.144

SP=science process; CI=creativity &innovation; CT=critical thinking; PS=problem solving; Col=collaboration skill; and Com=communication skill

Table 6

Teacher's Priorities among the 21st Century Skills

		M	SD	95% CI for Mean Difference		r	t	*df*	*p*
				lower	upper				
Pair 1	CI-CT	.226	2.063	-.342	.795	0.11	.799	52	0.428
Pair 2	CI-PS	.094	1.656	-.362	.551	0.06	.415	52	0.680
Pair 3	CI-Col	.660	1.870	.145	1.176	0.35	2.571	52	0.013
Pair 4	CI-Com	.736	1.711	.264	1.280	0.43	3.130	52	0.003
Pair 5	CT-PS	.094	1.656	.362	.551	0.06	.415	52	0.680
Pair 6	CT-Col	-.547	1.907	.021	1.073	0.29	2.089	52	0.042
Pair 7	CT-Com	.189	1.773	-.289	.660	0.10	.793	52	0.432
Pair 8	PS-Col	.698	1.771	-.210	1.160	0.39	2.869	52	0.006
Pair 9	PS-Com	.811	1.971	-.268	1.355	0.41	2.996	52	0.004
Pair 10	Col-Com	.593	2.061	.030	1.155	0.29	2.113	52	0.039

CI=creativity &innovation; CT=critical thinking; PS=problem solving; Col=collaboration skill; and Com=communication skill

The analysis indicates significant difference in prioritizing creativity and innovation and problem solving over collaboration and communication skills. The mean difference between critical thinking and

collaboration skills, and collaboration and communication skills are significant. However, the mean difference between critical thinking and communication skills is not significant. Similarly, when comparing creativity and innovation, critical thinking, and problem solving, the mean difference among these skills are not significant. The data suggests something similar to the first and second priority tiers noted above with creativity and innovation and problem solving in the first tier and collaboration and communication skills in the second tier. The difference is that in this analysis the priority means for critical thinking and communication are not significantly different.

The third research question is about possible associations between teachers' priority and type of school, teaching subject, gender, years of teaching, teachers' age, professional certification status, and teachers' education background. We used a parametric statistic Pearson Chi square test to test for possible association (Field, 2009). The Pearson Chi square test results indicates that there is no significant difference in prioritizing the above curriculum objectives by type of school, teaching subject, teachers' age, professional certification status, and teachers' education background. However, the analysis indicates a small to medium association between years of teaching experience and teacher's priority on communication skills with $\chi 2$ (9) =21.572, p 0.01 at α = 0.05 and $Ø_C$ 0.368. Also, male science teachers report higher priority on problem solving than female science teachers, $\chi 2$ (3) =8.043, p 0.045 at α = 0.05, and φ=0.390. In general, the results suggest that, teachers prioritize creativity and innovation, critical thinking, and problem solving over other skills (collaboration and communication skills), scientific process, and science content (see supplementary data for details).

Discussion

The comparison of teacher priorities among curriculum objectives indicates that teachers prioritize the curriculum objectives differently. Teachers give higher priority to creativity and innovation, critical thinking, and problem solving over other skills. These findings echo the DiBenedetto (2015) findings that teachers' perspectives on their capability, responsibility, and urgency to teach skills preparing student for career readiness in the 21st century suggests a high priority to teach problem solving and critical thinking among other learning skills. Likewise, Newton (2012) found that teachers expressed their enthusiasm on facilitating students to think creatively and independently, even though teachers were less certain regarding the implementation and its practice, because teachers' beliefs that "creativity in learners was something to be valued" (Davies, Newton, & Newton, 2017 p. 10). Similarly, teachers' higher priority on problem solving could be a good sign of their inclination to integrate skills. As Odger, Symons, and Mitchell (2000) advocate, utilizing problem solving would potentially facilitate learning differentiation for diverse students.

The results also suggest that the 21st Century Learning Skills of collaboration and communication were less prioritized by Indonesian teachers. This result supports prior research that examined 71 high school teachers from three different schools in the state of Massachusetts and New York finding that most of math and science teachers strongly disagreed on providing opportunities for their students to communicate and to present their work in front of an

audience (Happ, 2013). Further analysis suggests that teachers prioritized science process over science content; although the data does not suggest that teachers do not prioritize science content. Teachers might think that science content objectives more reflect the previous curriculum (SBC), which mainly focused on developing student understanding of science content. The teachers could reasonably think that 21st Century Learning Skills and science process as more alike than science content.

In addition, other factors such as school type, teaching subjects, age, professional certification, and educational background are not found to be important with regard to teacher priority. Pearson chi square analysis indicates an association between years of teaching experience, gender, and teacher's priority. Although Happ (2013) finds that teachers' prioritization of 21st century skills increases with years of teaching experience, in this study, only teachers with the least experience, within a 1-5 years bracket, highly prioritized communication skills, $\chi 2$ (9) =21.572, p 0.01 at $\alpha = 0.05$, $Ø_C$ 0.368, and no relation between years of teaching and teachers' priorities on other skills. This finding is somewhat incongruous with the literature. Likewise, male science teachers in this study report higher priority on problem solving than female science teachers ($\chi 2$ (3) =8.043, p 0.045 at $\alpha = 0.05$, φ=0.390). However, to our knowledge, there is no literature that exists on gender differences and teacher's priority of the 21st Century Learning Skills, but a study on novice teachers' perception of their problem-solving skills level indicates that there are no difference perceptions based on gender (Tok, Tok, & Dolapçıoğlu, 2014).

Conclusions, Limitations, and Implications

This study adds to the literature by having assessed teacher priorities regarding the 21st Century Learning Skills of creativity and innovation, critical thinking, problem solving, collaboration, and communication skills as directed by three research questions. In response to the first research question on how teachers prioritize the 21st Century Learning Skills with respect to typical science content and science process objectives, the analysis indicates a positive finding that the vocational high school science teachers in the district of Pontianak are aware the inclusion of 21st Century Learning Skills in the 2013 curriculum. This might be because of the revision recency. In light of Schoenfeld's (2015) Teacher Decision-Making Model, if the goal is to help students become college and career ready in the 21st century, teachers will first need to prioritize relevant objectives. As per the Schoenfeld model, actual classroom decisions proceed from teacher knowledge (about curriculum objectives and students) and their orientations (including their priorities).

Regarding the second research question that examines how the 21st Century Learning Skills objectives are prioritized with respect to each other; this study indicates that teachers prioritize the various 21st Century Learning Skills differently. The analysis suggests that teachers prioritize creativity and innovation, problem solving, and critical thinking over collaboration and communication skills. Again, as per the Schoenfeld model, what happens with these differentiated priorities will depend on how teachers orient to actual classroom situations. Addressing the third research question on whether teachers from different types of schools, teaching subjects, gender, teaching professional certifications, and educational

backgrounds prioritize the 21st Century Learning Skills differently, the results indicate that these factors are not significantly associated with teachers' priorities, except for teaching experience and gender.

While the study of teacher priorities is important and speaks to teachers' intentions to implement the Indonesian curriculum reform, there are, however, limitations. The study is based on data from particular curriculum revision and vocational high school science teachers in the district of Pontianak, West Kalimantan, Indonesia. Caution should be used for generalizing to other populations with different characteristics. We also note that this present study is an initial investigation of teachers' 21st Century Learning Skills priorities in Indonesia. While it is important that teachers prioritize these skills, we do not know how teachers actually implement these skills in classrooms. Dam, Janssen, and van Driel (2018) suggest that teachers' awareness of reform and their inclinations can lead to the changing of their teaching practices.

According to Schoenfeld's (2015) Teacher Decision-Making Model, when the goals are established, teachers will make decisions consistent with these goals, considering what teachers will do in the classroom and what resources to use. Schoenfeld (2015) states that if the situation is familiar for teachers, the decision-making process could be relatively automatic. The teachers would convey their goal prioritization when developing their syllabus and apply it to instruction in the classrooms. However, if the situation is not familiar to the teachers, the mechanism of using subjective expected values of available options would direct teachers' decision making (Schoenfeld, 2015). The implication for future research based on Schoenfeld' model is then to assess teachers' decision to implement their goal prioritization and orientations.

Considering the Schoenfeld model, as teachers prioritize the 21st Century Learning Skills and their prioritization become salient and are activated, future research needs to understand how these skills are being taught in classroom practices to ascertain how these priorities are either implemented or re-oriented when teachers face the actual classroom situation. Also, it will be interesting to see how teachers implement creativity and innovation, problem solving, and critical thinking since they value these skills more prominently than the others. Additional research might explore factors that influence the difference in prioritizing, implementing, and identifying potential barriers in prioritizing and teaching the 21st Century Learning Skills.

Furthermore, this study adds to the literature on the implementation of 21st Century Learning Skills objectives, and thus our findings could be informative for further studies of implementation the 21st Century Learning Skills in other countries. Also, it would be interesting in the future to look at teachers' priority in different educational systems. The findings also provide information for the Indonesian' policy makers for further monitoring and evaluation of the C13 curriculum revision implementation.

Acknowledgment

Haryani, E. would like to acknowledge the financial support received from the Indonesian government through Indonesia Endowment Fund for Education (LPDP) Scholarship for performing her PhD program at the Mallinson Institute for Science Education, Western Michigan University, USA.

References

Ahmad, D. (2014). Understanding the 2013 curriculum of English teaching through the teachers' and policy makers' perspectives. *International Journal of Enhanced Research in Educational Development, 2,* 4. 6-15.

Aikenhead, G. S. (1985). Collective decision making in the social context of science. *Science Education, 96, 4.* 453-457.

Babbie, E. R. (1990). *Survey research methods*. 2nd Ed. Belmont, CA: Cengage Learning.

Badley, G. (1986). The teacher as change agent. *British Journal of In Service Education, 12*, 3. 151-158. doi: 10.1080/0305763860120305

Banner, I, Ryder, J. & Donnelly, J. (2009, September). *The role of teachers' priorities for science education in the enactment of science curriculum reform.* Paper presented at the European Science Education Research Association conference, Istanbul.

Czerniak, C. M. & Lumpe, A. T. (1996). Relation between teacher beliefs and science education reform. *Journal of Science Teacher Education, 7*(4), 247-266.

Dam, M. Janssen, F. J. J. M. & van Driel, J. H. (2018) Attention to intentions- How to stimulate strong intentions to change. *Research in Science Education, 48*, 369-387. doi: 10.1007/s11165-016-9572-4.

Dahar, R. W. (1996). *Teori-teori belajar*. Jakarta: Erlangga.

Darsih, E. (2014). Indonesia EFL teachers' perception on the implementation of 2013 English curriculum. *English Review: Journal of English Education, 2*(2), 192-199.

David, J.G. (2018). *A study of K-12 teachers' perceptions of teacher self-efficacy in relation to instruction of 21st century skills*. Retrieved from ProQuest Dissertations & Theses Global. (AAT 10820891)

Davies, L. M., Newton, L. D., & Newton, D. P. (2017). Creativity as a twenty-first-century competence: An exploratory study of provision and reality. *Education*. 3-13. doi: 10. 1080/03004279.2017.1385641.

DiBenedetto, C. A. (2015). *Teachers' perceptions of their proficiency and responsibility to teach the knowledge, skills, and dispositions required of high school students to be career ready in the 21st century*. Retrieved from: ProQuest Digital Dissertation. (3729140)

di Gropello, E., Kruse, A. & Tandon, P. (2011). *Skill for the labor market in Indonesia: Trends in demand, gaps, and supply*. Direction in development. World Bank © *World Bank.* https://openknowledge.worldbank.org/handle/10986/2282 License: CC BY 3.0 IGO.

Dillman, D. A., Smyth, J. D., Christian, L. M. (2014). *Internet, phone, mail, and mixed-mode surveys. The Tailored Design Method 4th edition.* Hoboken, New Jersey: John Wiley & Son.

Field, A. (2009). *Discovering statistics using SPSS 3rd edition*. Thousand Oaks, California: SAGE Publication Inc.

Friis, R. H. & Sellers, T. A. (2009). *Epidemiology for public health practice*. Sudbury, MA: Jones and Bartlett Publishers.

Fullan, M. (2007). *The new meaning of educational change 4th ed*. New York: Teacher College Press.

Haney, J.J., Czerniak, C. M., & Lumpe, A. T. (1996). Teacher beliefs and intentions regarding the implementation of science education reform strands. *Journal of Research in Science Teaching, 33*(9), 971-993.

Happ, D. W. (2013). *Results of a survey of 21st century skills of communication, Collaboration, critical thinking, and creativity*. Retrieved from ProQuest Digital Dissertations. (AAT 3575592)

Hertzog, M.A. (2008). Consideration in determining sample size for pilot studies. *Research in Nursing & Health, 31*, 180–191.

Hill, R. (1998). What sample size is "enough" in internet survey research? *Interpersonal Computing and Technology Journal for the 21st Century, 6*(3-4). Retrieved July 12, 2008, from http://www.emoderators.com/ipct-j/1998/n3-4/hill.html

Indonesia's Ministry of Education and Culture Regulation number 21 of 2016: The core standard for elementary and secondary education (Permendikbud no. 21 tahun 2016 tentang standard isi pendidikan dasar dan menengah). Retrieved from: https://luk.staff.ugm.ac.id/atur/bsnp/Permendikbud21-2016SIDikdasmen.pdf

Indonesia's Ministry of Education and Culture Regulation number 22 of 2016: The process standards for elementary and secondary education (Permendikbud no. 22 tahun 2016 tentang standard proses pendidikan dasar dan

menengah). Retrieved from: http://bsnp-indonesia.org/wp-content/uploads/2009/06/Permendikbud_Tahun2016_Nomor022_Lampiran.pdf

Isaac, S., & Michael, W. B. (1995). *Handbook in research and evaluation*. San Diego, CA: Educational and Industrial Testing Services.

Kirk, D. & MacDonald, D. (2001). Teacher voice and ownership of curriculum change. *Journal of Curriculum Studies, 33*(5), 551-567. doi: 10. 1080/00220270010016874.

Larson, L. C. & Miller, T. N. (2011). 21st century skills: Prepare students for the future. *Kappa Delta Pi Record, 47*(3), 121-123. doi: 10. 1080/00228958.2011. 10516575.

Lozano, L. M., García-Cueto, E. & Muñiz, J. (2008). Effect of the number of response categories on the reliability and validity of rating scale. *Methodology journal, 4*, 73-79. doi: 10.1027. 1614-2241.4.2.73

Machali, I. (2014). Kebijakan perubahan kurikulum 2013 dalam menyongsong Indonesia emas tahun 2045. *Jurnal Pendidikan Islam, 3*, 1. 71-94.

Mansour, N. (2009). Science teachers' beliefs and practices: Issues, implications and research agenda. *International Journal of Environmental & Science Education, 4*(1). 25-48.

National Research Council. (2011). Assessing 21st century skills: Summary of a workshop. Washington DC: The National Academies Press. https://doi.org/10.17226/13215

Newton, L. D. (2012). *Creativity for a new curriculum*. New York: Routledge.

Odger, S., Symons, A., & Mitchell, I. (2000). Differentiating the curriculum through the use of problem solving. *Research in Science Education, 30*(3), 289-300.

Pajares, M. F. (1992). Teachers' beliefs and educational research: Cleaning up a messy construct. *Review of Educational Research, 62,* 307-332.

Partnership for 21st Century Skills. (2009*). A. framework for 21st century learning*. Tucson: AZ: P21. Available at: http://www.p21.org/our-work/p21-framework

Rotherham, A. J., & Willingham, D. (2009). 21st Century skills: the challenges ahead. *Educational Leadership, 67*(1), 16-21.

Satten, G. A. and Grummer-Strawn, L. (2014). Cross-Sectional Study. Wiley StatsRef: Statistics Reference Online. Retrieved from:

http://onlinelibrary.wiley.com/doi/10.1002/9781118445112.stat05138/abstract?userIsAuthenticated=false&deniedAccessCustomisedMessage=

Schoenfeld, A. H. (2011). Toward professional development for teachers grounded in a theory of decision making. *ZDM Mathematics Education, 43*,457–469 doi: 10.1007/s11858-011-0307-8

Schoenfeld, A. H. (2015, February). *How we think: A theory of human decision-making, with focus on teaching.* Paper presented at the 12th International Congress on Mathematical Education pp 229-24, doi:10.1007/978-3-319-12688-3_16

Skourdoumbis, A. (2016). Articulating of teaching practice: A case study of teachers and "general capabilities". *Asia Pacific Education Rev. 17*, 545-554. doi: 10.1007/s 12564-016-94607.

Spillane, J. P. (1999). External reform initiatives and teachers' efforts to reconstruct their practice: the mediating role of teachers' zones of enactment. *Journal of Curriculum Studies, 31(*2), 143-175.

Tok, N. K., Tok, S. & Dolapçıoğlu, S. D. (2014). The perception levels of novice teachers' problem solving skills. *Procedia- Social and Behavioral Sciences, 116*, 412-420.

Trilling, B. & Fadel, C. (2009). *21st century skills: Learning for life in our times*. San Francisco, CA: Jossey-Bass.

Wiggins, G., & McTighe, J. (2005). *Understanding by design*. Alexandria, VA: Association for Curriculum and Development

Appendix A. Survey Items

A. TEACHING PRIORITIES

Each item below contains two potential teaching objectives for a science course. For each item Please choose which objective you would give the higher priority. Marking one circle indicates the strength of your priority of one objective over the other.

For example:

	high priority	priority	priority	high priority	
Volleyball	○	●	○	○	Football

This teacher prioritizes volley ball over football but not at the highest level

No		high priority			high priority	
1.	Science content	O	O	O	O	Science process
2.	Science process	O	O	O	O	Creativity &innovation
3.	Collaboration skill	O	O	O	O	History of science
4.	Writing skill	O	O	O	O	Collaboration skill
5.	Science process	O	O	O	O	Critical thinking
6.	Problem solving	O	O	O	O	Science content
7.	Science process	O	O	O	O	Problem solving
8.	Science content	O	O	O	O	Creativity &innovation
9.	Critical thinking	O	O	O	O	History of science
10.	Problem solving	O	O	O	O	History of science
11.	Science process	O	O	O	O	Collaboration skill
12.	Science content	O	O	O	O	Critical thinking
13.	Writing skill	O	O	O	O	Problem solving
14.	Critical thinking	O	O	O	O	Writing skill
15.	Science process	O	O	O	O	Communication skill
16.	Communication	O	O	O	O	Science content

17.	History of science	O	O	O	O	Science process
18.	Science content	O	O	O	O	History of science
19.	Creativity &innovation	O	O	O	O	Writing skill
20.	Writing skill	O	O	O	O	Science process
21.	Science content	O	O	O	O	Writing skill
22.	Collaboration skill	O	O	O	O	Science content
23.	History of science	O	O	O	O	Creativity & innovation
24.	History of science	O	O	O	O	Communication skill
25.	Communication skill	O	O	O	O	Writing skill
26.	Creativity & innovation	O	O	O	O	Critical thinking
27.	Problem solving	O	O	O	O	Critical thinking
28.	Collaboration skill	O	O	O	O	Communication skill
29.	Creativity & innovation	O	O	O	O	Problem solving
30.	Communication skill	O	O	O	O	Creativity &innovation
31.	Creativity &innovation	O	O	O	O	Collaboration skill
32.	Problem solving	O	O	O	O	Communication skill
33.	Critical thinking	O	O	O	O	Collaboration skill
34.	Communication skill	O	O	O	O	Critical thinking
35.	Collaboration skill	O	O	O	O	Problem solving

B. BACKGROUND INFORMATION

1. Please indicate with which type of school you are currently teaching?
   - o Public
   - o Private
2. What is your current teaching science? Please check all that apply
   - □ Physic
   - □ Chemistry
   - □ Natural Science
   - □ Other (please specify……)
3. How many years of experience have you had in teaching science?

   [ ] years

4. What is your age in years?

   ☐ years

5. What is your gender
   - Male
   - Female

6. Current certification status. Have you obtained the teaching professional certificate?
   - No
   - Yes

7. Are you teaching in a subject area in which you are professionally certified to teach?
   - No
   - Yes

8. What is the highest level of education you have completed?
   - Diploma
   - Bachelor in science education
   - Bachelor, non-science education
   - Master
   - Doctoral

Thank you for participating in this survey!

Appendix B. Supplementary Data

Pearson's Chi Square Analysis Result

Table 7

Analysis the Association between Teacher's Priority and Type of School

Objective		Type of school		Total	X^2	df	*p*-value
		Public	Private				
Science content	Least priority	7(18.4%)	1(6.7%)	8(15.1%)	3.887	3	0.274
	Less priority	24 (63.2%)	9(60%)	33(62.3%)			
	Priority	7 (18.4 %)	4(26.7%)	11(20.8%)			
	High priority	0	1(6.7%)	1(1.9%)			
Science process	Least priority	1(26%)	0	1(1.92%)	1.373	3	0.712
	Less priority	20(52.6%)	10(66.7%)	30(56.6%)			
	Priority	16(42.1%)	5(33.3%)	21(39.6%)			
	High priority	1 (2.6%)	0	1(1.9%)			
Creativity & Innovation	Least priority	-	-	-	4.279	2	0.118
	Less priority	7(18.4%)	5 (33.3%)	12(22.6%)			
	Priority	23(60.5%)	10(66.7%	33(62.3%)			
	High priority	8(21.1%)	0	8(15.1%)			
Critical thinking	Least priority	-	-	-	1.962	2	0.375
	Less priority	12(31.6%)	7(46.7%)	19(35.8%)			
	Priority	23(60.5%)	8(53.3%)	31(50.5%)			
	High priority	3(7.9%)	0	3(5.7%)			
Problem solving	Least priority	0	1(6.7%)	1(1.9%)	4.230	3	0.238
	Less priority	9(23.7%)	5(33.3%)	14(26.6%)			
	Priority	21(55.3%)	8(53.3%)	29(54.7%)			
	High priority	8(21.1%)	1(6.7%)	9(17%)			
Collaboration skills	Least priority	-	-	-	0.931	2	0.628
	Less priority	21(55.3%)	8(53.3%)	29(54.7%)			
	Priority	15(39%)	7(46.7%)	22(41.5%)			
	High priority	2(5.3%)	0	2(3.8%)			
Communication skills	Least priority	3(7.9%)	0	3(5.7%)	6.976	3	0.073
	Less priority	22(57.9%)	4(26.7%)	26(49.1%)			

Table 7 continued

Priority	12(31.6%)	10(66.7%)	22(41.5%)
High priority	1(2.6%)	1(6.7%)	2(3.8%)

There is no significant difference between public and private school science teachers' priority. Teachers reported they prioritized CI, CT, PS over other skills (Collaboration and Communication skills), SC, and SP.

Table 8

Analysis the Association between Teacher's Priority and Teaching Subject

Objective		Teaching subject				Total	X^2	df	*p*-value
		Physics	Chemistry	Natural Science	Others				
Science content	Least priority	1(8.3%)	4(20%)	1(8.3%)	2(25%)	8(15.1%)	9.538	9	0.389
	Less priority	9 (75%)	13(65%)	8(61.5%)	3(37.5%)	33(62.3%)			
	Priority	2 (16.7 %)	3(15%)	4 (30.8%)	2(25%)	11(20.8%)			
	High priority	0	0	0	1(12.5%)	1(1.9%)			
Science process	Least priority	1(8.3%)	0	0	0	1(1.92%)	7.521	9	0.583
	Less priority	6(50%)	13(65%)	8(61.5%)	3(37.5%)	30(56.6%)			
	Priority	5(41.7%)	6(30%)	5(38.5%)	5(62.5%0	21(39.6%)			
	High priority	0	1(5%)	0	0	1(1.9%)			
Creativity & Innovation	Least priority	-	-	-	-	-	6.231	6	0.400
	Less priority	4(33%)	2 (45%)	3(23.1%)	3(37.5%)	12(22.6%)			
	Priority	6(50%)	13(65%)	9(69.2%)	5(62.5%)	33(62.3%)			
	High priority	2(16.7%)	5(25%)	1(7.7%)	0	8(15.1%)			
Critical thinking	Least priority	-	-			-	8.119	6	0.229
	Less priority	4(33%)	9(46.7%)	3(23.1%)	3(37.5%)	19(35.8%)			
	Priority	8(66.7%)	8(53.3%)	10(76.9%)	5(62.5%)	31(50.5%)			
	High priority	0	0	0	0	3(5.7%)			
Problem solving	Least priority	0	0	1(7.7%)	0	1(1.9%)	9.372	9	0.404
	Less priority	2(16.7%)	4(20%)	6(46.2%)	2(25%)	14(26.6%)			
	Priority	21(55.3%)	14(70%)	4(30.8%)	4(50%)	29(54.7%)			
	High priority	8(21.1%)	2(25%)	2(15.4%)	2(25%)	9(17%)			
Collaboration skills	Least priority	-	-	-	-	-	3.935	6	0.686
	Less priority	7(58.3%)	11(55%)	7(53.8%)	4(50%)	29(54.7%)			
	Priority	4(33%)	9(45%)	6(46.2%)	3(37.5%)	22(41.5%)			
	High priority	1(8.3%)	0	0	1(12.5%)	2(3.8%)			

Table 8 continued

Communicati on skills	Least priority	1(8.3%)	2(10%)	0	0	3(5.7%)	10.133	9	0.340
	Less priority	5(41.7%)	12(60%)	5(38.5%)	4(50%)	26(49.1%)			
	Priority	6(50%)	6(30%)	6(46.2%)	4(50%)	22(41.5%)			
	High priority	0	0	2(15.4%)	0	2(3.8%)			

There is no significant difference in priority among teachers with different science subjects. Teachers reported they prioritized CI, CT, PS over other skills (Collaboration and Communication skills), SC, and SP.

Table 9

Analysis the Association between Teacher's Priority and Years of teaching

Objective		Years of teaching				Total	X^2	df	*p*-value
		1-5	6-10	11-19	20+				
Science content	Least priority	1(6.3%)	1(7.1%)	4(28.6%)	2(22.2%)	8(15.1%)	8.769	9	0.459
	Less priority	9(56.3%)	9(64.3%)	9(64.3%)	6(66.7%)	33(62.3%)			
	Priority	5(31.3 %)	4(28.6%)	1(7.1%)	1(11.1%)	11(20.8%)			
	High priority	1(6.3%)	0	0	0	1(1.9%)			
Science process	Least priority	0	0	0	1(11.1%)	1(1.92%)	8.775	9	0.458
	Less priority	9(56.3%)	8(57.1%)	7(50%)	6(66.7%)	30(56.6%)			
	Priority	7(43.8%)	6(42.9%)	6(42.9%)	2(22.2%)	21(39.6%)			
	High priority	0	0	1(7.1%)	0	1(1.9%)			
Creativity & Innovation	Least priority	-	-	-	-	-	5.029	6	0.540
	Less priority	5(31.3%)	5 (33.3%)	3(21.4%)	1(11.1%)	12(22.6%)			
	Priority	10(62.5%)	10(66.7%	7(50%)	6(66.7%)	33(62.3%)			
	High priority	8(21.1%)	0	4(28.6%)	2(22.2%)	8(15.1%)			
Critical thinking	Least priority	-	-	-	-	-	6.486	6	0.371
	Less priority	9(56.3%)	4(26.4%)	3(21.4%)	3(33.3%)	19(35.8%)			
	Priority	6(37.5%)	9(64.3%)	11(78.6%)	5(55.6%)	31(50.5%)			
	High priority	1(6.3%)	1(7.1%)	0	1(11.1%)	3(5.7%)			
Problem solving	Least priority	0	0	1(7.1%)	0	1(1.9%)	12.370	9	0.193
	Less priority	8(50%)	3(21.4%)	2(14.3%)	1(11.1%)	14(26.6%)			
	Priority	8(50%)	8(537.1%)	7(50%)	6(66.7%)	29(54.7%)			
	High priority	8(21.1%)	3(21.4%)	4(28.6%)	2(22.2%)	9(17%)			
Collaboration skills	Least priority	-	-	-	-	-	12.664	6	0.050
	Less priority	9(43.8%)	9(64.3%)	9(64.3%)	2(22.2%)	29(54.7%)			
	Priority	7(55.3%)	5(35.7%)	5(35.7%)	5(55.6%)	22(41.5%)			
	High priority	0	0	0	2(22.2%)	2(3.8%)			

Table 9 continued

Communicati on skills	Least priority	0	0	0	0	3(5.7%)	21.572	9	0.010
	Less priority	6(37.5%)	9(64.3%)	8(57.1%)	3(33.3%)	26(49.1%)			
	Priority	8(50%)	5(35.7%)	3(33.3%)	3(33.3%)	22(41.5%)			
	High priority	2(12.5%)	0	0	3(33.3%)	2(3.8%)			

There is no significant difference in priority among teachers with different length of teaching experience except for communication skills. Teachers with 1-5 years of teaching experience reported highly prioritize communication skills, $\chi 2$ (9) =21.572, p 0.01 at $\alpha = 0.05$, $Ø_C$ 0.368. In general, teachers reported they prioritized CI, CT, PS over other skills (Collaboration and Communication skills), SC, and SP.

Table 10

Analysis the Association between Teacher's Priority and Age

Objective		Age			Total	X^2	df	p-value
		20-35	36-49	50+				
Science content	Least priority	1(4%)	5(27.8%)	2(20%)	8(15.1%)	8.851	3	0.182
	Less priority	15 (60%)	12(66.7%)	6(60%)	33(62.3%)			
	Priority	8(32 %)	1(5.6%)	2(20%)	11(20.8%)			
	High priority	1(4%)	0	0	1(1.9%)			
Science process	Least priority	0	0	1(10%)	1(1.92%)	6.627	6	0.357
	Less priority	14(56%)	10(55.6%)	6(60%)	30(56.6%)			
	Priority	11(44%)	7(38.9%)	3(30%)	21(39.6%)			
	High priority	0	1(5.6%)	0	1(1.9%)			
Creativity & Innovation	Least priority	-	-	-	-	5.018	4	0.285
	Less priority	7(28%)	3(16.7%)	2(20%)	12(22.6%)			
	Priority	17(68%)	10(55.6%)	7(70%)	33(62.3%)			
	High priority	1(4%)	5(27.8%)	1(10%)	8(15.1%)			
Critical thinking	Least priority	-	-	-	-	3.534	4	0.473
	Less priority	11(44%)	5(27.8%)	3(30%)	19(35.8%)			
	Priority	12(48%)	13(72.2%)	6(60%)	31(50.5%)			
	High priority	2(8%)	0	1(10%)	3(5.7%)			
Problem solving	Least priority	0	1(5.6%)	0	1(1.9%)	10.599	6	0.102
	Less priority	11(44%)	2(11.1%)	1(10%)	14(26.6%)			
	Priority	12(48%)	10(55.6%)	7(70%)	29(54.7%)			
	High priority	2(8%)	5(27.8%)	2(20%)	9(17%)			

Table 10 continued

Collaboration skills	Least priority	-	-	-	-	9.210	4	0.056
	Less priority	14(56%)	11(61.1%)	4(40%)	29(54.7%)			
	Priority	11(44%)	7(38.9%)	4(40%)	22(41.5%)			
	High priority	0	0	2(20%)	2(3.8%)			
Communication skills	Least priority	0	1(5.6%)	2(20%)	3(5.7%)	8.445	6	0.207
	Less priority	13(52%)	10(55.6%)	3(30%)	26(49.1%)			
	Priority	10(40%)	7(38.9%)	5(50%)	22(41.5%)			
	High priority	2(8%)	0	0	2(3.8%)			

There is no significant difference in priority among teachers with different age. Teachers reported they prioritized CI, CT, PS over other skills (Collaboration and Communication skills), SC, and SP.

Table 11

Analysis the Association between Teacher's Priority and Gender

Objective		Gender		Total	X^2	df	*p*-value
		Male	Female				
Science content	Least priority	5(25%)	3(9.1%)	8(15.1%)	3.233	3	0.357
	Less priority	12(60%)	21(63.6%)	33(62.3%)			
	Priority	3(15 %)	8(24.2%)	11(20.8%)			
	High priority	0	1(3%)	1(1.9%)			
Science process	Least priority	0	1(3%)	1(1.92%)	5.008	3	0.171
	Less priority	14(70%)	16(48.5%)	30(56.6%)			
	Priority	5(25%)	16(48.5%)	21(39.6%)			
	High priority	1 (5%)	0	1(1.9%)			
Creativity & Innovation	Least priority	-	-	-	1.137	2	0.566
	Less priority	3(15%)	9 (27.3%)	12(22.6%)			
	Priority	14(70%)	19(57.6%	33(62.3%)			
	High priority	3(15%)	5(15.2%)	8(15.1%)			
Critical thinking	Least priority	-	-	-	2.356	2	0.308
	Less priority	5(25%)	14(42.4%)	19(35.8%)			
	Priority	13(65%)	18(54.5%)	31(50.5%)			
	High priority	2(10%)	1(3%)	3(5.7%)			
Problem solving	Least priority	0	1(3%)	1(1.9%)	8.043	3	0.045
	Less priority	5(25%)	9(27.3%)	14(26.6%)			
	Priority	8(40%)	21(63.6%)	29(54.7%)			

Table 11 continued

	High priority	7(35%)	2(6.1%)	9(17%)			
Collaboration skills	Least priority	-	-	-			
	Less priority	11(55%)	18(54.5%)	29(54.7%)	0.146	2	0.930
	Priority	8(40%)	14(42.4%)	22(41.5%)			
	High priority	1(5%)	1(3%)	2(3.8%)			
Communicati on skills	Least priority	3(15%)	0	3(5.7%)			
	Less priority	8(40%)	18(34%)	26(49.1%)	5.633	2	0.131
	Priority	8(40%)	14(42.4%)	22(41.5%)			
	High priority	1(5%)	1(3%)	2(3.8%)			

There is no significant difference in priority among teachers with different gender in prioritizing SP and the skills except for problem solving. 35% of male teachers reported highly prioritized problem solving, $\chi 2$ (3) =8.043, p 0.045 at $\alpha = 0.05$, φ=0.390. Teachers reported they prioritized CI, CT, PS over other skills (Collaboration and Communication skills), SC, and SP.

Table 12

Analysis the Association between Teacher's Priority and Professional Certification

Objective		Professional Certification		Total	X^2	df	p-value
		Yes	No				
Science content	Least priority	6(22.2%)	2(7.7%)	8(15.1%)			
	Less priority	17(63%)	16(61.5%)	33(62.3%)	3.831	3	0.280
	Priority	4(14.8 %)	7 (26.9 %)	11(20.8%)			
	High priority	0	1(3.8%)	1(1.9%)			
Science process	Least priority	1(3.7%)	0	1(1.92%)			
	Less priority	16(59.3%)	14(53.8%)	30(56.6%)	2.544	3	0.467
	priority	9(33.3%)	12(46.2%)	21(39.6%)			
	High priority	1 (3.7%)	0	1(1.9%)			
Creativity & Innovation	Least priority	-	-	-			
	Less priority	6(22.2%)	6 (23.1%)	12(22.6%)	5.241	2	0.073
	Priority	14(51.9%)	19(73.1%)	33(62.3%)			
	High priority	7(25.9%)	1(3.8%)	8(15.1%)			
Critical thinking	Least priority	-	-	-			
	Less priority	8(29.6%)	11(42.3%)	19(35.8%)	1.595	2	0.450
	Priority	18(66.7%)	13(50%)	31(50.5%)			
	High priority	1(3.7%)	2(7.7%)	3(5.7%)			

Table 12 continued

Problem solving	Least priority	0	1(3.8%)	1(1.9%)	4.938	3	0.176
	Less priority	5(18.5%)	9(34.6%)	14(26.6%)			
	Priority	15(55.6%)	14(53.8%)	29(54.7%)			
	High priority	7(25.9%)	2(7.7%)	9(17%)			
Collaboration skills	Least priority	-	-	-	2.016	2	0.365
	Less priority	14(51.9%)	15(57.7%)	29(54.7%)			
	Priority	11(40.7%)	11(42.3%)	22(41.5%)			
	High priority	2(7.4%)	0	2(3.8%)			
Communication skills	Least priority	3(51.9%)	0	3(5.7%)	5.319	3	0.150
	Less priority	14(57.9%)	12(46.2%)	26(49.1%)			
	Priority	10(37%)	12(46.2%)	22(41.5%)			
	High priority	0	2(7.7%)	2(3.8%)			

There is no significant difference in priority among teachers with different professional certification status. Teachers reported they prioritized CI, CT, PS over other skills (Collaboration and Communication skills), SC, and SP.

Table 13

Analysis the Association between Teacher's Priority and Educational background

Objective		Educational background			Total	X^2	df	*p*-value
		BA science education	BA non-science education	Master degree				
Science content	Least priority	4(14.3%)	2(11.8%)	2(25%)	8(15.1%)	3.859	6	0.696
	Less priority	16 (57.1%)	11(64.7%)	6(75%)	33(62.3%)			
	Priority	7 (25%)	4(23.5%)	0	11(20.8%)			
	High priority	1(3.6%)	0	0	1(1.9%)			
Science process	Least priority	1(3.6%)	0	0	1(1.92%)	6.986	6	0.322
	Less priority	15(53.6%)	11(64.7%)	4(50%)	30(56.6%)			
	Priority	12(42.9%)	6(35.3%)	3(37.5%)	21(39.6%)			
	High priority	0	0	1(12.5%)	1(1.9%)			
Creativity & Innovation	Least priority	-	-	-	-	9.187	4	0.057
	Less priority	7(18.4%)	5(29.4%)	2(25%)	12(22.6%)			
	Priority	23(60.5%)	8(47.1%)	3(37.5%)	33(62.3%)			
	High priority	8(21.1%)	4(23.5%)	3(37.5%)	8(15.1%)			
Critical thinking	Least priority	-	-	-	-	2.936	4	0.569
	Less priority	10(35.7%)	6(35.3%)	3(37.5%)	19(35.8%)			

Table 13 continued

	Priority	15(53.6%)	11(64.7%)	5(62.5%)	31(50.5%)			
	High priority	3(10.7%)	0	0	3(5.7%)			
Problem solving	Least priority	0	1(5.9%)	0	1(1.9%)			
	Less priority	7(25%)	6(35.3%)	1(12.5%)	14(26.6%)	4.502	6	0.609
	Priority	17(60.7%)	7(41.2%)	5(62.5%)	29(54.7%)			
	High priority	4(14.3%)	3(17.6%)	2(25%)	9(17%)			
Collaboration	Least priority	-	-	-	-			
skills	Less priority	17(60.7%)	7(41.2%)	5(62.5%)	29(54.7%)	5.081	4	0.279
	Priority	10(35.7%)	10(58.8%)	2(25%)	22(41.5%)			
	High priority	1(3.6%)	0	1(12.5%)	2(3.8%)			
Communication	Least priority	2(7.1%)	0	1(12.5%)	3(5.7%)			
skills	Less priority	14(50%)	8(47.1%)	4(50%)	26(49.1%)	2.448	6	0.874
	Priority	11(39.3%)	8(47.1%)	3(37.5%)	22(41.5%)			
	High priority	1(3.6%)	1(5.9%)	0	2(3.8%)			

There is no significant difference in priority among teachers with different educational background. Teachers reported they prioritized CI, CT, PS over other skills (Collaboration and Communication skills), SC, and SP.

Corresponding Author Contact Information:

Author name: Esty Haryani

University, Country: Western Michigan University, USA

Email esty.haryani@wmich.edu

Please Cite: Haryani, E., Cobern, W. W. & Pleasants, B. A-S. (2019). Indonesia Vocational High School Science Teachers' Priorities Regarding 21st Century Learning Skills in Their Science Classrooms. *Journal of Research in Science, Mathematics and Technology Education*, *2*(2), 105-133. doi: 10.31756/jrsmte.224

Received: April 1, 2019 ▪ Accepted: May 9, 2019