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Assessing Teachers' Readiness in Implementing The 21st Science Teaching Pedagogical Practice: A Cross-Sectional Study in West Kalimantan-Indonesia

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ABSTRACT
This cross-sectional survey was conducted to assess the level of readiness in implementing 21st century science teaching pedagogical practices among primary, secondary, and high school teachers in West Kalimantan-Indonesia. A total of 365 teachers was drawn as sample consisting of 180 primary, 120 secondary, and 65 senior high school teachers. To assess the teachers' readiness level by using a Likert scale questionnaire. Based on data analysis, the findings of this research were: (1) The readiness level of implementation of science teaching pedagogical practices by teachers was in moderate category; (2) The level of readiness of senior high school was better than primary and secondary school teachers, the female was better than male teacher, and the senior was better than junior teacher. The supporting and inhibiting factors came from the content, environment, learning materials, teachers, and students. Innovative learning models based on Information and Communication Technology (ICT) need to be continued to build teacher professionalism skills in implementing meaningful science teaching pedagogy in schools.

INTRODUCTION

Due to rapid changes in the economic sector, information and communication technology, and the world of work, the education system in many countries in the world is experiencing changes [1] [2]. These changes need to be anticipated to adapt to future learning needs and students' abilities to be able to solve problems in their daily lives. The aim of formal education is not only directed at creating skilled and qualified workers, scientists from various scientific disciplines, but also training and improving critical thinking skills [3] which it is hoped will become quality and competitive citizens. Until now, the formal education process at the elementary to higher education levels in many developing countries, including Indonesia, is still considered necessary to make it more relevant to students' daily lives [4]. In the learning and teaching process in many countries, students are burdened with many learning activities to remember various factual knowledge. Many students felt that the teaching material taught by teachers at school is abstract, irrelevant and meaningless. Teachers often do not consider students' prior knowledge and rarely train higher-order thinking skills [5] [6].

To anticipate students' needs to be able to face various future demands, teacher must change the teaching pedagogical paradigms in their teaching and learning processes that align with 21st century learning, teachers should; (1) develop ability to solve problem; (2) train skills of higher order thinking: (3) cultivate collaborative learning; (4) apply approach of technological-pedagogical content knowledge; (5) develop or choose appropriate learning media; (7) reflect their teaching activities; (8) implement project based learning; (9) use authentic assesments ; (10) encourage transfer of learning; (11) teach how to 'learn to learn' or metacognition; (12) correct misunderstanding directly; (13) increase students' creativity and originality ; (14) use metacognitive approach [1] [2] [3] [7] [8] that can be extracted as shown in Figure 1.

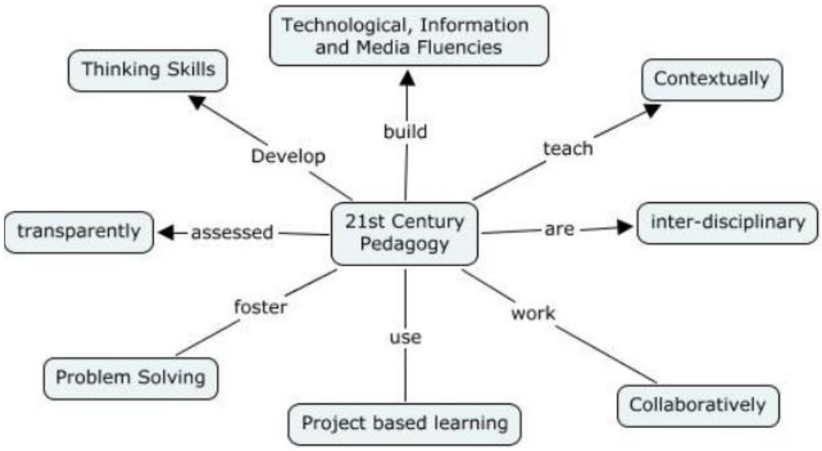

Fig 1. *21th Pedagogical Practicem* [9]

In the Independent Curriculum (*Kurikulum Merdeka*), it is stated that teacher should apply well the five principles of teaching and learning activities in teaching and learning. Learning should be designed to: (1) consider the current stage of development and level of achievement of students according to learning needs, and reflects the characteristics and development of diverse students so that learning becomes meaningful and enjoyable; (2) implement to build capacity to become lifelong learners; (3) support the development of students' competencies and character holistically; (4) be relevant to the context, environment and culture of students, and involves parents and the community as partners; and (5) align to a sustainable future [9].

Based on the frameworks and the principles of the implementation of Independent Curriculum (*Kurikulum Merdeka*) as mentioned above, I extracted them into 8 (eight) principles that relevant to science learning, they are: higher order thinking skills, project-based learning, reflection, collaborative skills, authentic assessment, problem solving, technology, and knowledge construction. In this study, the implementation of these principle will be assessed by using the questionnaire. Science teaching skills and pedagogical practices as mentioned above must be prepared to help students face the real needs of the future. Efforts to promote the pedagogical practices will require redesigning the many interrelated components of the education system. Any government educational policies and efforts to improve the quality of Indonesian education, they should be based on the form of micro-scale improvement-based classrooms that mainly involve teachers in schools [10]. Educational change depends on what teachers do and think [11] [12].

Teachers are the ones who exert the first formal education influence on children. Teacher plays a very important role for the development of learning [12]. Research on in-service teachers had shown that many teachers felt uncomfortable teaching science or they were not prepared to teach it due to low confidence in science [13]. Research has also shown that teachers with low efficacy might avoid teaching science [14] or used a didactically unattractive approach [11]. Given the importance of teachers in schools (primary and secondary education), possessing 21st century teaching pedagogical practice skills, assessing the readiness of teachers for these skills has been the focus of much research. Wei & Othman [9], for instance, investigated 21st century teaching and learning practices in five primary schools involving 92 teachers in Kuching-Sarawak. They concluded that the overall average score of the teaching and learning practices of 21st century teachers was 3.22 in the sufficient category. Another previous study [15] had conducted research on the views and perceptions of Turkish primary school pre-service teachers on 21st teaching pedagogical skills in lifelong learning (LLL) skills. Demirel et al [16] found that pre-service teachers did not have sufficient knowledge or awareness about the LLL. This study found that there were significant differences between male and female teacher candidates' perceptions of the LLL.

Studies of expertise in carrying out pedagogical practices are mostly in the form of comparisons of novice-expert teachers (senior versus junior). The study conducted by Sohani et al [19], for example, involved 18 novice and 18 experienced English teachers in Iran, using a Likert scale teacher questionnaire, found that self-efficacy for classroom management differed, but not in efficacy for personal teaching and external influences. Based on his study, Firman [20] concluded: (1) In teaching, beginners and experienced have the same target concept according to the content of the chemistry curriculum; (2) Novice teachers tend to use more modes of knowledge transmission in teaching where explicit knowledge is told directly to students; and (3) Novice teachers use limited and poor illustrations and analogies after sharing explicit knowledge. Overall, the class is more passive and deductive. It has been established that experienced teachers differ from novice teachers in their knowledge, skills, and beliefs [18]. Therefore, it can be concluded that they also differ from novice teachers in their professional development needs. Furthermore, the recent survey research involved amount of 120 public elementary school teachers in Pontianak concluded; (1) as many as 9.2% of teachers stated "never and rarely" practice 21st century science teaching pedagogical, amount of 20.0% said "often", and the remaining 70.8% said "sometimes"; and (2) there is no significant difference between the performance of experienced teachers and novice teachers in implementing 21st century science teaching pedagogical practices [19].

Although many researchers and education experts agreed on important issues to improve the quality of teacher teaching in developing student skills and 21st century science pedagogical practices, the readiness level of implementation in Indonesia, especially in West Kalimantan, remains questionable. There are still few empirical studies that assess the practice of teachers at all levels of school (primary, secondary, and senior high school) with an analysis of the supporting and inhibiting factors. Research that analyzes differences in the level of readiness for implementing 21st century science teaching pedagogical practice in terms of gender and teacher status (senior and junior) has not been extensively carried out. Therefore, this research is considered quite rational.

The focus of the problem in this study: "What is the profiles of readiness level of implementation of science learning pedagogical practices and their aspects by primary, secondary, and senior high school teachers in West Kalimantan-Indonesia?". Specifically, the research questions are: (1) Is there different the readiness level of implementation of 21st century science learning pedagogical practices in terms of school levels, gender, and teacher status (senior and junior)?

METHOD

This study applied a cross-sectional survey method [23]. The target population of this study were primary, secondary, and senior high school science teachers at public schools in Westkalimantan. There were seven districts involved in this study, namely; Pontianak, Singkawang, Sambas, Ketapang, Mempawah, Sintang, and Kubu Raya. The sample of this research will be taken using multistage random sampling technique [24] by considering the district, the geographical location, and the level of the school. A total of 365 teachers consisting of 180 primary, 120 secondary, and 65 senior high school teachers who were teaching in academic year 2020/2021.

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To assess the readiness level of implementation of 21st century science learning pedagogical practices and their aspects, this study used a Likert Scale questionnaire with a range of "score 1: *Never*, score 2: *Seldom*, score 3: *Sometimes*, score 4: *Often*, and score 5: *Always*, adopting Wei & Othman [9] by adding supporting and inhibiting factors. This questionnaire was developed based on the pedagogical aspects of 21st century learning, which consists of 8 (eight) aspects, namely; (i) high order thinking skills, (ii) project-based learning, (iii) reflection, (iv) collaborative skills, (v) assessments, (vi) problem solving, (vii) technology, and (viii) construction of knowledge/skills.

The blueprint and the reliability coefficient of this research questionnaire--which has been tested on as many as 45 school teachers in Pontianak City who were not involved in this study, shows that the questionnaire reliability coefficient (all aspects of the pedagogical construct of 21st science teaching pedagogical) tested with "Cronbach Alpha" is 0.69 (in the category of quite feasible to use) as shown in Table 1.

Table 1. Construct of the 21st Century Science Pedagogical Practices and Its Cronbach Alpha Reliability Coefficients

Construct of 21th Century Science Pedagogical Practices	Item	Number of items	Reliability Coefficients
High level thinking skills	1. 2. 3. 4. 5	5	0.66
Project-based learning	6. 7. 8. 9	4	0.77
Reflection	10. 11. 12. 13	4	0.73
Collaborative skills	14. 15. 16. 17	5	0.74
Assessments	19. 20. 21. 22. 23. 24	6	0.69
Problem solving	25. 26. 27. 28.29	5	0.61
Technology	30. 31. 32 .33	5	0.66
Construction of skills	34. 35. 36. 37	4	0.67
Total		**37**	**0.69**

The numeric data collected through this research questionnaire is considered to be on an interval scale. Therefore, if the assumptions of normality are met, the data analysis uses parametric statistics. The details of the data analysis in this study are as follows: (1) To find out the profiles of the readiness level of implementation of 21st century science learning pedagogical practices by primary, secondary, and senior high school science teachers, the data were analyzed by using a simple percentage technique; (2) To test whether there are differences in the level of readiness to apply 21st century science learning pedagogical practices in terms of the three school levels, the data were analyzed by using one-way anova (F-test); (3) To test whether there are differences in the level of implementation in terms of gender and teacher status, the data were analyzed by using independent samples t-test ; and (4) To find out the supporting and inhibiting factors felt by teachers in schools to implement 21st century science learning pedagogical practices, the teacher's responses will be grouped qualitatively and presented in the form of percentages. The classification of the level of implementation of 21st century science learning pedagogical practices in this study was interpreted using Table 2. Based on Table 2 , if the total mean of each aspect of indicators is in the mean interval 1.00-2.33, then its classification of readiness level is low. Similarly, the mean interval 2.34-3.67, its classification of readiness level is moderate, and the mean interval 3.68-5.00, its level classification is high. The data analysis is conducted by using SPSS program.

Table 2. Classification of Implementation Readiness Levels of 21st Century Science Teaching Pedagogical Practice

Mean Interval	Implementation Level
1.00 – 2.33	Low
2.34 – 3.67	Moderate
3.68 – 5.00	High

RESULTS AND DISCUSSIONS

The Implementation Profiles of 21st Century Science Teaching Pedagogical Practice

To find out the profile of the implementation level of 21st century science learning pedagogical practices by primary, secondary, and senior high school science teachers the data were analyzed by using simple percentage calculations and descriptive statistics on means and the results were grouped into three implementation categories. An example of data analysis to calculate the average score of the implementation of the Higher Order Thinking Skills (HOT) aspect of indicator 1 is presented in Table 3. Based on the data analysis carried out, the profiles of readiness level in implementing the 21st century science learning pedagogical practices in terms of the average score is presented in Table 3.

Table 3. Profiles of the Implementation Readiness Levels

No.	Aspects	Indicators	Mean	Category
1	High level thinking skills (HOT)	Planning HOT skills in lesson plans and when interacting with students in class	2.11	low
		Using high-level questions and questions when learning and interacting in class	2.15	low
		Guiding students to ask and answer higher order thinking questions and questions (HOTs)	2.17	low
		Using tools/media that can stimulate HOTs in classroom learning	2.11	low
		Teaching and modeling higher order thinking skills in class in solving problems/tasks	2.16	low
		Total mean of aspect 1	**2.14**	**low**
2	Project-based learning	Giving assignments based on PjBL to students	2.20	Low
		Encouraging students to work together on projects	2.33	Low
		Ensuring student assignments use a multi-disciplinary approach and skills (lessons)	2.15	Low
		Encouraging students to apply appropriate technology when implementing PjBL	2.15	Low
		Total mean of aspect 2	**2.21**	**Low**
3	Reflection	Asking students to write down their reflections and feedback correctly to improve the next learning	2.74	Moderate
		Encouraging students to convey or write down their level of understanding or things they think are difficult about the teaching material after learning	2.15	Moderate
		Requesting and obtaining feedback from colleagues (colleagues) on the learning practices that have been carried out in class	2.78	Moderate
		Writing feedback from peers for improvement of further learning practices	2.74	Moderate
		Total mean of aspect 3	**2.61**	**Moderate**
4	Collaborative skills	Collaborating with peers to develop professional learning communities (groups)	2.36	Moderate
		Encouraging students to use various social media to interact in learning	2.41	Moderate
		Adopting and applying Lesson Study to improve professionalism in teaching	2.86	Moderate
		Using effective communication skills	2.56	Moderate
		Total mean of aspect 4	**2.46**	**Moderate**

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No.	Aspects	Indicators	Mean	Category
5	Assessments	Using a collaborative approach in the teaching and learning process	2.56	Moderate
		Conducting assessments based on student work or performance (authentic assessment)	3.31	Moderate
		Focusing on judgment based on higher order thinking	2.74	Moderate
		Encouraging students to self-evaluated	2.56	Moderate
		Involving students to conduct peer assessment	2.67	Moderate
		Providing an assessment according to the ability or achievement of students	3.10	Moderate
		Providing direct feedback (either individual or classical) on student work	3.22	Moderate
		Total mean of aspect 5	**2.88**	**Moderate**
6	Problem solving	Practicing and modeling clearly teaching through a problem-solving approach	3.20	Moderate
		Connecting the topics taught to everyday life problems (contextual)	3.05	Moderate
		Encouraging and guiding students to use various strategies in problem solving	3.11	Moderate
		Guiding students to solve given problems related to everyday life	3.07	Moderate
		Using a teaching method or model that uses ICT, not always lecture (traditional model)	3.09	Moderate
		Total mean of aspect 6	**3.10**	**Moderate**
7	Technology	Encouraging students to use appropriate technology to prepare for learning and training	3.09	Moderate
		Encouraging students to use social media (internet, handphone, laptop) to interact in learning	3.16	Moderate
		Using appropriate and easy-to-use software during interactions	3.00	Moderate
		Using online learning e.g e-books, e-videos, e-learning, and others	2.88	Moderate
		Total mean of aspect 7	**3.03**	**Moderate**
8	Construction of skills	Familiarizing students with using information-based skills (from journals, radio, newspapers, magazines, tv, internet)	2.73	Moderate
		Familiarizing students with using media-based skills and learning aids/visual aids	2.95	Moderate
		Familiarizing students with technology-based skills (computers, scientific calculators etc.)	2.88	Moderate
		Familiarizing students to use reflection-based skills for teacher and self-improvement	2.73	Moderate
		Total mean of aspect 8	**2.82**	**Moderate**

From Table 3, the results indicated that the profiles of the implementation level of 21st century science learning pedagogical practices in terms of the average score is 2.68 (the category is classified as moderate). Furthermore, the profiles of the implementation based on the frequency of statement responses as presented in Table 4.

Table 4. Profiles of the Implementation Level Based on Response Frequency

No.	Aspects of Teaching Pedagogical Practices	Never f(%)	Seldom f(%)	Sometime f(%)	Often f(%)	Always f(%)
1	High level thinking skills (HOT)	685 (38%)	623 (34%)	300 (16%)	206 (11%)	10 (1%)
2	Project-based learning	497 (34%)	485 (33%)	291 (20%)	176 (12%)	11 (1%)
3	Reflection	221 (15%)	367 (25%)	480 (33%)	274 (19%)	63 (4%)
4	Collaborative skills	416 (28%)	409 (28%)	376 (26%)	227 (16%)	39 (3%)
5	Assessments	685 (19%)	623 (23%)	300 (29%)	206 (25%)	10 (3%)
6	Problem solving	231 (13%)	320 (18%)	554 (30%)	547 (30%)	173 (9%)
7	Technology	172 (11%)	285 (20)	483 (33%)	424 (29%)	96 (7%)
8	Construction of skills	217 (14%)	396 (26%)	507 (35%)	325 (22%)	37 (3%)

In this study, the respondents' response to each statement is "*often*" and "*always*", as assumed as "*Has Implemented*", and "*never*" and "*seldom*" is assumed as "*Not Implemented*". So, the results of this study are the profiles of the implementation level of 21st century science learning pedagogical practices in terms of the frequency of teacher responses is 12.50% have implemented, 33.50% have not implemented yet, and the remaining 54.00% sometimes implement it.

This finding is in line with the research of Wei & Othman [9] which concluded that 21st century teaching and learning practices in five elementary schools involving 92 teachers in Kuching-Sarawak showed the overall average score is 3.22 in the moderate category. Djudin's survey [22] involved 120 public elementary school teachers in Pontianak concluded; (1) amount of 9.2% of teachers stated "never and rarely" practice 21st century science teaching pedagogy, 20.0% stated "often", and the remaining 70.8% stated "sometimes", and (2) there is no significant difference between the performance of experienced teachers and novice teachers in implementing 21st century science teaching pedagogical practices.

According to Saavedra & Opfer [5], implementation of 21st century science learning skills and pedagogy can be summarized into nine points as follows.

First, make curriculum relevant. To be effective. whatever the curriculum should be relevant to student life. *Second*, teaching through scientific disciplines. Learning through a discipline requires learning not only knowledge of the discipline but also skills related to the production of knowledge within the discipline. Through a curriculum of disciplines and instruction students must learn why discipline is important, how experts create new knowledge, and how they communicate about it.

Third, collaboratively develop higher order thinking skills. Low level exercises are quite common in the existing curriculum, while higher order thinking activities are much less common. Higher-order thinking tends to be difficult for students because it requires them not only to understand the relationships between different variables (low-level thinking), but also how to apply—or transfer—that understanding to new, uncharted contexts (higher-order thinking).

Fourth, encourage transfer of learning. Students must apply the skills and knowledge they have acquired in one discipline to another. They must also apply what they learn in school to other areas of their lives. This application — or transfer — can be a challenge for students (and for adults too).

Fifth, teach students to "*learn how to learn*". There is a limit to skills, attitude, and the disposition that students can learn through formal schooling. Therefore, educating them for the 21st century requires teaching them how to learn on their own. To do so, students must be aware of how they learn. Teachers can develop students' metacognitive capacity by encouraging them to explicitly examine how they think. It is also important for students to develop positive mental models of how we learn, our learning limits, and indication of failure.

Sixth, direct identification of misconceptions. Learners have many misconceptions about how the world works, and they hold on to these misconceptions until they have had a chance to construct alternative explanations based on experience. To overcome misconceptions, learners need to actively build new understanding.

Seventh, promote teamwork as a process and an outcome. Students should discuss concepts in pairs or groups and share what they understand with the whole class. They might develop their arguments and debates. *Eighth*, take full advantage of technology to support learning. Technology offers the potential to give students new ways to develop their problem solving, critical thinking, and communication skills, transfer them to a different context, reflect on their thinking and that's their comrades, practice overcoming their misunderstandings, and collaborate with colleagues—all on topics relevant to their lives and using interesting tools.

Differences of The Readiness Level of Implementation

1. *Among primary, secondary, and senior high school*

The mean value of the three groups, standard deviation, the results of the data normality test using the Kolmogrov-Smirnov, and the variance similarity test using the Lavene test showed results as shown in Table 5.

Table 5. Descriptive Statistics between Groups

School level	N	Mean	SD	Significancy of normality	Data Distribution	Significancy of Homogenity
Primary	180	2.48	0.47	0.119*	Normal	0.095*
Secondary	120	2.62	0.44	0.127*	Normal	(equal variance)
Senior	65	2.94	0.34	0.106*	Normal	
Total	365	2.68	0.46	0.201*	Normal	

* sig > 0.05

With the fulfillment of the assumption of data normality and variance similarity, as shown in Table 5, the analysis of the different levels of readiness for implementing 21st century science learning pedagogical practices between three school levels uses *One-way anova* inferential parametric statistics. The results of the analysis of the differences between the school levels are presented in Table 6.

Table 6. Result of Anova Analysis

	Implementation Level				
	Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	4.021	2	2.010	11.581	0.000*
Within Groups	18.227	364	0.174		
Total	22.248	365			

* sig < 0.05

From Table 6, it is known that p (0.000) < 0.05, then Ho is rejected. The conclusion is that there is a significant difference in the level of implementation of 21st century science learning pedagogical practices by elementary school teachers, secondaryschool. and senior high school in West Kalimantan. Because of there is a difference, the analysis must be continued using the post-hoc analysis (*Scheffe-test*) whose results are presented in Table 7.

Table 7. Result of Post-Hoc Analysis

School Level	Mean Difference (I-J)	Sig.	95% Confidence Interval	
Primary (SD)	(SD-SMP) = -0.1419	0.355		
Secondary (SMP)	(SD-SMA) = -0.4613*	0.000*	-0.3858	0.1019
Senior (SMA)	(SMP-SMA) = -0.319*	0,006*	-0.7052	-0.2175

* sig < 0.05

From Table 7, it can be concluded:

1. There is no difference in the readiness level of implementation of 21st century science learning pedagogical practices by teachers in West Kalimantan between primary and secondary school ($p = 0.355 > 0.05$).
2. There is a significant difference in the readiness level of implementation of 21st century science learning pedagogical practices by teachers in West Kalimantan between primary and senior high school ($p = 0.000 < 0.05$).
3. There is a significant difference in the readiness level of implementation of 21st century science learning pedagogical practices by teachers in West Kalimantan between primary and senior high school ($p = 0.006 < 0.05$).

These differences might occur due to several factors, e.g characteristics of science teaching materials, and mastery of teaching materials, and teacher challenges. Science teaching materials at the primary level are generally presented verbally (declaratively). The use of mathematical formulas and calculations (quantitatively) has not been much found in science teaching materials in primary schools. Besides that, teaching material in primary school is still an integration of biological material, physics, and chemistry. At the senior high school level, the use of mathematical formulas and calculations has been introduced. At the senior high school level, science teaching materials have been separated into physics, chemistry, and biology which requires an understanding of the concepts and principles of science in the context of everyday life. Science teachers in high school are required to have good basic math skills.

Therefore, teachers' ability to master science teaching materials at the high school level should be better than primary and secondary school teachers. The challenges for teachers to be able to teach high school science teaching materials are certainly more numerous and complex than the challenges of teaching science at the primary and senior high school levels. The use of science and technology learning media in high school is more varied. Scientific experiments related to scientific concepts and principles are increasing. This challenge will be felt by the teacher when it is associated with the characteristics of senior high school students, and the number of students who feel uninterested, unmotivated, and do not have adequate mathematical skills. However, whatever level of teacher, every science teacher is required to be able to teach science teaching material so that it is easier to understand, makes more sense, and felt more useful for students.

According to Stinner [25], to generate a powerful science learning, teachers need to pay attention to the three interrelated areas, namely; (1) logical plane; (2) evidential or experimental plane; and (3) psychological plane. These three areas support the creation of successful learning. A brief description of these three areas is presented as follows.

First, logical plane implies that learning must contain scientific scientific products (eg facts, concepts, principles, laws, theories, models) which are universally agreed upon by scientists. In this context, textbooks play the role of pedagogic vehicles for the appreciation of normal science. Textbook-centered science teaching will emphasize mastery of scientific products. Students will be trapped in learning activities to "memorize" the product of science. Students see little connection between experiences and concepts they learn from textbooks. As a result, learning effectiveness is seen from the extent to which students can memorize science products and complete exercises using various mathematical formulas. To connect logical plane and evidential plane, a teacher must need to raise the question "*operations that connect the concepts learned by students with student experiences or* *everyday events*". The answers to these questions will determine the science study undertaken to help students master concepts and relate them to student experiences.

Second, the evidential plane implies that learning should also include learning activities that connect and support science products in the world of student experience. learning activities that include the implementation of experiments or simple demonstrations, which can be initiated by the teacher or the student. By carrying out this experimental activity, students are expected to be able to give meaning to various symbolic generalizations (formulas) in various contexts. The question that needs to be answered on the evidential plane is: "*What are the reasons for believing that ...*", with this question, the teacher should look for evidence that "makes sense" to students. The second question is: "*What are the various relationships of the concept*?". Accuracy needs to be made to demonstrate that a concept is valid when used in areas that appear to be different from scientific inquiry. Further. the more different relationships the teacher can create, the stronger the concept is in the student's memory.

Third, the psychological plane implies that teachers need to consider various students' initial conceptions and mastery of science concepts from the previous school level. The activity of identifying students' initial conceptions needs to be done by the teacher. Textbooks, in general, rarely pay attention to students' initial conceptions. As a result, textbook-oriented teachers tend not to pay attention to how these students' initial conceptions interact with the concepts they teach.

In compliance with teachers' readiness in implementing science teaching pedagogy, Rogan & Mosha [29] argued that the effectiveness of the teacher depends on her competence (academically and pedagogically), efficiency (ability, workload, and commitment), teaching and learning resources and methods, and support from education administrators and supervisors. Teacher professional development programs seem to provide opportunities for teachers to look for new roles, develop new instructional techniques, and improve themselves both as educators and as individuals. In Gender's view [30], the professional developments included formal experiences such as attending workshops, participating in professional meetings, and mentoring and informal experiences such spreading professional publications, watching television documentaries related to a discipline.

2. *Between Male and Female Teacher*

The number of male teachers is 124 (mean = 2,546, SD = 0.451) and the number of female teachers is 241 (mean = 2.828, SD = 0.404). The data of both groups were normal (sig = 0.12 and sig = 0.200) and indicate homogeneous variance (sig = 0.024). The different level of readiness for implementing 21st century science learning pedagogical practices between male and female groups using independent sample *t*-test and the results are presented in Table 8.

Table 8. Result of independent sample t- test

Gender	N	Mean	SD	t	sig
Male	124	2.546	0.451	-6.061	0.000*
Female	241	2.828	0.404		

* sig < 0.05

Table 8 showed that p (0.000) < 0.05. then Ho is rejected. The conclusion is that the level of readiness for the implementation of 21st century learning pedagogical practices by female is higher than that of male teachers.

This finding is in line with the study by Demirel et al [18] which concluded that there is a significant difference between the perceptions of male and female teacher candidates about 21st century learning pedagogical practices. Some forms of teacher treatment differ by sex starting in the early grades of elementary school and continuing into college Teachers tend to discipline boys more and give them more praise and feedback than girls. They praise the work of girls mostly for physical appearance, like neatness, cleanliness, or artistic quality. In subjects such as language arts and arts, girls receive more teacher interaction than boys because these subjects are considered "feminine". In high school and college, male students are still more likely to take courses such as advanced mathematics, science, and techniques than female students, which affects the percentage of women entering the profession. Gender stereotypes are one of the obstacles that make education a dream for many individuals. Gender bias in society sometimes limits people from achieving their dreams because they conform to social norms, certain positions are not suitable for every gender [19] [20] [27].

3. Between Senior and Yunior Teacher

In this study, a senior teacher is who has more than 15 years working period, and junior teacher is who has less than or equal 15 years working period. The number of senior teachers is 193 (mean = 2.861, SD = 0.334) and the number of junior teachers is 172 (mean = 2.503, SD = 0.435). The data of both groups were normal (sig = 0.289 and sig = 0.302) and had homogeneous variance (sig = 0.028). The different levels of readiness for implementing 21st century science learning pedagogical practices between senior teachers and junior teachers using independent sample t-test and the results are presented in Table 9.

Table 9. Result of independent sample t- test

Teacher status	N	Mean	SD	T	sig
Senior	193	2.861	0.334	6.394	0.000*
Yunior	172	2.503	0.435		

* sig < 0.05

Table 9 showed that p (0.000) < 0.05, then Ho is rejected. The conclusion is that the level of readiness for implementing 21st century learning pedagogical practices by teachers with senior status is better than juniors.

The findings of this study are in line with the study of Atik-Kara & Kurum [17] which found that the views and perceptions of pre-service (junior) primary school teachers in Turkey about lifelong learning skills were sufficient. Firman [18] concludes; (1) In his teaching, beginner and experienced teachers have the same target concept according to the content of the chemistry curriculum; (2) Novice teachers tend to use more modes of knowledge transmission in teaching where explicit knowledge is told directly to students; and (3) Novice teachers use limited and poor illustrations and analogies after sharing explicit knowledge. Overall, class is more passive and deductive. It was also found that experienced teachers differed from novice teachers in knowledge, skills, and their beliefs. Therefore, it can be concluded that they also differ from novice teachers in their professional development needs [22] [28].

Knowledge of the characteristics of experts (experienced teachers, senior teachers) and beginners (junior teachers) has implications for developing and assessing their pedagogical practice. Because the specific perspectives in the literature on the difference between expert and novice vary from domain to domain. Some generalizations across domains can be made. According to Sohani et al [19], experts (senior teachers) have more knowledge and a more organized knowledge structure in their domain than novices (juniors). The process by which they solve problems and complete tasks in their domain of expertise is also different. They also asserted that skilled performance and experience alone are not enough to become an expert. Individuals must be able to go beyond mastery and contribute their creative ideas and innovations to the task at hand. It takes several years of practice and experience to gain routine behavior and full automaticity. Experts should be encouraged to obtain a high level of performance control that allows further improvements to be made.

In line with the theories of expertise, I summarize the characteristics of expertise (expertise), as follows; (1) has a large and well-developed knowledge base that enables fast and accurate performance in routine situations; (2) in more complex situations, they can apply their knowledge flexibly when trying to understand a situation and decide on further actions; (3) have developed a rich and coherent knowledge structure that allows direct access to knowledge, strategy, skills. and relevant control mechanisms; (4) reflect, monitor, and carefully adapt their performance in sustainable processes and outcomes that can be improved; (5) accommodate their knowledge and skills through study, practice and experience; and (6) enhance learning from their experiences by seeking feedback, clear, experts have more knowledge and a more organized knowledge structure in their domain than beginners. Finally, keep in mind that becoming an expert requires an individual's motivation to improve his or her own performance and invest effort in deliberate practice.

CONCLUSION AND SUGGESTION

In line with research objectives, it can be concluded that the level of readiness for the implementation of 21st century science learning pedagogical practices by teachers in West Kalimantan-Indonesia is in moderate category, In particular, it is also concluded that the level of readiness of senior high school teachers is better than primary and secondary high school teachers, The female teachers are better than male, and the senior teachers are better than junior, The supporting and inhibiting factors of the implementation of 21st century science learning pedagogical practices by teachers could come from 5 (five) interrelated components, namely; content or teaching materials, learning materials, learning environment, teacher, and students, Based on these findings, it is recommended to train teachers in positions related to the deepening of teaching materials, Innovative learning models based on Information and Communication Technology (ICT) needs to be continued to build teacher professionalism skills in implementing meaningful science teaching pedagogy in schools.

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