Teacher's Perception of Science Practices Learning (SPL)

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Abstract. The purpose of this study was to determine (a) developing survey instruments for Teacher's Perception of Science Practices Learning (SPL) and (b) describing the perception of science learning practices. This research uses descriptive survey method. Respondents in this study were elementary school, junior high school and high school science teachers in the Central Java region, totalling 74 teachers. The research instrument used was a science learning practice perception questionnaire. The instrument has gone through the stages of expert validation and empirical testing. The instrument validity uses exploratory factor analysis. Data analysed by descriptive. The research results that the perception of science teachers on SPL is not different. Elementary, middle and high school science teachers have enough categories. The dimension of EPK for elementary science teachers have enough categories, middle and high school science teachers are in good category. The dimensions of IT in elementary, middle and high school science teachers are good. Science teachers' perceptions of SPL are in the enough category.

1. Introduction

Teachers play a role in implementing a good integrated science learning strategy as a source of learning, learning facilitators, learning managers, demonstrators, instructors of learning, motivators, and evaluators in learning [1]. An important competency that must be possessed by an educator to be able to carry out learning with a scientific approach is that educators master the varied learning strategies [2]. The quality of teachers in teaching becomes an important factor in the success of science learning. The teacher's role as a facilitator must be supported by the teacher's ability to plan learning, manage classes, and teacher creativity in presenting learning [3]. Lack of student interest due to learning with lectures and no questions and answers [4]. Teachers' teaching skills and student learning motivation correlate strongly with learning outcomes [5]. There is a positive relationship between teacher teaching skills with student motivation [4].

For significant shifts in science teaching that enable all students to actively engage in scientific practices and apply crosscutting concepts to core disciplinary ideas [6]. The classroom teaching model is delivered by a teacher center approach that positions students as listeners tends to be applied by science teachers in Indonesia [7]. The hopes and challenges associated with efforts to support teacher
implementation of the NGSS put a great onus on researchers to measure relevant changes in science teachers’ instructional practice [8]. Examining teachers’ perceptions of Science Instructional Practice (SIP) is an essential need to determine the level of knowledge and practices. Survey instruments are commonly used to capture instructional practices due to their practicality in administration [9]. This research aims to describe of science teacher perception of science practical learning.

Many factors determine the success of students in learning science including teachers [10]. Learning that tends to only convey knowledge information, will result in students who can only know information about science [11]. The teacher as a key figure in the class must be able to create a challenging and enjoyable learning environment for students [12]. Teachers also face various obstacles such as the availability of learning resources that do not support or implement effective learning strategies. The difficulty experienced by teachers is the trigger for the birth of learning failure in students and raises the view that science is a difficult subject [13]. Science teachers generally design science learning not in accordance with its nature which results in misconceptions in children, and do not pay attention to the psychology of children from opening to evaluation at the end of learning, and in turn science learning becomes less meaningful [14]. Reported that some of the teacher's abilities were still lacking in the implementation of learning, namely using various approaches, media and learning resources; lack of teacher's ability to facilitate interaction between students and not yet maximal in engaging students actively in learning activities including, in involving students seeking extensive information about the material or topic being taught. Science practical learning, according to can be divided into five dimensions, which are (1) empirical investigation, (2) evaluation and explanation, (3) science discourse and communication, (4) engaging prior knowledge, (5) traditional instruction. Each of them is explained as follows (a) Empirical Investigation (EI), focus on investigation procedure: asking questions, determining what needs to be measured, observing phenomena, planning experiments, and collecting and analyzing data; (b) Evaluation and Explanation (EE), focus on modeling, evaluation, and argumentation: constructing explanations, evaluating appropriateness based on evidence, fitting models, and critiquing ideas; (c) Science Discourse and Communication (SDC), opportunities for participation in scientific discourse that enculturates students into scientific language and practices; (d) Engaging Prior Knowledge (EPK), engaging students’ prior knowledge, real-world, and home applications of science to bridge between science epistemologies and students’ experience; (d) Traditional Instruction (TI); (e) Traditional teacher-centered approaches, including direct instruction, demonstration, worksheet, or textbook work [8].

2. Methods
In order to examine teachers’ perceptions of Science Practical Learning (SPL), this study used a quantitative approach. The method of research use descriptive survey. Descriptive survey which concerns itself with the present phenomena in terms of conditions, practices beliefs, processes, relationships or trends invariably is termed as “descriptive survey study. In this research, the researchers describe SPL science teacher perception [16]. The study was conducted on senior high school, junior high school, and elementary school in central java province science teachers. The research subjects were 74 science teachers consisting of 26 male students and 48 female teacher. The sampling technique uses disproportionate stratified random sampling

2.1. Phase 1: Item Pool
To develop the survey, the theoretical framework and related literature are used. An item pool, including 31 items, is formed. The items for five subscales 1) EI, 2) EE, 3) SDC, 4) EPK, and 5) TI are evaluated with the options of “totally measuring,” “somewhat measuring,” or “not measuring” by 12 students from the doctoral postgraduate science education study program. Next, the 31 items, labeled “totally measuring” by at least eleven members from the doctoral postgraduate, were selected. In Table 1, minimum and maximum points for each subscale are presented.
Higher scores for each subscale indicate higher perceived acquaintance with the applications of the knowledge base. The survey items are answered by means of a Likert-type scale with five response choices, including “1=never,” “2=ever,” “3=seldom,” “4=often,” and “5= very often.”

### Table 1. Minimum and Maximum Points for Each Subscale

| Subscale | No of Items | Min. Point | Max. Point |
|----------|-------------|------------|------------|
| EI       | 12          | 12         | 60         |
| EE       | 6           | 6          | 30         |
| SDC      | 4           | 4          | 20         |
| EPK      | 3           | 3          | 15         |
| TI       | 6           | 6          | 30         |

### 2.2. Phase 2: Survey Validity

Validity studies of the survey are conducted with 78 science teachers. Phase 2 involves testing the construct validity of the SPL survey. The factor validity of the five subscales is examined using exploratory factor analysis (EFA). EFA is used to verify whether the survey items for each subscale successfully measure each variable. Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett’s Test of Sphericity (BTS) are applied to the data prior to factor extraction to ensure the characteristics of the data set are suitable for EFA. Since the KMO and BTS results indicate the data satisfy the psychometric criteria for factor analysis, the EFA is performed. Furthermore, item-total correlations and Cronbach’s alpha internal consistency coefficient are calculated.

#### 2.2.1. Calculating Correlation Matrix

Before conducting factor extraction, the KMO and BTS are applied to ensure that characteristics of the data set are suitable for factor analysis. The KMO and BTS results are provided in Table 2.

### Table 2. KMO dan BTS Value

| Measure of Sampling Adequacy | Value |
|-----------------------------|-------|
| Kaiser-Meyer-Olkin           | .890  |
| Bartlett's Test of Sphericity| 2068.698 |

KMO score at measure of sampling adequacy (KMO MSA) is 0.89 with significance 0.000. The score 0.913 is higher than 0.5 and significance 0.000 is categorized good based on Norusis’ criteria. BTS score reaches Chi Square 2068.69 with freedom degree 406 with significance 0.000, which means correlation matrix is not identity matrix so that factor analysis can be applied. The score of anti image correlation (AIC) gets MSA price lower than 0.50 at components number 20 and number 22 so that these two numbers are left or unanalyzed in the next process.

#### 2.2.2. Factor Extraction

The table 4 of total variance explains that there are 18 components included in the factor analysis and it obtains eigenvalues higher than 1 (>1) as many as 5 factors. It shows that the amount of factors is suitable with the amount of estimated indicators. Therefore, reviewed from construct validity, this instrument is valid. Besides, factor content variance explains that there are 36.622 % content variance of the first factor, 9.245 % of the second factor, 6.690 % of the third factor, 5.377 % of the fourth factor, and 5.026 % of the fifth factor, so that the total content variance of those five factors is 62. 960 %.

#### 2.2.3. Conducting Rotation

Factor matrix covers eight times of rotation or iteration. The analysis result shows that the components passing factor content “cut off point” is less or as many as 0.30 and more
than -0.30. The most factor content is component 19 which is 0.797, while the least is component 23 which is 0.455. In Table 3, rotated component matrix values are presented.

2.2.4. Naming the Factor. Factor matrix shows items from each factor in Table 3. Five factors which represent the components can be seen in Table 4.

2.2.5. Test Reliability. For the reliability of the scale, Cronbach’s alpha coefficient is used. The internal consistency scores for each subscale 0.917 for the survey items.

Table 3. Rotated Component Matrix(a) Value

| Component | 1   | 2   | 3   | 4   | 5   |
|-----------|-----|-----|-----|-----|-----|
| VAR00019  | .797|     |     |     |     |
| VAR00018  | .790|     |     |     |     |
| VAR00017  | .768|     |     |     |     |
| VAR00021  | .688|     |     |     |     |
| VAR00013  | .574|     |     |     |     |
| VAR00029  |     | .846|     |     |     |
| VAR00031  |     | .713|     |     |     |
| VAR00030  |     | .635|     |     |     |
| VAR00028  |     | .562|     |     |     |
| VAR00015  |     |     | .751|     |     |
| VAR00004  |     |     | .745|     |     |
| VAR00003  |     |     | .666|     |     |
| VAR00025  |     |     |     | .818|     |
| VAR00026  |     |     |     | .761|     |
| VAR00023  |     |     |     | .455|     |
| VAR00012  |     |     |     |     | .767|
| VAR00007  |     |     |     |     | .547|
| VAR00011  |     |     |     |     | .479|

Table 4. Naming The Factor

| Factor Name | Factor | Item          |
|-------------|--------|---------------|
| EI          | 1      | 13,17,18,19,21|
| EE          | 2      | 28,29,30,31   |
| SDC         | 3      | 03,04,15      |
| EPK         | 4      | 23,25,26      |
| TI          | 5      | 07,11,12      |

2.3. Phase 3
The survey was conducted using the online questionnaire method using the google form service. Surveys are disseminated through whatapps, facebook and Gmail services. The descriptive analysis was used to analyze the data. The descriptive analysis was used to analyze the data. The analysis of data resulting was converted and classified into five categories. Azwar (2011) makes a classification with comparison to the ideal average score ($X$) and the ideal standard deviation score (S$Bi$) as basis. The categorization perception science teacher presented in Table 5.
Table 5. SPL Category

| No | Interval Skor                      | Category   |
|----|-----------------------------------|------------|
| 1  | $X > X_i + 1.5 Sbi$               | Very Good  |
| 2  | $X_i + Sbi < X < X_i + 1.5 Sbi$   | Good       |
| 3  | $X_i - 0.5 Sbi < X < X_i + Sbi$   | Enough     |
| 4  | $X_i - 1.5 Sbi < X < X_i - 0.5 Sbi$ | Bad       |
| 5  | $X < X_i - 1.5 Sbi$               | Very Bad   |

3. Results and Discussion

3.1. Comparison of elementary, middle and high school science teachers

The perception of elementary, middle and high school science teachers on SPL is no different. Elementary, middle and high school science teachers have enough categories. El dimension, EE, SDC elementary, middle and high school science teachers are enough categories. The dimensions of the EPK for elementary science teachers are enough in category, middle and high school science teachers are in good category. The dimensions of IT in elementary, middle and high school science teachers are good. Comparison of Perception of SPL for science teachers can be seen in Table 6.

Table 6. Comparison SPL perception of science teacher

| SPL Dimension | Science Teacher | Group |
|---------------|-----------------|-------|
|               | Elementary School | Grade | Science Teacher Junior High School | Grade | Science Teacher Senior High School | Grade |
| EL            | 2.8             | Enough | 2.8             | Enough | 3.3             | Enough |
| EE            | 3.4             | Enough | 3.6             | Enough | 3.6             | Enough |
| SDC           | 3.1             | Enough | 3.2             | Enough | 3.5             | Enough |
| EPK           | 3.7             | Enough | 4.0             | Good   | 4.1             | Good   |
| TI            | 4.0             | Good   | 4.0             | Good   | 3.8             | Good   |
| Average       | 3.4             | Enough | 3.5             | Enough | 3.7             | Enough |

SPL instrument model is adopted from Hayes et al (2016). The total amount of valid SPL instrument is 18 components. SPL instrument has fulfilled validity with Principal Component Analysis (PCA) approach as exploratory approach. The score of KMO MSA 0.89 is categorized good based on Kaiser rule, in which: KMO MSA ≥ 0.90 is very good, ≥ 0.80 is good, ≥ 0.70 is fair, ≥ 0.50 is poor, and < 0.50 is unacceptable. BTS score reaches Chi Square 2068.69 with freedom degree 406 with significance 0.000, which means correlation matrix is not identity matrix so that factor analysis can be applied. SPL is conceptually in accordance with five estimated factors theory [8]. The score of Rotated Component Matrix for 18 components is > 0.3. The component will be deleted if its factor content rotation is less than 0.30 (< 0.30) and more than -0.30 (> -0.30). The internal consistency scores for each subscale 0.917 for the survey items are quite high. For scales used in research, the level of an acceptable Cronbach’s alpha coefficient is suggested as 0.70.

The perception of the science teacher’s practice lies with the teacher enough for the dimensions of the scientific investigation. The dimensions of activities carried out by teachers and students in scientific inquiry activities are often carried out by teachers and students. Perceptions of science learning practices for the dimensions of scientific explanation and evaluation are often carried out by teachers and students. Science learning involves thinking and reasoning skills that support the formation and modification of concepts and theories about natural and social knowledge [17]. Learning that enhances scientific reasoning includes skills involved in investigation, experimentation, evidence of evaluation, and conclusions made to achieve conceptual change or scientific understanding [18]. Students clearly have
difficulties in composing arguments and linking claims for evidence [19]. Learning from students in evaluating and explaining tasks in ways that are lower cognitive involvement, breaking tasks into subtasks with detailed directions [20]. Teachers are wishing to demand higher levels of student cognitive involvement in moving into guided evaluation and explanation of tasks, supporting student induction into scientist habits of mind [20-21]. Complex problems with different basic problems and many consequences require students to practice scientific reasoning skills, such as understanding, thinking, researching, and criticizing [22].

Perceptions of science learning practices for the dimensions of discourse and scientific communication are often carried out by teachers and students. Communication becomes an important skill or basic skill in scientific communication [23]. Components needed in learning to improve scientific communication are structured instructional and performance tasks [24]. Learning activities with demonstration methods or direct practice with science objects are able to develop scientific communication skills in students [25]. Researchers and scientists reveal the problems to be solved, the process of obtaining data, analyzing and concluding results through the language of scientific communication. Scientists must master these skills in communicating findings and ideas with students [24]. Training to incorporate student prior knowledge and real-world connections in the classroom [26]. Perceptions of science learning practices for traditional teaching dimensions are often carried out by teachers and students. Science learning is dependent on interweaving of content and process, which may require direct instruction to scaffold students' understanding of scientific ideas and principles [18]. The results of the teacher perception survey on science learning practices are in the sufficient category. The implementation of science learning encounters problems. More broadly barriers and dilemmas are grouped in three dimensions, namely the technical dimension, the political dimension and the cultural dimension [27]. The technical dimensions include limited teaching ability constructively, limited commitment, limitations in assessment, difficulty in group work, challenges to the role of new teachers, challenges to the role of new students, and lack of adequate training. The political dimensions include limited teacher training, parental resistance, lack of resources, and different judgments about justice and fairness.

The problems of science learning come from teacher readiness. Some of the teacher's abilities were still lacking in the implementation of learning, namely using various approaches, media and learning resources; lack of teacher's ability to facilitate interaction between students and not yet maximal in involving students actively in learning activities including, in involving students seeking extensive information about the material or topic being taught [15]. Regarding the understanding of science and pedagogic content, based on the results of the initial competency test conducted by the Ministry of Education and Culture in 2011, it was pointed out that there were still many natural science teachers who did not meet the standards with low scores. The barriers and dilemmas are grouped in three dimensions, namely technical dimensions, political dimensions and cultural dimensions [27]. The technical dimensions include limited teaching ability constructively, limited commitment, limitations in assessment, difficulty in group work, challenges to the role of new teachers, challenges to the role of new students, and lack of adequate training. The political dimensions include limited teacher training, parental resistance, lack of resources, and different judgments about justice and fairness. To improve teacher quality, the Government has made every effort to conduct training services by holding upgrades, training, workshops in a few weeks so that the teacher leaves the classroom, but after returning to school the teachers do not apply their knowledge to make learning effective [28].

4. Conclusions

The validity and reliability of the SIP survey are checked with science teachers. First, a pool of 31 items is formed and reduced to 18 items after evaluation. Then, EFA is conducted to examine the construct validity and the factor structure of the survey. Based on the EFA, the results show the survey items for each subscale successfully measure each variable. KMO and BTS measures also indicate the data satisfy the psychometric criteria for the EFA.
The science teacher’s perception of SPL is no different. Elementary, middle and high school science teachers have enough categories. El dimension, EE, SDC elementary, middle and high school science teachers are enough categories. The dimensions of the EPK for elementary science teachers are enough in category, middle and high school science teachers are in good category. The dimensions of IT in elementary, middle and high school science teachers are good. Science teachers’ perceptions of the practice of science learning are in the enough category.

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