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Analysis of the Level of Conceptual Understanding

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Abstract. The study aimed to analyze the level of chemistry student's understanding of chemical concepts and critical thinking disposition that learn using problem based learning model. This research is a descriptive research. The subjects of the study were 35 students in the sixth semester of chemistry education program, University of Mataram, Indonesia. The student level of conceptual understanding data was obtained through three levels multiple choice tests, whereas the level of student critical thinking disposition data was collected by CTD questionnaire. The student level of conceptual understanding results showed that 58.57 % of students understood the concept well, 4.99 % understood the concept, 23.46 % were unsure and had misconceptions and 12.98 % had not understood the concept correctly. The analysis of the level of critical thinking disposition indicates that the student critical thinking disposition was categorized as positive. Correlation test indicated a significant correlation between conceptual understandings with critical thinking disposition. In conclusion, the level of conceptual understanding and the critical thinking disposition of students after learning using problem-based learning model were categorized as positive and both have a significant correlation.

Keywords : Chemical concept, learning model, problem-based

1. Introduction

Education in Indonesia continues to improve its quality to meet the challenges of the 21st century. Teacher quality improvement is one of the main targets. Teachers must hold appropriate skills, one of them is the ability of high-level understanding [1,2]. Teachers must have a correct understanding of the concept. Understanding of the content of knowledge plays an important role for teachers in order to be able to teach effectively. In addition, the level of teachers understanding of the concept may determine the level of professionalism. Improving the professionalism of teachers is an important effort in improving the quality of education [3,4].

High quality education produces highly skill teachers that in line with its demands. There are nine learning criteria for producing 21st century skill teachers: curriculum relevant to the learner's daily life, learning involving multiple disciplines, developing high-level thinking skills, applying knowledge gained to other areas that intersect with daily life day learner, learn how to learn to learners, learning that prevents misconception, team learning, utilizing technology to support learning, encourage creativity of learners [5-8].

The constructivism learning approach is one of the learning approaches that meet the above criteria. Constructivism approaches include problem based learning model, project-based learning model, inquiry learning model and discovery learning model. Problem-based learning (PBL) model is developed to help learners develop thinking skills, problem solving, and intellectual skills, learn various roles of adults, through their involvement in real-life experiences or simulations, and become independent learners. PBL focuses on learning on selected issues so that learners not only learn the concepts related to the problem but also the scientific method to solve the problem [9,10].

In the chemistry context, the physical chemistry subject has many abstract concepts. It involves the macroscopic (observable), microscopic (particle constituent) and symbolic (substance) aspects so that the physical chemistry course is difficult for students to understand. It is reported that students enter the classroom with negative perceptions of the chemistry course and have low success expectations for this course. Students' difficulties in studying chemistry are triggered by difficulty understanding the term, difficulty understanding chemical concepts, and difficulty in numbers. These learning difficulties can be overcome through the management of good chemistry learning, especially in the learning planning stage and learning process [9-14]. On the one hand, the students' ability to understand concepts is related to the level of student thinking, such as the tendency to think critically. The purpose of this research is to analyze the level of understanding of chemistry concept and critical thinking deposition of prospective teachers whom teaches by problem-based learning model.

2. Methods

This research is descriptive research type. The dependent variable is conceptual understanding and critical thinking disposition. Attribute variable is a problem-based learning model. Research subjects are chemistry education students of Faculty of Teacher Training and Education, University of Mataram. The subjects consisted of 35 students in the third years that programmed Physics Chemistry 3 courses.

Data on concept comprehension level was obtained through three-level double choice test and analyzed using modified Certainty of Response Index technique. The criteria for concept comprehension level are: 1). understand the concept correctly, 2). understand concept but not sure, 3). misconceptions and do not know the concept [15].

Data on the level of critical thinking was obtained through questionnaires. The critical thinking tendency questionnaire consists of 75 statements representing 7 indicators of critical thinking disposition. These indicators are: truth-seeking, open mindedness, analyticity, systematicity, self-confidence, inquisitiveness, and maturity of judgment. The questionnaire comes with a selection of answers that use Likert scale 1 to 6, from strongly agree to strongly disagree. Each flat indicator has

10 statements and each indicator has a minimum score of 10 and a maximum score of 60. The overall score is at least 70 and a maximum of 420 with the score ≥ 349 enters in a strong category, 280-348 positive, 211-279 ambivalent, and ≤ 210 negative [16].

The data obtained were analyzed using descriptive statistical test in the percentage using formula:

$$P = \frac{\Sigma x}{\Sigma x1} x\ 100\ \% \qquad 1$$

Where P = Percentage of concept level understanding per category; Σx = Frequency in each category;

$\Sigma X1$ = Total frequency. The relationship between the levels of understanding of the concept with the level of critical thinking tendency is analyzed using correlation test.

3. Results and Discussion

The level of understanding of concepts was obtained through the three-tier select test at the end of the lecture. It is categorized into 4 levels: understanding the concept correctly (MB), understanding concepts but not convincing (M), misconceptions (MSK) and not knowing the concept (TM). The distribution of the concept comprehension level is expressed in percent (%) as in Table 1.

Table 1. Data on conceptual understanding

Sub topic	Level of understanding Concept (%)			
	MB	M	MSK	BM
Mechanism of liquid phase reaction	68.57	6.86	19.43	5.14
Photochemistry	47.62	2.86	26.66	22.86
Irreversible processes.	59.52	5.24	24.29	10.95
Total Average	58.57	4.98	23.46	12.98

The level of understanding of chemical concepts of prospective teacher students was identified using a three-tier select test with 17 items that included sub-materials on the mechanisms of liquid phase reaction, photochemistry and irreversible processes. The results indicated that there are 58.57 % of students who understand the concept correctly. Percentages of students who understand the concept correctly are over 50 %. This indicates that the applied PBL model facilitate the students to be able to understand the concept correctly.

This result is in line with previous conducted research which states that the mastery of learning concepts of learners can be improved using problem-based learning model. Implementation of problem-based learning model includes learning activities in the form of: giving questions, simple experiments, study of literature, test hypothesis and discussion. All these things can help students understand the correct concept and minimize misconceptions [17-19].

However, there are still 23.46 % students experiencing misconceptions. Learning with constructivism approach also allows students to experience misconception. Some students construct their knowledge according to the concepts that experts agree on, but there are also students who

misconstruction their knowledge. This misconception constructed by students is what causes misconceptions.

Based on the learning theory of Piaget [20], students will examine every new concept with existing concepts, for example, students are faced with a natural phenomenon, then the students are asked to create a hypothesis, then the lecturer and student test the hypothesis with the lab. If the student's hypothesis does not match the result of the practicum (misconceptions are wrong), then the student will experience a cognitive conflict that may result in a change of cognitive structure, so that misconception can be corrected.

The results of the correlation test between the critical thinking disposition and conceptual understanding is depicted in Table 2. It shows that the significance of value (2-tiled) is 0.019 < 0.05. It means that there is a positive correlation between understanding the concept with the critical thinking disposition with the value of r is 0.395. The results of this study are in line with the currently reported research that there is a positive and weak relationship between the critical thinking tendency and academic achievement of the prospective teacher students in Turkey [21]. Students with a high critical thinking tendency will have a better level of conceptual understanding than students with low critical thinking disposition.

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Table 2. The relationship between conceptual understanding and critical thinking disposition

		Critical thinking disposition	Conceptual understanding
Critical thinking disposition	Pearson Correlation	1.00	0.39
	Sig. (2-tailed)	-	0.02
	N	35.00	35
Conceptual understanding	Pearson Correlation	0.39	1.00
	Sig. (2-tailed)	0.02	-
	N	35.00	35.00

Identification of the indicator of the tendency of critical thinking and its categorization is shown in Figure 1. In general, students have an average critical thinking tendencies with positive categories and the largest indicator (85.7%) contribute to positive category is the indicator of inquisitiveness. The indicator that categorized as the strongest (37.14%) is open-mindedness. Both of these indicators seem to have developed quite well on the application of problem-based learning models, thereby encouraging students' thinking to achieve a good level of conceptual understanding.

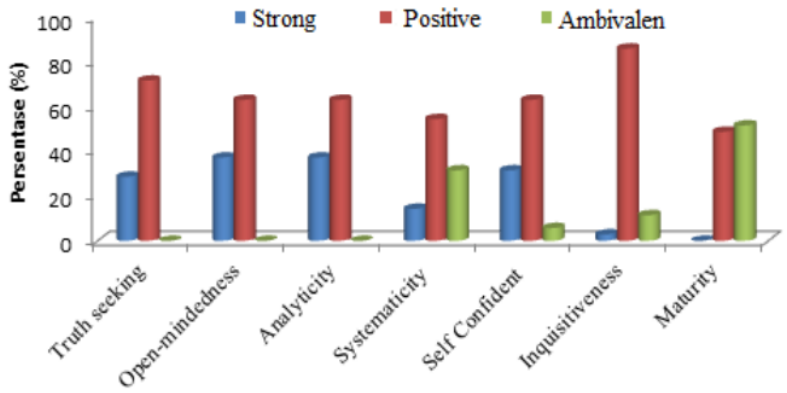

Figure 1. Tendering Profile of Student Critical Thinking.

The results showed that the level of understanding of the concept of prospective teachers is categorized as high. In addition, it is influenced by the PBL model and the level of critical thinking disposition. The result of critical thinking tendency analysis shows that all students have critical thinking tendency level in positive category. It means that students have a positive tendency to seriously undergo the learning process that gives positive outcome.

4. Conclusion

The level of understanding of the concept and the students' critical thinking disposition after applying problem based learning model within the learning process were categorized as positive and both have a significant positive correlation.

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