Journal of Physics: Conference Series - 2019

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Submission date: 17-Dec-2019 03:23PM (UTC+0700)
Submission ID: 1235923324
File name: 2._J._Phys.__Conf._Ser._1307_012018-Burhan_Utiya.pdf (596.86K)
Word count: 2466
Character count: 12365

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Journal of Physics: Conference Series

Improving critical thinking skill of preservice chemistry teacher through writing assignment

Improving critical thinking skill of preservice chemistry teacher through writing assignment

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ABSTRACT. Critical thinking is a skill that can be trained, which has some indicators such as thinking clearly and rational, be able to evaluate an information credibly through interpretation, analysis, argumentation and making conclusion. There are three indicators that can be used to identify critical thinking skill of chemistry student, i.e. analysis, evaluation and inference. These indicators are formulated based on the chemistry subject to be learned and explicitly can be formulated in the learning plan, student activity sheet, and learning material. Through writing assignment at the end of learning phase of the Reality-based Chemistry Learning Model, students's critical thinking can be identified.

1. Introduction

A meaningful learning means that students should understand what they have learned and then can apply it, not just memorizing [1]. In order to support these goals, a student-centered learning environment is needed to give students an opportunity in strengthening their conceptual, procedural, metacognition knowledge and some other cognition processes and also to induce their motivation. In order to increase student understanding in chemistry a more thinking-centered learning is needed [2]. When chemistry students can act as active thinkers, their motivation to learn chemistry will increase and this can be shown by their level of understanding in chemistry concepts.

Critical thinking as a cognitive skill is a convergent thinking that in line with rational, systematic and appropriate thought in accordance with logically and scientifically reasons to solve a problem [3,4]. Furthermore, it is stated that critical thinking is a rational-reflective thought by focusing to problems to reach a valid conclusion [5]. In addition, critical thinking also means an ability to analyze critically phenomena and arguments based on currently scientific knowledge and facts to decide the best explanation among some other models and explanations. In another statement, it is pointed out that Critical thinking is a skill and not using a mechanistic thought in all occasions. Learning using critical thinking will be able to increase an academic achievement and students will have an ability to solve problems in other situations even after school [6]. The Committee for the Assessment of Student Learning - Henry Ford Community College [7] has applied three indicators to evaluate the critical thinking, namely analysis, evaluation, and inference. An analysis means an ability to solve something in its parts and then can identify among the parts, while evaluation means an ability to differ some arguments or to hold a different point of view between a strong and relevant problem and a weak and irrelevant one in a specific question or issue. Inference means an ability to decide the best one to reach

a conclusion by investigate an individual case, then can differ among some evidences from some resources.

Based on these explanations, it can be stated that an application of critical thinking means to try to get values, usefulness and validity of something according to valid principles. By applying a critical thinking in learning, it means avoiding mistakes in making a conclusion, increasing an understanding, and showing an ability to solve a problem efficiently in different situations and occasions especially in everyday-life.

There are five phases as a syntax of learning in The Model of Chemistry Learning Based on Reality, namely: orientation phase, verification phase, formulation phase, evaluation phase and writing assignment [8]. The orientation phase is a first steps of the learning in this learning model. The aim of this step is to motivate student before learning begin in order for them to be ready with the next activities. The second step is the activities which student in their group, which consist of 4 to 5 students, have to look for references to answer the problems in student sheet. Then, the formulation phase means student have to formulate their answer in a summary. The evaluation phase is the step which means students have to check and recheck all aspects in their group summary. The last step of learning is writing assignment. In this phase, all students have to write individually their conclusion not more than in a page long. Before next learning schedule, all students writing report have already marked by lecturer, which means the mark is a qualitative comments regarding to critical thinking analysis, evaluation and inference depend on the problem to be solved.

How to write chemistry concept is similar with how to learn chemistry calculation. In order to mastering the chemistry calculation and writing in chemistry, students should practice in the same time while learning process in progress. Writing assignment have four benefits, i. e increasing student critical thinking skill in chemistry concepts , minimizing misconceptions, increasing student ability in writing communication, and increasing students social skill through group activities [9].

Writing assignment is just not an illustration of chemistry lesson material. The assignment should emphasize to how the chemistry concepts are synthesized in one idea. Writing is one of the effective way to foster student critical thinking. This statement is true because when student write their chemistry idea, their idea will be proceeded to explain the concepts to be narrated mentally. Writing also will increase students esteem because they can claim that the writing is their result of idea that proceeded mentally [10].

2. Research method

Participants in this study consisted of students who attending basic chemistry. This students consisted of three classes, which was each class consisted of 23, 26 and 26 students at Chemistry Education Study Program FKIP, University of Mataram. All the students followed the instruction in the topic of Solution. At the end of learning process, all students wrote their summary individually for not more than one page as writing assignment.

Table 1. N-Gain criteria and category.

CT skill	N-Gain	Category
1	$g \geq 0.7$	High
2	$0.7 \leq g \leq 0.3$	Moderate
3	$g \leq 0.3$	Low

Writing assignment is the last learning steps of The Reality-based Chemistry Learning Model [8]. To practice the step of writing assignment, the first up to fourth learning step namely orientation, verification, formulation and evaluation phase should be applied in the learning process. Students' critical thinking skill data collected through an individual critical thinking appraisal assessment instrument in each class of experiment. And the instrument was applied in the beginning and at the end

of the learning process. The N-Gain and CT-Category for each student was based on their score in pre-test and post-test, see table 1.

3. Result and discussion

Critical thinking skills data obtained through an individual critical thinking assessment instrument. The data of student critical thinking skill in first experiment for class A can be seen in table 2.

Table 2. Data of students critical thinking skills based on experiment in Class A.

Student	Pre-test		Post-test		N-Gain	Category
	Score	Value	Score	Value		
1	12	50.00	21	87.50	0.75	High
2	10	41.67	17	70.83	0.50	Moderate
3	12	50.00	21	87.50	0.75	High
4	9	37.50	20	83.33	0.73	High
5	13	54.17	19	79.17	0.55	Moderate
6	12	50.00	21	87.50	0.75	High
7	11	45.83	22	91.67	0.85	High
8	11	45.83	20	83.33	0.69	Moderate
9	12	50.00	23	95.83	0.92	High
10	13	54.17	20	83.33	0.64	Moderate
11	10	41.67	19	79.17	0.64	Moderate
12	12	50.00	19	79.17	0.58	Moderate
13	12	50.00	20	83.33	0.67	Moderate
14	14	58.33	22	91.67	0.80	High
15	13	54.17	19	79.17	0.55	Moderate
16	10	41.67	22	91.67	0.86	High
17	12	50.00	20	83.33	0.67	Moderate
18	7	29.17	21	87.50	0.82	High
19	8	33.33	20	83.33	0.75	High
20	8	33.33	22	91.67	0.88	High
21	9	37.50	22	91.67	0.87	High
22	12	50.00	20	83.33	0.67	Moderate
23	11	45.83	22	91.67	0.85	High

Based on table 2, it can be seen that in general the student critical thinking skill before and after learning process has developed in the category of high. Students critical thinking skill obtained through an assessment in each critical thinking indicator based on problems that student answered for the specific critical thinking indicator assessed.

The increasing of student critical thinking skill in summary can be seen in table 3. Based on the data in table 3, it can be seen that the increasing of student critical thinking skill indicator i.e analysis, evaluation and inference for each problem was in high category. This data indicated that there was an increased of student critical thinking skill before and after learning process through the steps of learning.

Table 3. Data summary of students critical thinking skills in the first experiment in Class A.

CT-Indicator	Pre-test	Post-test	Pre-test value	Post-test value	N-Gain	Category
Analysis	51	91	47.22	84.26	0.70	High
	46	89	42.59	82.41	0.69	Moderate
Evaluation	50	97	46.30	89.81	0.81	High
	43	91	39.81	84.26	0.74	High
Inference	48	93	44.44	86.11	0.75	High
	48	89	44.44	82.41	0.68	Moderate

Tabel 4. Data summary of students critical thinking in the second experiment in Class B.

CT-Indicator	Pre-test	Post-test	Pre-test value	Post-test value	N-Gain	Category
Analysis	51	91	47.22	84.26	0.70	High
	46	89	42.59	82.41	0.69	Moderate
Evaluation	50	97	46.30	89.81	0.81	High
	43	91	39.81	84.26	0.74	High
Inference	48	93	44.44	86.11	0.75	High
	48	89	44.44	82.41	0.68	Moderate

Tabel 5. Data summary of students critical thinking in the second experiment in class C.

CT-Indicator	Pre-test	Post-test	Pre-test value	Post-test value	N-Gain	Category
Analysis	35	99	24.31	68.75	0.59	Moderate
	34	108	23.61	75.00	0.67	Moderate
Evaluation	43	119	29.86	82.64	0.75	High
	41	123	28.47	85.42	0.80	High
Inference	41	117	28.47	81.25	0.74	High
	41	107	28.47	74.31	0.64	Moderate

The second experiment in two other classes (Class B and C) which applied with the same steps of learning process and the same assessment also gave the similar result. The category of each indicator was high in both class and the data summary can be seen in table 4 and 5. Based on these data summaries of experiment, it can be seen that students' critical thinking skill have been improved through the application of writing assignment. Writing is an effective means for improving thinking skills, because a person must mentally process ideas in order to write an explanation. Writing also improves self-esteem because mentally processed ideas then belong to the writer and not just to the teacher or textbook author [9]. In this element, there are four functions to accomplish with the writing assignments: (1) to encourage students for thinking about the chemical concepts, (2) to find out if the students understand the chemical

concepts or to minimize student's misconception, (3) to show students that chemical concepts can be-very practical, and (4) to help students improve their written communication in chemistry.

4. Conclusion

Writing assignment in the Model of Chemistry Learning Based-on Reality is the last step of learning process that consists of five steps of learning. The learning steps of the model begin with an orientation phase, then verification, formulation, evaluation, and the last is writing a report. Writing is one of the effective ways to foster student critical thinking. This statement is true because when student write their chemistry idea, then their idea will be proceeded to explain the concepts to be narrated mentally. Writing also will increase student esteem because they can claim that the writing is their result of idea proceeded mentally.

Acknowledgments

I would like to cordially thank to the Dean of the Faculty of Teacher Training and Education, University of Mataram for giving an opportunity to do experiment, and the Chairman of Chemistry Education Study Program for facilitating the needs during experimentation.

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