Example in concept map on discovery and reporting problem based learning accompanied by instructional techniques

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Abstract. The research aims to calculate the example scores in CM by applying instructional techniques in the PBL discovery and reporting stage. This research was a classroom action research with planning, actions and observations, and reflection procedures. The participants were 35 high school students. Data collection techniques were the observation, assessment of students’ CM on the elements of example, performance assessment, interviews, and documentation. The data collected were the example CM scores and percentage of syntax implementation. Data validation used the triangulation method, which included CM example scores, interviews, and documentation. Data analysis with qualitative analysis, including data reduction, data presentation, and conclusions drawing. The results of the research in the pre-cycle, cycle 1, and cycle 2 respectively showed an average score of example CM was 14%, 20%, 60%, thus the percentage of the score of example CM has increased. The increase in the percentage of example CM scores because of the application of instructional techniques to the discovery and reporting stage of PBL.

1. Introduction
Example (E) is a component that shows the specific knowledge of students as an explanatory concept in CM [1]. The specific knowledge represented by component E in CM shows the understanding and ability of students to apply the concept [2]. Understanding of the concepts and abilities of students in applying concepts is accommodated through analyzing and investigating activities [3]. Analysis and investigation activities are accommodated by solving unstructured problems [4]. Learning that accommodates unstructured problem solving is PBL [5].

PBL is a learning model that uses complex problems as a stimulus in learning [6]. Complex problems stimulate students to integrate and apply information from various disciplines to solve problems [7]. Problem-solving activities accommodate participants to conduct discussions, reviews and compare information from various points of view to find relevant information [8], which is accommodated by each stage in the PBL.

PBL consists of several syntaxes, namely meeting the problem, problem analysis, and learning issues, discovery and reporting, solution presentation and reflection, overview, integration, and evaluation [9]. The discovery and reporting phase accommodates to make connections, outline ideas and concept synthesis, which builds students' specific knowledge [10], visualized by component E.

The results of observing component E on CM using PBL showed an average percentage of the class of 14%. The percentage of scores obtained by students was 0-58% of the total 100%, thus, based on the application of PBL learning purely showed the percentage of E scores obtained by students
was less than optimal, so optimization was needed. Optimization is carried out by applying instructional techniques in the form of teacher questions [11].

Instructional techniques in the form of teacher questions accommodate students to build knowledge [12]. Instructional techniques in the form of teacher questions can be applied at all stages of PBL, including at the discovery and reporting stage because students have difficulty in making connections and finding relevant concepts [13]. The application of instructional techniques in the form of teacher questions at the discovery and reporting stage accommodates the process of finding and applying concepts [14], making it easier for students to find specific knowledge visualized by component E.

2. Research Method

This research was a classroom action research consisting of pre-cycles, cycle 1, and cycle 2 to measure the students' concept map scores. Each cycle had stages of planning, observation and action, and reflection.

Pre-cycles used a problem-based learning model improved by adding instructional techniques in the form of teacher questions in the discovery and reporting stage in cycle 1 and cycle 2. The material used in pre-cycle is the types of environmental pollution, cycle 1 used the source material and types of pollutants, while cycle 2 used environmental pollution indicator materials.

Participants were 35 high school students. The data collected were the percentage of component E scores in CM of students with supporting data in the form of implementation of the syntax of instructional techniques in the form of teacher questions at the discovery and reporting stage in PBL, interviews, and documentation. The validity test used data triangulation. Data analysis techniques were qualitative analysis comprising data reduction, data presentation, and drawing the conclusion. The percentage calculation of the E scores was done based on the expert concept map in the pre-cycle, cycle 1, and cycle 2. The methods and standard calculations of the E component are presented in Table 1.

Table 1. Total E scores in pre-cycle, cycle 1 and cycle 2

| Action  | Expert CM | Calculation       | Percentage |
|---------|-----------|-------------------|------------|
|         | E Skor    |                   |            |
| Pre-cycle | 31 31 | 31/31 x 100%      | 100%       |
| Cycle 1  | 44 44    | 44/44 x 100%      | 100%       |
| Cycle 2  | 16 16    | 16/16 x 100%      | 100%       |

3. Result and Discussion

3.1. Result

The results of the calculation of the percentage score of component E in pre-cycle, cycle 1, and cycle 2 are shown in Figure 1.

Figure 1. Percentage Score of Component E in Pre-Cycle Cycle 1 and Cycle 2
Figure 1 shows the percentage score of the E component of students in the pre-cycle, cycle 1, and cycle 2. The average grade of component E in the pre-cycle was 14%. The highest percentage of E scores obtained by students was 58.8%, while the lowest percentage score was 0%, thus, the percentage of component E scores in the range of 0-58.8% of 100%. Based on the class average, the percentage score of component E in the pre-cycle was not optimal, so it required improvement in the next action. Improvements in cycle 1 and cycle 2 were carried out by applying instructional techniques to teacher questions at the discovery and reporting stage in PBL, on the source material and types of pollutants, as well as environmental pollution indicators.

The class average for component E in cycle 1 was 20%. The highest percentage of E scores obtained by students in cycle 1 was 52%, while the lowest percentage score was 0%; thus, the range of percentage scores for component E was 0-52% of the total 100%. Based on the average class percentage of component E, the percentage score of component E has increased from pre-cycle to cycle 1, but the range of percentage gains in E score has decreased, thus, increasing the percentage acquisition of component E was less than optimal in cycle 1, so that treatment continued in cycle 2.

The class average for component E in cycle 2 was 60%. The highest percentage of E scores obtained by students was 100%, while the lowest percentage score was 37.5%; thus, the range of percentage scores for component E was 37.5-100% of the total 100%. Based on the class average and the range of percentage scores obtained by students, the percentage of E scores has increased from cycle 1 to cycle 2.

3.2. Discussion.
Based on the range of percentage scores of component E in pre-cycle, cycle 1, and cycle 2, which changed linearly or positively, due to many factors including 1) the percentage of learner scores has decreased in cycle 1 but has increased in cycle 2, and 2) performance assessment conducted through PBL learning.

Based on the percentage of the E scores that has decreased in cycle 1 showed that students had difficulty in building specific knowledge. Difficulty building specific knowledge because of complex learning topics [15]. Complex learning topics cause students difficulty in linking old knowledge with new concepts [16], so that the ability to build specific knowledge decreased in cycle 1, although it has decreased, the percentage of component E score has increased in cycle 2. The increase in the percentage of E scores in cycle 2 is due to the ability of students to use their experience to process information in a complex manner [17], making it easier for students to build specific knowledge [18].

An increase in the percentage of E scores linearly shows that students can develop specific knowledge [19]. The ability to build specific knowledge supports the mastery of concepts [20]. Concept mastery is accommodated by the application of instructional techniques in the form of teacher questions [21]. Teacher questions stimulate students to build knowledge in the form of interconnected concepts [22], so students are able to build specific knowledge as an explanation of a concept [1].

The improvement of students’ ability to build specific knowledge was supported by performance assessment indicators, namely making observation and inference, group work, and oral presentations. The results of the performance assessment in pre-cycle, cycle 1, and cycle 2 are shown in figure 2. The average percentage of making observation and inference in the pre-cycle, cycle 1, and cycle 2 respectively were 31.64%, 37.3%, and 39.9%. The average percentage of group work in pre-cycle, cycle 1 and cycle 2 were 74.76%, 79.17%, and 82.2% respectively. The average percentage of oral presentations in pre-cycle, cycle 1, and cycle 2, respectively were 52.23%, 55.93%, and 57.7%.
The average percentage of making observations and inferences increased linearly. An increase in the average percentage of making observation and inference showed that students focus on the observed problems so that they can find the main concepts based on the results of observations [23]. The ability to find key concepts based on observations, accommodate students to formulate hypotheses to clarify the phenomena under investigation [24] through group collaboration.

The average percentage of group work in performance assessment has increased linearly from pre-cycle, cycle 1, and cycle 2. The increasing percentage of group work average shows the ability of students to work in groups has increased [25]. The ability to work in groups encourages students to solve problems and build an understanding of concepts from a variety of different perspectives [26]. Problem-solving activities in groups accommodate students to find specific information [27], so that it affects the fluctuation of E scores.

The average percentage of oral presentations increased linearly from pre-cycles, cycle 1, and cycle 2. The increase in the percentage of oral presentations represented learners’ understanding of the concepts learned [28]. Students’ understanding of the concepts learned is indicated by voice intonation, and the choice of words used in explaining a concept [29]. Students can explain a concept demonstrating the ability to integrate information into specific knowledge [30], which is visualized by component E in CM.

4. Conclusion
Instructional techniques in the form of teacher questions at the PBL discovery and reporting stage affect the ability of CM construction, especially in the example component, while also affecting group collaboration activities, presentations and scientific abilities in the form of observation and making conclusions.

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