Instructional technique questions in the planning phase of project based learning to increase the score of concept map

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Abstract. The study aimed to improve student’s Concept map (CM) scores through the application of instructional techniques questions in the form of planning investigation according to driving questions (planning) in Project Based Learning. Research is a Class Action Research with 3 Cycles, including: planning to compile the lesson plan and its completeness, implementation of actions, observation, reflection and construct of expert CM. The research subjects consist of 35 high school students. Validation data use triangulation method: verification of CM scores suitability and documentation based on CM experts and interviews. Data analysis is done with qualitative descriptive: reducing, presenting data and drawing conclusions based on complete CM data. The results showed that the teacher’s questions functioned as instructional techniques that increased the CM scores of students but variation presented in component CM.

Keywords: questions, project based learning, concept map

1. Introduction

One of phase in project based learning is “planning and investigation according to driving question” [1] it accommodates students to make plans based on driving question [2]. Appropriate investigation plans affect the allocation of time, process, and cognitive learning products [3]. Cognitive learning products are used as assessments [4], that carried out at the end of learning process, one of them is concept map [5].

Concept map (CM) is a graphic illustration that contains the relationship of several concepts in the form of hierarchy [6]. Concept map (CM) is composed of several components, that is validationship, crosslink, hierarchy, pattern, branching, example [7]. The concept map (CM) component indicates the ability to understand the relationship between concepts [8]. The component of concept map (CM) is quantitatively calculated through the concept map (CM) scores [7]. The results of concept maps score percentage by using project based learning [1] is 6.29%, so project based learning is not optimal for construct the concept maps score. Optimization of the concept maps score through use project based learning is done by improving the communication of teachers and students using questions [9], which is one part of instructional techniques [10].

Instructional techniques questions that occur in phase “planning and investigation according to driving question” focus students to make a proper plans from driving question [11]. Question instructional techniques accommodate organizing answers in the form of lists [7] which help students understand the relationship between concepts [12]. The relationship between concepts are represented in concept maps (CM) scores. The assumption is that by adding instructional techniques to the question planning phase according to driving question in project based learning, it can improve the concept maps (CM) score, so the aim of the research is to increase the concept maps (CM) score through the application of
instructional techniques in the form of questions in the planning an investigation phase according to the driving question project based learning.

2. Research Method
This type of research is a Class Action Research according to Kemmis and Mc. Taggart (2007) in [13] includes: planning, implementation, observation and reflection. Problems found from observation activities in the learning process, thus research subject is the students' concept map (CM) score.

Learning process uses the project based learning model in Musci, Anthocerophyta, and Marchantiophyta with sequential expert CM is 2395, 641 and 1359. At the end of the learning process a measurement of CM scores is used as research data. The research data is the CM score supported by the data performer assessment. The research data was tested for validity using data triangulation techniques and analyzed using qualitative descriptive analysis techniques. Qualitative descriptive analysis techniques consist of reducing incomplete data, presenting data and drawing conclusions.

Calculation of CM components refers to [7]. The Calculated is valid relationship: 1 point, crosslink: 10 points, hierarchy: 5 points, branching: 1 point in the first branching and 3 other branching points, example: 1 point, pattern: 5 points, so the expert CM score calculation in Musci is 2395 which consists of 307 points of valid relationships, 1970 points of crosslink, 25 points of hierarchy, 78 points of example, 10 points of branching, 5 points of pattern. The calculation of the expert CM in Anthocerophyta score is 641 which consists of 65 points of valid relationships, 520 points of crosslink, 30 points of hierarchy, 8 points of example, 10 points of branching, 5 points of pattern. The calculation of the expert CM in Marchantiophyta is 1359 consists of 199 points of valid relationships, 1040 points of crosslink, 25 points of hierarchy, 80 points of example, 10 points of branching, 5 points of pattern. based on this, the percentage of cm scores was obtained through the CM component score divided by the CM expert score multiplied by one hundred percent.

3. Result and Discussion
The results of the pre-cycle study using project based learning learning, the cycle I uses question instruction techniques in the planning and investigation phase according to driving question (planning) on project based learning and cycle II improvements from cycle I are shown in Figure 1, Figure 2, and Figure 3 as follows:

![Comparison of the Number of student with component of Concept Map (CM) scores below the Low Standard in Pre-cycle, Cycle I, Cycle II](image)

Figure 1. Comparison of the Number of student with component of Concept Map (CM) scores below the Low Standard in Pre-cycle, Cycle I, Cycle II

Figure 1 shows the number of students who received VR (Valid Relationship) component scores below the average in general experienced a decrease from pre-cycle, cycle I and cycle II activities is 18%, 18% and 12%. Component H (hierarchy) generally decreases: 34%, 31% and 12%. Component C (crosslink) generally decreases: 18%, 15% and 15%. Component B (branching) significantly decreased in cycle II, that is 34%, 31% and 12%. Component P (pattern) generally decreases, that is 34%, 31% and 28%. Component E (example) experienced an increase in cycle I compared to pre-
cycle but decreased significantly in cycle II, that is 21%, 34% and 0%, so it was concluded that there is decrease in the total number of students who scored low, that is 18% in pre-cycle, 18% in cycle I and 12% in cycle II.

Figure 2. Comparison of the Number of Students with component of Concept Map (CM) scores above the High Standard in Pre-cycle, Cycle I, Cycle II

Figure 2 shows the number of students who received Concept Map (CM) scores above the average in general experienced an increase from pre-cycle, cycle I and cycle II activities, namely: 6%, 15% and 15%. Components Hierarchy (H), Crosslink (C), Branching (B) and Pattern (P) have the same pattern that has increased in cycle I compared to pre-cycle, but has decreased in cycle II. The percentage of Hierarchy (H) components are: 0%, 25% and 9%. The percentage in component Crosslink (C) is: 15%, 21% and 9%. The percentage in component Branching (B) is: 0%, 25% and 18%. The percentage of Pattern (P) components are: 0%, 21% and 0%, thus it is concluded that in general the number of students with high scores in cycle I has increased compared to pre-cycle, but some components have decreased in cycle II. The results of the percentage of the number of students with a high total Concept Map (CM) score gain in general is 6% in pre-cycle, 25% in cycle I and 6% in cycle II. The acquisition of Concept Map (CM) scores of students from pre-cycle, cycle I and cycle II experiences a fluctuating increase in each component. The increase in the average Concept Map (CM) score of students is shown in Figure 3 as follows:

Figure 3. Comparison of Average Score of Concept Map (CM) components in Pre-Cycle, Cycle I, Cycle II

Scores of Concept Map (CM) on the hierarchical (H), Branching (B), and Pattern (P) components at cycle I have increased compared to pre-cycle activities. The increase in cycle I compared to pre-cycle was caused by several factors: one of the observations made in the study was the performance assessment of students in the group work indicators. Group work consists of several activities that can be observed and measured [14]. The quality of group work affects the learning outcomes of students [15]. Data on performance assessment indicators of group work in pre-cycle and cycle I increased by 57.08% and 59.24%. Group work has an effect on increasing self-confidence in making decisions and
skills in dealing with problems during the learning process [15], so that maximizing learning activities. Another factor that causes an increase in the component score of Hierarchy (H), Branching (B), and Pattern (P) in cycle I compared to pre-cycle is instructional technique.

The instructional technique planning an investigation according to driving question (planning) on project based learning help students focus on a concept or idea [16]. For example, in the planning stage the teacher asks questions without giving direct instructions, thus giving students the opportunity to determine the investigation decisions to be made. Opportunities in determining decisions make it easier for individuals to overcome the possible obstacles that will be faced because of taking these decisions [17].

Question instructional techniques are an effort to guide students to develop the driving questions has been determined to be an investigation plan [18]. Question instructional techniques directly stimulate student’s prior knowledge [16]. Prior knowledge relates to initial understanding as the basis for determining an investigation plan [18], and help in compiling Concept Map (CM) by facilitating the process of formulating the material hierarchically [19], so increase in scores of Concept Map (CM) on the components of Hierarchy (H), Branching (B), Pattern (P) and Example (E) is consistent with the application of instructional techniques to the question at the planning an investigation according to driving question in helping students determine the investigation and stimulated prior knowledge.

Scores of component Valid Relationship (VR), Crosslink (C), and Example (E) decreased in cycle I compared to pre-cycle due to several factors, that is: VR is a form of connecting nodes or points [20], and C for different hierarchy [21]. Example (E) shows the ability to name examples that clarify the meaning of a concept [22]. Instructional techniques to the question help students to arrange material hierarchically [19], and connecting prior knowledge with the knowledge being studied improve students understanding of a material [22]. Material understanding is represented by Hierarchy (H), Branching (B) and Pattern (P) scores, thus it is possible that instructional techniques do not have an optimal effect on Valid Relationship (VR) and Crosslink (C) scores.

Hierarchy (H), Branching (B), and Pattern (P) scores ideally increase in cycle II compared to cycle I, but in cycle II scores H, B and P decrease due to several factors: one of the observations is observe the performent assessment of students on the ability to make and use a classification system. The average value of performent assessment of students on the ability to make and use the classification system in cycle II is 62.62%, while in cycle I is 66.66%. Assessment indicators in the classification system focus on the ability of students to explain in general to specifics, and to classify an object. Pattern (P) indicates students' overall understanding through the skill of explaining material from general to specific [7]. Hierarchy (H) and Branching (B) are forms of concept representation in the structure of the lower order as in the classification system [23], thus the alignment of the performent assessment indicators of students on the ability to make and use a classification system with components Hierarchy (H), Branching (B), and Pattern (P) in Concept Map (CM) explained that the decrease in the score of the Hierarchy (H), Branching (B), and Pattern (P) components in the second cycle compared to the first cycle was due to the decreasing performent assessment of students, especially in the indicator of the ability to make and use a classification system. Factors that cause the score of the components of Hierarchy (H), Branching (B), and Pattern (P) in cycle II compared to the other cycle I are the complexity of the material.

Material complexity affects the motivation of students who are less than optimal [24]. The teacher takes longer to focus on each stage of learning. Time management at each stage that requires longer time results in the allocation of students' time in working on CM shorter. Time management influences the efficiency of a task [25], so that less organized time allocation causes the Concept Map (CM) score to be less than optimal.

Less organized time allocation also affects other components, namely VR and C. Components of Valid Relationship (VR) and Crosslink (C) have increased scores in cycle II compared to cycle I. Score increases are caused by several factors, namely: Valid Relationship (VR) and Crosslink (C) show the ability of students to make relationships between nodes or points and clarify the meaning of a concept by mentioning various examples of a material [20,21,26]. Time management in cycle II
which causes Concept Map (CM) allocation is not maximal causes students to be able to mention, but less than the maximum in comprehension comprehensively evidenced by increasing scores on Valid Relationship (VR) and Crosslink (C) components but decreases on Hierarchy (H), Branching (B), and Pattern (P) which are indicators of comprehension of the overall material.

4. Conclusion
The conclusion of the study is that the application of instructional techniques at the planning investigation stage according to driving question on project based learning increases the concept map scores of students, especially in components Hierarchy (H), Branching (B), and Pattern (P).

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