Instructional technique questions in the evaluating stage of project based learning to improve concept map score

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Abstract. The study aimed to improve student’s Concept map (CM) scores teacher’s questions on evaluating data, arriving a conclusion, presenting the project in class as preferred and discussion (evaluating data) stage of Project Based Learning. This research was a classroom action research with 3 Cycles. Procedure of this research are planning to compile the lesson plan, implementation of actions, observation, reflection, and construct expert concept map. The subject of this research consisted of 36 students of senior high school. The research data is the concept map score. Validation use triangulation method. verification of CM scores suitability and documentation based on CM experts and interviews. Data obtained by reducing data, graph transformation, and drawing conclusions. The result of this research showed that the teacher’s questions functioned as instructional techniques that improve the CM scores of students.

Keywords: project based learning, questions, concept map

1. Introduction
One of the stages in project based learning is evaluating data, arriving a conclusion, presenting the project in class as preferred and discussion. This stage accommodates students to present and evaluate the product results of all groups through class discussion [1]. Project based learning supports students for problem solving which ends with composing cognitive products [2]. One cognitive product is the concept map [3].

Concept map is a graphic form that represents the relationship between concepts [4]. Concept map helps students understand the concepts they have in long-term memory [5]. Concept map helps students understand the concepts learned [6] by training in organizing concepts, so that students are able to find concepts and connect the framework between concepts [7]. Concept maps have components that include: crosslink, hierarchy, branching, pattern, example and valid relationships that visualize finding and linking [4]. The concept map component is measured quantitatively in the form of scores [8].

The map concept score of students using project based learning shows an average score of 9.50%, thus project based learning has not accommodated students to compile the concept map, so the concept map score is less than optimal. The preparation of the concept map requires communication with the teacher in the form of questions [9]. Communication question that occurred on evaluating the data, arriving a conclusion, presenting the project in class as a preferred and discussion stage serves to
accommodate students to present and evaluate the results of the product all through class discussion group [1]. But in the stage, students find it difficult to understand all the content presented by all groups during the presentation of product results [10], so that the optimization of the concept map score is done by adding instructional techniques teacher’s questions [11]. Instructional technique teacher’s questions help students focus on the learning process [9]. Teacher questions focus students to compile answers in the form of lists, thus making it easier to organize concepts in form concept maps [12]. The concept map instructional technique in the form of a list helps students to organize and connect between concepts [10]. Instructional techniques teacher's question at the stage of evaluating the data, arriving a conclusion, presenting the project in class as a preferred and discussion are assumed to increase the score of concept maps, thus the purpose of research is to improve scores concept map by implementing instructional techniques teacher's question at the stage of evaluating the data, driving a conclusion, presenting the project in class discussions as preffered and learning project-based learning.

2. Research Method
Research uses a collaborative action research approach with 3 cycles. The action research research process according to Kemmis and Mc. Taggart (2007) [13] is through a series of activities which include planning, implementation, observation and reflection. Action research aims to overcome the problems that occur in the learning process [14] identified from the results of observations related to concept map scores and supporting components. Optimization of students' concept map score is done by adding instructional techniques to the teacher's questions at the evaluating data, driving a conclusion, presenting the project in class as preffered & discussion of project based learning using material musci on pre-cycle, anthocerophyta in cycle I and marchantiophyta in cycle II . At the end of each cycle, the concept map score is measured according to the material used. The concept map score is research data supported by other data in the form of interviews and documentation. The concept map score is research data supported by other data in the form of interviews and documentation. Research data analysis was carried out with qualitative descriptive analysis technique consisting of data reduction to select complete data, presentation of data in the form of confirmation from data into graphs, and drawing conclusions obtained from graphs based on complete concept map scores. Analysis of the calculation of the concept map score in accordance with the expert concept map of each material. Musci, Anthocerophyta and Marchantiophyta material had expert scores of 2395, 641 and 1359, respectively.

An example of calculating students' concept map scores according to Novak & Gowin (1984) [6] is as follows: valid relationship, hierarchy level, branchings, pattern, cross-link and specific examples have a maximum score that is different. Valid relationship is a relationship between concepts which is indicated by the connecting lines and conjunctions with a value of 1 point. hierarchy level is a vertical concept map arrangement that shows the level of each concept with a value of 5 points. Cross-link is a meaningful relationship between different concepts of segments with a score of 10. Pattern is a concept map pattern that is compiled and has a maximum value of 5 points. Specific example is a more specific concept and is an example of each concept that is indicated by a score of 1 point.

3. Result And Discussion

3.1 Result
The results of the action research on pre-cycle using project-based learning, cycle I with the addition of instructional techniques teacher questions at evaluating data, driving a conclusion, presenting the project in class as preffered & discussion of project based learning, cycle II with improvements from cycle I show the results respectively in Figure 1, Figure 2, and Figure 3 as follows:
Figure 1. Comparison of number of students with scores below the map concept components standart low on prasiklus, cycle I, cycle II
Description: Valid relationship (VR), hierarchy (H), crosslink (C), branching (B), pattern (P) and example (E)

Figure 1 shows the percentage comparison of the number of students with the lower standard concept map component scores in pre-cycle, cycle I, cycle II. The VR component shows the total students who received a low score below the standard average was 13.89% in the pre-cycle, then increased to 19.44% in the first cycle and decreased in the second cycle to 11.11%. Component H shows that the total students who received a low score below the standard average were 22.22% in pre-cycle, then normal in cycle I with 22.22% and decreased to 0% in cycle II. Component C shows the total students who received a low score below the standard average was 22.22% in pre-cycle, then normal in cycle I with 22.22% and decreased to 11.11% in cycle II.

Component B shows the total students who received a low score below the standard average was 27.78% in the pre-cycle, then decreased to 22.22% in the first cycle and decreased to 0% in the second cycle. Component P shows the total students who received a low score below the standard average was 13.89% in pre-cycle, then increased to 19.44% in cycle I and decreased to 0% in cycle II. Component E shows the total students who received a low score below the standard average of 22.22% in pre-cycle, then normal in cycle I with 22.22% and decreased to 16.67% in cycle II.

Figure 2. Comparison of the number of students with concept map scores below the low standard in pre-cycle, cycle I, cycle II
Description: Valid relationship (VR), hierarchy (H), crosslink (C), branching (B), pattern (P) and example (E)

Figure 2 shows the percentage of the comparison of the number of students with the component map concept above the low standard on pre-cycle, cycle I, cycle II. The VR component shows the total students who get high scores above the standard average is 11.11% in pre-cycle, then normal in cycle I with 11.11% and increases to 16.67% in cycle II. Component H shows the total students who received a high score above the standard average is 13.89% in pre-cycle, then decreased to 5.56% in cycle I and increased to 11.11% in cycle II. Component C shows that the total students who received high scores above the standard average were 13.89% in pre-cycle, then increased to 25.00% in cycle I and decreased to 5.56% in cycle II.

Component B shows the total students who received high scores above the standard average were 13.89% in the pre-cycle, then decreased to 5.56% in the first cycle and increased to 11.11% in the second cycle. Component P shows that the total students who received high scores above the standard average were 0% in the pre-cycle, then increased to 8.33% in the first cycle and increased to 25% in the second cycle. Component E shows the total students who got high scores above the standard average were 11.11% in the pre-cycle, then increased to 22.22% in the first cycle and decreased to 13.89% in the second cycle. All CM component scores experience varying decreases and increases.

Figure 3. Comparison of average concept map scores in Pre-cycle, Cycle I, and Cycle II

Figure 3 shows the general improvement for all components of the concept map, namely VR, H, C, B, P and E in each cycle. The increase is obtained from the scores of students who vary in each component. The average Component V, H, B and P scores experienced an increase from pre-cycle to cycle I and decreased in cycle II. The average score of Components C and E decreased from pre-cycle
to cycle I and increased in cycle II. 2.78% of students get the lowest score on pre-cycle and increase in cycle I and II.

### 3.2 Discussion

Concept map score visualizes the ability to find and connect concepts with components that include VR, C, H, B, P dan E [4]. The ability of students to find concepts is represented through hierarchical components, branching [15] patterns [16] and examples [17] in CM, while valid relationships and crosslinks show ability to connect one concept to another [3]. The total CM score of students in each cycle generally has different variations for VR, H, C, B, P and E components in pre-cycle, cycle I, and cycle II.

Components of VR, C and E from pre-cycle to cycle I have decreased, while components H, B and P have increased from pre-cycle to cycle I. Decreasing component scores of VR, C and E in CM from pre-cycle to cycle I is caused by the time students spend to revise and maintain CM, thus students do not focus on the whole of the concept [18], so time runs out before students are able to connect between concepts.

Increasing the score of components H, B and P in CM from pre-cycle to cycle is caused by project-based learning models that provide meaningful experience [19], so that students progressively restructure their knowledge and create a complex and interrelated conceptual framework that can create many hierarchies and branching level [20]. Component H scores that are increased are caused by prior knowledge of students [17] which is high because prior knowledge is indicated by component H in CM [21]. Increased P component scores caused by the application of questions that build understanding in CM, while P shows students' concept understanding [16] so that P scores increase.

Components H, B and P from cycle I to cycle II have decreased, while components of VR, C and E have increased from cycle I to cycle II. Decreasing the score of components H, B and P in CM from pre-cycle to cycle I is caused by learning material. Materials contribute to building students' understanding [22]. Students' ability to understand concepts is represented through hierarchical components, branching [15] and hierarchy while in cycle II uses material that is more complex [16] than cycle I, so students experience a decrease in score. CM components, especially H, B and P, from cycle I to cycle II. Another effect is the decrease in component score scores of H, B and P because students build CM using paper and pencil, so that the difficulties in constructing concepts are complicated, especially for students who are unfamiliar with CM [16].

The increase of VR and C component scores in CM from cycle I to cycle II was caused by the application of teacher's questions in evaluating data, driving a conclusion, presenting the project in class as preferred & discussion that focused students to compile answers in the form of lists, thus making it easier to organize concepts in the form of concept maps [12]. The concept map instructional technique in the form of a list helps students to organize and connect between concepts [10] so that the VR, C score has increased because students are able to connect between concepts. The increase in component E scores is caused by the application of questions that build understanding of concepts in CM, while Edig used to support a concept [17], so that E scores increase. CM components of students have a decrease and increase in variation, but the percentage of total CM scores has increased from pre-cycle to cycle II with the average percentage of each cycle in a row is 9.50%, 33.98% and 36.23%.

Detailed discussion for each component of VR, H, C, B, P and E is fluctuated. Valid relationship (VR) is represented by a line connecting two concepts [15]. The total students who received VR below the standard average were 13.89% in pre-cycle, increasing to 19.44% in cycle I and decreasing to 11.11% in cycle II. The total students who received normal VR were 75% in pre-cycle, decreased to 69.44% in cycle I and increased to 72.22% in cycle II. The total students who get VR above the standard average are 11.11% in pre-cycle, still in the first cycle 11.11% and increase to 16.67% in cycle II.

Hierarchy (H) shows prior knowledge which is more differentiated and relates to one another [21]. The increase in the H score is supported by the increase in the students' performance assessment scores related to the appearance of the product which has a clear background usage indicator in preparing the
product. The total students who received H below the standard average were 22.22% in the pre-cycle, still in cycle I with 22.22% and decreased to 0% in cycle II. The total students who received normal H were 63.89% in pre-cycle, increasing to 72.22% in cycle I and increasing to 88.89% in cycle II. The total students who received H above the standard average were 13.89% in pre-cycle, decreased in the first cycle 5.56% and increased to 11.11% in the second cycle.

Crosslink (C) shows some parts of knowledge that students represent in CM and represent the creativity of students' knowledge [6]. Crosslink connects branches that are interrelated to build the concept map. The increase in C score is supported by the increase in the students' performance assessment scores related to poster assessment and oral presentation which has an indicator of the use of pictures, photos, diagrams and graphs that are appropriate in preparing the product so that it represents the creativity of students. The total students who received C below the standard average were 22.22% in the pre-cycle, still in the first cycle with 22.22% and decreased to 11% in the second cycle. The total students who got normal were 63.89% in pre-cycle, decreased to 52.78% in cycle I and increased to 83.33% in cycle II. The total students who received C above the standard average were 13.89% in pre-cycle, increasing in the first cycle by 25% and increasing to 5.56% in the second cycle.

Branching (B) shows relationships between more specific concepts to more general concepts [15]. The total students who received B below the standard average were 27.78% in pre-cycle, decreased in cycle I with 22.22% and decreased to 0% in cycle II. The total students who received normal B were 58.33% in pre-cycle, increasing to 69.44% in cycle I and increasing to 88.89% in cycle II. The total students who received B above the standard average were 13.89% in pre-cycle, decreased in the first cycle 8.33% and increased to 11.11% in the second cycle.

Pattern (P) shows students' concept [16]. The total students who received P below the standard average were 25.00% in the pre-cycle, increasing in the first cycle with 52.78% and decreasing to 0% in the second cycle. The total students who obtained normal P were 61.11% in pre-cycle, decreased to 41.67% in cycle I and increased to 88.89% in cycle II. The total students who received P above the standard average were 13.89% in pre-cycle, decreased in the first cycle 5.56% and increased to 11.11% in the second cycle.

Example (E) is the content used to show similarities and differences and to support the meaning of a concept [17]. The increase in E score is supported by the increasing performance assessment scores of students related to oral presentations which have indicators of the use of accurate scientific concepts and understanding of students' concepts [23]. The total students who received E below the standard average were 13.89% in pre-cycle, increasing in cycle I with 19.44% and decreasing to 0% in cycle II. The total students who received normal E were 86.11% in pre-cycle, decreased to 72.22% in cycle I and increased to 75.00% in cycle II. The total students who received E above the standard average were 0% in the pre-cycle, increasing in the first cycle 8.33% and increasing to 25.00% in the second cycle. CM components have variations in results based on the results of pre-cycle to cycle II. CM components experience classical and individual increases and decreases. Components that increase classically from pre-cycle to cycle I are H, B and P. Component H increased from 15.69 to 21.53. B increased from 4.33 to 7.92, while P increased from 3.11 to 3.53. Components that increase classically from cycle I to cycle II are VR, C and E. VR increased from 21.36 to 53.03. C increased from 160.56 to 410.56, while E increased from 2.94 to 4.72.

Individual scores have increased for VR components by 27.78% from pre-cycle to cycle I and 100% from cycle I to cycle II. The increase for component H is 66.67% from pre-cycle to cycle I and 2.78% from cycle I to cycle II. The increase for component C is 36.11% from pre-cycle to cycle I and 97.22% from cycle I to cycle II. The increase for component B is 69.44% from pre-cycle to cycle I and 2.78% from cycle I to cycle II. The increase in component P by 50% from pre-cycle to cycle I and 8.33% from cycle I to cycle II. The increase for component E is 16.67% from pre-cycle to cycle I and 44.44% from cycle I to cycle II, thus instructional techniques for teacher questions in evaluating data, driving a conclusion, instructional presenting the project in class as preferred & discussion project based learning to increase students' CM scores for each cycle.
4. Conclusion
The conclusion of the study is that the application of instructional techniques in the investigation planning stage according to driving question in project based learning increases the concept map scores of students.

5. Reference
[1] Turgut H 2008 Prospective Science Teachers’ Conceptualizations About Project Based Learning
[2] Doppelt Y 2003 Implementation and assessment of project-based learning in a flexible environment Int. J. Technol. Des. Educ. 13 255–72
[3] Novak J D and Cañas a J 2008 The Theory Underlying Concept Maps and How to Construct and Use Them IJMC C. 1–36
[4] Yin Y, Vanides J, Ruiz-Primo M A, Ayala C C and Shavelson R J 2005 Comparison of two concept-mapping techniques: Implications for scoring, interpretation, and use J. Res. Sci. Teach. 42 166–84
[5] Rye J A and Rubba P A 1998 An Exploration of the Concept Map as an Interview Tools to Facilitate the Externalization of Students’ Understanding about Global Atmospheric Change J. Res. Sci. Teach. 35 521–46
[6] Novak J D and Gowin D B 1984 Learning How to Learn - Joseph D 1–2
[7] Tribuzi S B 2015 Efficacy of Concept Mapping Instructional Techniques to Teach Organizational Structures and Interactions
[8] Stoddart T, Abrams R, Gasper E and Canaday D 2000 Concept maps as assessment in science inquiry learning- a report of methodology Sci. Educ. 22 1221–46
[9] Pandey R 2017 Understanding and use of Non-verbal communication in classroom by teacher educator of secondary teacher training institutions of Ranchi, Jharkhand Rahul 8 44–7
[10] Thomas J W 2000 A Review Of Research On Project-Based Learning
[11] Al-Zahrani M Y and Al-Bargi A 2017 The Impact of Teacher Questioning on Creating Interaction in EFL: A Discourse Analysis English Lang. Teach. 10 135
[12] Cañas A J, Novak J D and Reiska P 2012 Freedom vs. Restriction of Content and Structure during Concept Mapping - Possibilities and Limitations for Construction and Assessment Concept Maps Theory, Methodol. Technol. Proc. Fifth Int. Conf. Concept Mapp. 2 247–57
[13] Kemmis S and Mttaggart R 2007 <21157_Chapter_10.pdf> 271–330
[14] Pelton R P 2010 Action Research for Teacher Candidates
[15] Cronin P J, Dekkers J and Dunn J G 1982 A procedure for using and evaluating concept maps Res. Sci. Educ. 12 17–24
[16] Liu C C, Don P H and Tsai C M 2005 Assessment based on linkage patterns in concept maps J. Inf. Sci. Eng. 21 873–90
[17] Safdar M 2012 Concept maps: An instructional tool to facilitate meaningful learning Eur. J. Educ. Res. 1 55–64
[18] Tsai C C, Lin S S J and Yuan S M 2001 Students’ use of web-based concept map testing and strategies for learning J. Comput. Assist. Learn. 17 72–84
[19] Woro S 2015 The Strengths and Weakness of the Implementation of Project Based Learning Int. J. Sci. Res. 4 478–84
[20] Broggy J and McClelland G 2008 An Investigation to Determine the Impact of Concept Mapping on Learning in an Undergraduate Physics Course HE Acad. Commun. 1 34–8
[21] Kumar R, Sarukesi K and Uma G 2013 Exploring Concept Map and Its Role As Knowledge Assessment Tool (2009-2012) Int. J. Adv. … 2 1534–40
[22] Illeris K 2009 Contemporary theories of learning
[23] Poonpon K 2017 Enhancing English Skills Through Project-Based Learning English Teach. 10 1–10
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