Concept connection strategy to develop higher-order thinking in geography courses

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Abstract. The Connecting Concepts learning strategy is a logic game that asks students to connect two or more to form a logical narrative. The formation of a narrative that emerges from two concepts that are brought together is at the level of high order thinking (HOTS) in Bloom-Anderson's taxonomy. This research uses a quasi-experimental method with a pre-post test design. The sample was second grade high school students from three high schools in Sumedang, West Java Province, Indonesia (n=160). An independent t-test revealed significant differences in the mean scores on the pre-test in favor of the post-test ($p < 0.05$). It is concluded that the concept connection strategy has the potential to develop high-level thinking skills because it can increase students' creative thinking.

1 Introduction

21st Century education that develops critical thinking, collaboration, communication and creativity skills refers to a learning model oriented towards Higher Order Thinking Skills (HOTS). HOTS-oriented learning can be a bridge to train critical thinking, the ability to understand a complex problem by connecting one piece of information with other information so that various new perspectives emerge to find a solution to a problem. Critical thinking is the general term given to a wide range of cognitive skills and intellectual dispositions needed to effectively identify, analyse, and evaluate arguments and truth claims [1]. Cox proposed ten learning strategies to improve higher order thinking skills which are (1) help students determine what Higher-Order Thinking is, (2) connect concepts, (3) teach students to infer, (4) encourage students to question, (5) use graphic organizers, (6) teach students problem-solving strategies, (7) encourage students' creative thinking, (8) use mind movies, (9) teach students to elaborate their answers, and (10) teach QARs [2]. Researchers in the same context have proposed seven methods that have the potential to improve HOTS, namely (1) question and answer, (2) inquiry, (3) heuristics, (4) discussion, (5) role playing, (6) cycle nutation, and concept connection [3]. One strategy that has the potential to increase students' HOTS, especially in Geography subjects in high school is the concept connection strategy [2, 3].

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2 Methods

As an initial study to see the potential of the concepts connection strategy to increase students' HOTS, a quasi-experimental pre-test and post-test design was employed [4, 5]. The test was conducted by selecting a group of high school students (n=160) from three high schools in Sumedang, West Java, Indonesia. First having the group participated in a pre-test session, participated in class using concepts connection strategy as the triage method, and then compared post-test results with pre-test scores using probability statistics t-Tests analysis to show statistical significance. If post-test scores were above the pre-test scores, it can be assumed that the triage teaching strategy was potential to increase students' HOTS.

3 Results and Discussion

The concept connection strategy applied in Geography subjects invites students to connect one concept with another concept to form a concept that they understand completely, especially in material about the Flora and Fauna of Indonesia and the World. The learning implementation is as follows:

1) Students are divided into five groups
2) Each student is asked to read the lesson material and then each group writes 3-5 concepts that are considered important on a piece of paper
3) In the first round, two groups each were asked to propose one concept that had been written and the three other group tried to connect the two concepts
4) The second and subsequent rounds are carried out alternately, two groups each propose one concept, and the other group tries to connect them.
5) The game ends after all groups have had a turn connecting the concepts.
6) For each group whose turn it is to play, the teacher provides reinforcement by clarifying the analysis that is not quite right or providing a more in-depth review of the analysis that is correct.

After the above learning activities are completed, students are asked to take the post-test again and the results are shown in the following table:

Table 1. Mean scores on connecting concepts competencies

Schools	Class	n=160	Pre-test mean	Post-test mean	t	p
SMA Cimalaka	2nd Social	24	57,22	71,66	2,012	0,035
SMA Cimalaka	2nd Natural	26	26,02	71,79	2,008	0,000
SMA 3 Sumedang	2nd Social	27	28,38	62,86	1,995	0,000
SMA 3 Sumedang	2nd Natural	25	26,00	57,60	2,011	0,000
SMA 2 Sumedang	2nd Natural	27	24,69	26,17	2,006	0,556
SMA 2 Sumedang	2nd Social	31	20,32	41,29	2,001	0,000

The mean of post-test scores were significantly higher than pre-test scores ($p < 0.05$), except for only one class. An independent t-test also revealed significant differences in the mean scores on the pre-test in favor of the post-test ($p < 0.05$), except for only one class. The results of this initial study show that concept connection games can be used to develop HOTS. Concept connection is a basic principle of students' inquiry process which can be observed from their train of thought when creating narratives or statements that connect two or more

concepts. The concept connection in Bloom's taxonomy, is the Creation level (C-6) because in it there is a serious effort to produce a rational train of thought. The inquiry process is often interpreted as students' efforts to answer questions without paying attention to the number of concepts contained in the question [6]. In the inquiry process, the number of concepts becomes a standard for the level of difficulty in thinking. Below are examples of questions containing one, two, and three concepts.

1) When does the sun circulate on the Tropic of Cancer?
2) Why do teak trees in Indonesia wither when the sun is on the Tropic of Cancer?
3) During El Nino symptoms, even though the sun is on the Tropic of Capricorn, teak trees in Indonesia are still withering. Why does this happen?

The three questions above, students will think harder to answer question number three because there are three connected concepts. Concept connection strategies are a family of cognitive learning theories that are built on the assumptions of knowledge construction from the processes of assimilation, accommodation and equilibrium [7, 8]. The concept connection strategy was developed long ago by Ausubel [9]. The idea is that learning occurs through the assimilation of new concepts and propositions into the propositional framework of existing concepts held by the learner. The development of Ausubel's theory was carried out by Novak by realizing it in the form of a concept map [10]. He believes that concept mapping is very useful for facilitating meaningful learning. Concept mapping can help organize knowledge. Concept maps not only enable the utilization of knowledge in new contexts, but also the storage of knowledge for long periods of time [10, 11].

4 Conclusion

Concept connection strategies in geography learning have the potential to train HOTS in students. Apart from this potential, the concept connection strategy also requires teachers to improve students' logic and train of thought when they make mistakes in explaining the results of their concept connections. Apart from that, teachers have to think hard to connect concepts if the concepts shown in the game are random. If the teacher fails to make conclusions between two or three connected concepts, this can threaten the decline in students' confidence in the teacher's competence in the classroom.

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