Activity

8

Concept Maps: Connecting the Dots

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Context: Out of class, Foundations of Engineering
Keywords: first-year experience; concept maps
Student Activity Time: 1-3 hours

Students reflected on their knowledge of the class concepts and how those concepts are related.

Introducing the Reflection Activity

In an introduction to engineering class at Virginia Tech, first-year engineering students reflected on their experiences and learning while they are solving ill-structured problems by creating a series of six concept maps. Students constructed the initial and final overview concept maps individually, and the intervening sub-concept maps as groups based on specific course experiences such as an in-class discussion or an assignment. Group sub-concept maps focused on refining specific areas of the initial individual overview concept maps. CMAP Tools software was used to facilitate concept map construction. The final concept map was constructed through reflection on the initial and sub-concept maps.

This field guide entry focuses on the final concept map because it was an opportunity to compare the first and last concept maps, and a culmination of the six concept map sequence at the end of the semester, which makes visible student progress over the course of the class. In this individual assignment, students refined or reconstructed their concept map in response to the question: "what are key skills involved in problem solving and how do they support problem solving?" This reflection asked students to look back at their first concept map and sub-concept maps to explore how their understanding of problem solving changed. Students were required to elaborate the connections between concepts and skills and elements of the key skills discussed in class: problem formulation, visual representation, questioning strategies, communication, and evaluation/self-awareness. They were also encouraged to think broadly beyond these skills.

In terms of outcomes, this activity provided students with an opportunity to think deeply about skills involved in problem solving and to describe the connections between these skills. This reflection activity has the potential to enhance students' problem solving skills, and that they can think differently and more deeply about problem solving.

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8.1 Summary of Concept Map Assignments

Recreating the Reflection Activity

	Description
1	Introduce the idea of concept maps and CMAP software. (Complete once, prior to the first concept map.)
2	Position students to make strong connecting words, including facilitating a discussion about connecting words, guiding students through constructing a practice concept map about something known and personal, showing students examples, and showing students related video from the web. This is achieved through in-class practice map and feedback on initial and sub-concept maps leading up to the final concept map.
3	Discuss with students the evaluation and purpose of the concept maps.
4	Assign the final concept map. In class and outside of class, provide students with assignment description, i.e., via course website, printed copy in class, and/or projecting.
5	Allow students 2-3 days to complete the concept map assignment, focusing students' attention on the course content.
6	Grade assignment using a "specs" grading rubric. Specs grading is a level scaled grading based on thoughtful, honest effort—did the student put forth a really thoughtful, honest effort? Did they kind of have a lackluster effort? Or essentially no effort?
7	Debrief class after grading the assignment.

In the words of the Educator: Tips and Inspiration

Give students opportunities to practice making concept maps. I think it is important to give students opportunities to practice making concept maps.

Help students see the relevance and usefulness of concept maps. Thoughtfully constructed concepts maps can help students develop a richer understanding of course content and identify where their understanding is weak. Also, engage students in making a number of concept maps to support the refinement of students' thinking, but not so many that they develop concept map fatigue.

Use a "specs" grading approach to cut down on the overhead in grading. This grading approach will help educators avoid grading every little detail, which has the potential to making grading tedious for the educator and not always as informative for the students.

Debrief students on the assignment. When handing the written assignment back to students, take a few minutes to debrief what you saw in the reflections.

Provide opportunities to catch and correct misconceptions. Do not let misconceptions take root and grow. Some options for evaluating and correcting concept maps include: providing brief feedback along with your specs grading, giving general feedback to the class, having students conduct peer reviews, having students collaborate on concept map construction or revision, or having students compare their maps to an "expert" concept map.

What was the inspiration for the reflection activity? In exploring the use of concept maps for this course, my thinking was influenced by my: (1) use of concept maps as an advance organizer in a different course; (2) interest in the scholarly problem solving work of Educational Psychologist David Jonassen; and (3) collaboration with colleagues at Virginia Tech.

Previously in a different course, I had used a concept map as an advanced organizer, as a way to show the progression and connections of the concepts. I started thinking that it was a good first step for students to see how others think the content is structured, but I was curious what would happen if I asked them to articulate how the class content was structured and interconnected.

This class and the overall problem solving module, were largely influenced by the work of David Jonassen in his book "Learning to Solve Problems: A Handbook for Designing Problem-Solving Learning Environments."[1] In this work, Jonassen emphasizes the importance of key cognitive tasks or skills that support ill-structured problem solving.

My primary influence came from talking with other people teaching this class at Virginia Tech. In redesigning the class, one of the learning objectives was to help students learn how to work through an authentic engineering task. In my search of approaches to help students assimilate their understanding and experience of problem solving, one pedagogical approach that seemed promising was concept maps. What were particularly salient about concept maps were the differences between expert and novice knowledge and the frameworks that experts have versus the sparsely populated, less connected information that students typically have. I saw concept maps as a way of promoting richer interconnection of content and elaboration around content within that conceptual space.

[1] Jonassen, D. H. (2010). *Learning to solve problems: A handbook for designing problem-solving learning environments.* Routledge.