This presentation introduces concept maps, and presents reasons why we may want to use concept maps for assessment.
Outline of the presentation:
- What concept maps are, why we care about them, and how we make concept maps.
- How to use concept maps for assessment in different ways.
- In the final part you will make concept maps collaboratively using a digital tool and talk about your experience.
In 1972, Joseph Novak and his research team at Cornell University have developed the technique of concept mapping as a means of representing the emerging science knowledge of students. Concept maps have their origin in the learning movement called constructivism. Novak's work is based on the cognitive theories of David Ausubel (assimilation theory), who stressed the importance of prior knowledge in being able to learn new concepts. When the meaningful learning takes place, some changes in our cognitive structure occur, modifying the previous concepts, and linking them with the new ones.
Concept maps are graphical tools for organizing and representing knowledge. With concept maps, you can organize ideas about a particular topic so that relationships among various subtopics can be displayed visually. It has been used as a tool to increase meaningful learning in the sciences and other subjects as well as to represent the expert knowledge of individuals and teams…
• Concept maps include concepts, usually enclosed in circles or boxes.
• Concepts are connected with labeled arrows, showing the relationships between concepts.
• The relationship between concepts is articulated with linking phrases, e.g., "gives rise to", "results in", "is required by," or "contributes to".
• A final feature that may be added to concept maps is specific examples of events or objects that may help to clarify the meaning of a given concept. Normally these are not included in ovals or boxes, since they are specific events or objects and do not represent concepts.
Concept maps can take many forms. But, we can place concept maps into 4 large categories.

- **Spider**: Organized by placing the central theme or unifying factor in the center of the map. Outwardly radiating sub-themes surround the center of the map.
- **Hierarchical**: Presents information in a descending order of importance. The most important information is placed on the top. Distinguishing factors determine the placement of the information.
- **Flowchart**: Organizes information in a linear format.
- **Systems**: Organizes information in a format which is similar to a flowchart with the addition of 'INPUTS' and 'OUTPUTS'.
An example concept map (source: Google images).
In this example the concepts are represented in a hierarchical fashion with the most inclusive, most general concepts at the top of the map and the more specific, less general concepts arranged hierarchically below. The hierarchical structure for a particular domain of knowledge also depends on the context in which that knowledge is being applied or considered. So, it is best to construct concept maps with reference to some particular question we seek to answer, which we have called a focus question.
Another example of hierarchical concept map.
Why create concept maps?

- To display a concept’s components
- To visualize the relationships
- To organize thoughts
- To measure concept understanding
- To discover new problem solving methods
- To promote creativity, as well as effective externalization and visualization of ideas (Cristea & Okamoto, 2001)

- You can use concept maps to display a concept’s components, using boxes or circles, and visualize the relationships among a set of connected concepts and ideas. You can organize your thoughts or of lots of information into a form that is easily understood.
- Linking concepts and visualizing their relations may help discover new problem solving methods.
- Concept maps can be used as knowledge organizing tools, meaningful learning tool, and assessment tool.
Concept Maps can be used to externalize and make explicit the conceptual knowledge (both correct and erroneous) that students hold in a knowledge domain. Because, concepts maps:

• are objective, meaningful assessments through which the instructor can monitor student progress, self-evaluate instruction, and revise the delivery of instruction in the classroom.
• are effective in identifying both valid and invalid ideas held by students.
• can be a useful for assessing both the knowledge students have coming into a program or course and their developing knowledge of course material.
• can give students and faculty meaningful information about student performance, and indirectly the performance of the instructor in the classroom.
• can be used to model experts’ thinking.

Concept maps, as assessment tools, can be thought of as a set of procedures used to measure the structure of a student’s declarative knowledge.
Summative:

- Ask students to create a concept map at the beginning of the semester to assess the knowledge they have coming into a course. This can give you a quick window into the knowledge, assumptions, and misconceptions they bring with them and can help you pitch the course appropriately.
- Assign the same concept map activity several times over the course of the semester. Seeing how the concept maps grow and develop greater nuance and complexity over time helps students (and the instructor) see what they are learning. For example, studies of students’ concept mappings over time have revealed that as expertise within a domain is developed, vocabulary becomes increasingly precise and more interconnections between concepts are created.
Concept maps for assessment

- Develop your own version of a map for a particular concept; extract a list of critical related concepts, and use it as a grading guide.
- Consider emphasizing the accuracy or validity of the knowledge students represent rather than an exact replica of what you consider correct.
- Ensure your grading technique covers key concepts and links, allowing for unexpected and creative responses.

(Angelo & Cross, 1993; Zeilik, 1999)
There are multiple ways of using concept maps as assessment tools.

**Do as a small group activity.** Give your students a problem, case study, or question about a key concept. Divide them into small groups of 4-5 students. Have each group create a concept map as they analyze and synthesize previously learned information into this new scenario. Have the groups present their conclusions.

**Do as a whole class activity.** As a class, create, a concept map and use it as a springboard to discuss relationships among the concepts and ideas listed in the map.

**Fill in the blanks.** Before class, create a concept map of the material you want to cover in class. Then, remove some of the concepts and labels. Give the map to students to complete.

**Use as an in-class pre-assessment.** Prior to discussing a topic, ask students to create a concept map. Then, as you discuss the information, they can add to or modify their map to reflect their understanding about the topic.
Steps to follow for CM exercise

1. Create a focus question (instructor)
2. Generate a list (students or instructor)
3. Revise (students)
4. Score (students or instructor)

1. Create a focus question that clearly specifies the issue that the concept map should address, such as “What are the potential effects of cap-and-trade policies?” or “What is materials science?”
2. Tell students (individually or in groups) to begin by generating a list of relevant concepts and organizing them before constructing a preliminary map.
3. Give students the opportunity to revise. Concept maps evolve as they become more detailed and may require rethinking and reconfiguring.
4. Students and/or instructor can score the concept maps based on the rubric the instructor decide to use.
For teachers wishing to measure students’ conceptual change, the following scoring guide adapted from Novak & Gowin (1984) and used by Markham, Mintzes, and Jones (1994) should provide a good starting point.

<table>
<thead>
<tr>
<th>Element</th>
<th>Definition (Jones &amp; Vesilind, 1994)</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concepts</td>
<td>represent major ideas</td>
<td>1 pt. for each concept</td>
</tr>
<tr>
<td>Relationships</td>
<td>indicate the extent of domain knowledge</td>
<td>1 pt. for each valid relationship</td>
</tr>
<tr>
<td>Branching</td>
<td>represent progressive differentiation in the knowledge domain</td>
<td>1 pt. for the first branching</td>
</tr>
<tr>
<td>Hierarchies</td>
<td>represent knowledge subsumption</td>
<td>3 pts. for each successive branching</td>
</tr>
<tr>
<td>Crosslinks</td>
<td>reflect the extent of knowledge integration and synthesis</td>
<td>5 pts. for each hierarchy</td>
</tr>
<tr>
<td>Examples</td>
<td>represent specificity of knowledge</td>
<td>10 pts. for each crosslink</td>
</tr>
</tbody>
</table>

Markham, Mintzes, and Jones (1994)
Pros and Cons

Pros
- Practical
- Engaging
- Objective
- Allows for self-assessment
- Creative
- Collaborative use (e.g., Haugwitz, Nesbit, & Sandmann, 2010)

Cons
- Using concept maps for grade-based evaluation
- May be challenging for those who are used to rote learning

It may be challenging to evaluate what level of construction on a concept map represents a meaningful level of understanding by students. Concept maps should show both breath and depth of knowledge.
Example: Collaborative Use (Haugwitz et al., 2010)

- 248 secondary students
- 77 self-selected collaborative groups
- Biology
- Essay or concept map

Collaborative use example:

Data were gathered from 248 secondary students who learned about the circulatory system in 77 self-selected collaborative groups. The learning outcomes of biology students who summarized by collaborative concept mapping were compared with those of students who summarized by collaborative writing. Learning groups randomly assigned to construct concept maps instead of conventional summaries generated more relations in the summary task and their members obtained higher individual scores on a post-test (Haugwitz, Nesbit, & Sandmann, 2010).
Can also use google docs drawing.
Standalone CM Tools

• Cmap (http://cmap.ihmc.us/)
• Xmind (http://www.xmind.net/)
• Inspiration (http://www.inspiration.com/)
• Kidspiration (http://www.inspiration.com/Kidspiration)
Lets Make a Concept Map!

Step 1
Go to www.giffany.com
- Start by placing Main Idea (in our case, "Assessment") in the center circle.

Step 2
- Make a list of all possible items you want to include in your map.
- Highlight all of the Large Topics.
- Place the highlighted topics in circles around the center circle or graphic.
- Draw lines to connect each of the Large Topics to the Main Idea.

Step 3
- List the Subtopics that are part of each Large Topic.
- Place these Subtopics into the next set of circles or graphics out from the Large Topic they are related to.
- Draw lines to connect each of the Subtopics to their Large Topic.

Step 4
- Check the connections on your map. Label the relationships. If you think something should be in a different place, move it.
- Make sure you have at least two Subtopics for every Large Topic listed!!
References