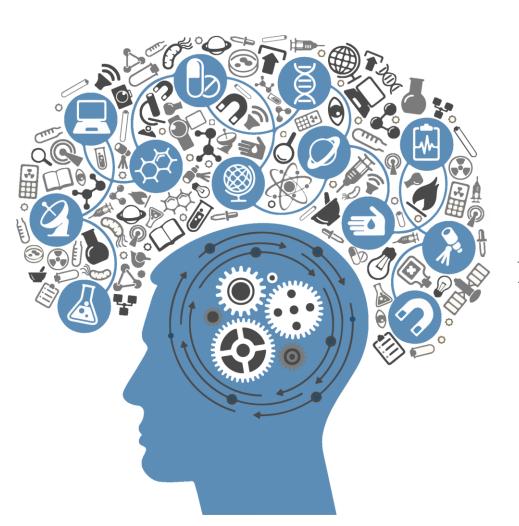
Concept Maps as Teaching, Learning, and Assessment Tools



A Serve-Learn-Sustain Assessment Workshop

Presented at the Georgia Institute of Technology Friday January 20, 2017

By:

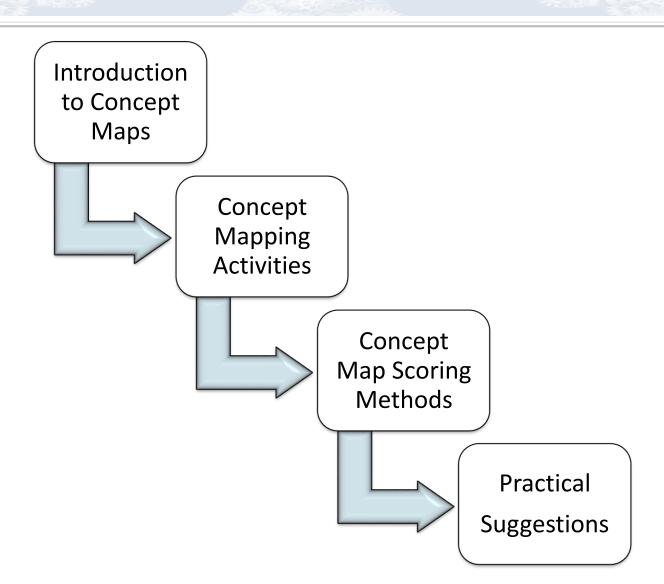
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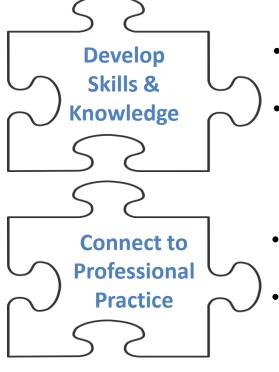


Workshop Overview



"Serve-Learn-Sustain" Context

Serve-Learn-Sustain (SLS) Learning Outcomes:



- <u>Identify</u> relationships among ecological, social, and economic systems.
- <u>Describe</u> how sustainability and community engagement relate to their civic lives.

- <u>Describe</u> how sustainability relates to their professional practice.
- <u>Describe</u> the social and cultural impact of their professional practice.

Many outcomes target improving conceptual knowledge.

What is Conceptual Knowledge?

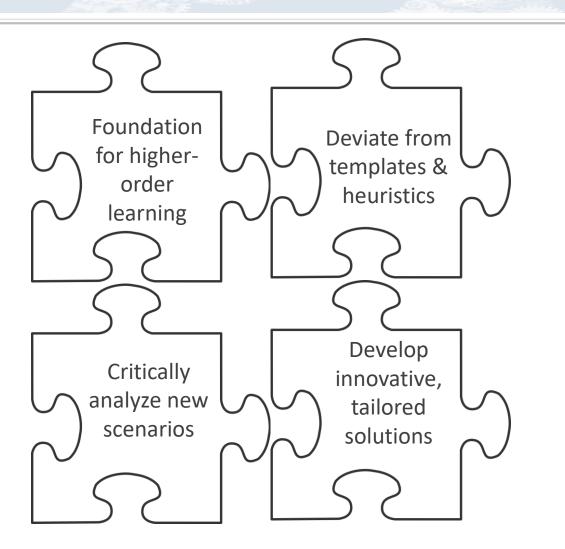
Includes facts, generalizations, and principles.

Includes relationships between concepts.

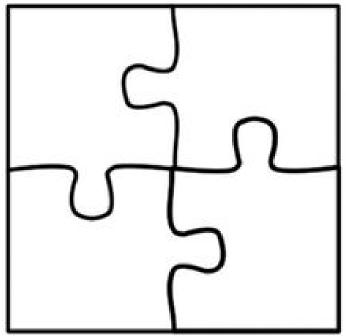
Encompasses how facts are organized.

Should be deep and rich with connections.

Why is conceptual knowledge important?

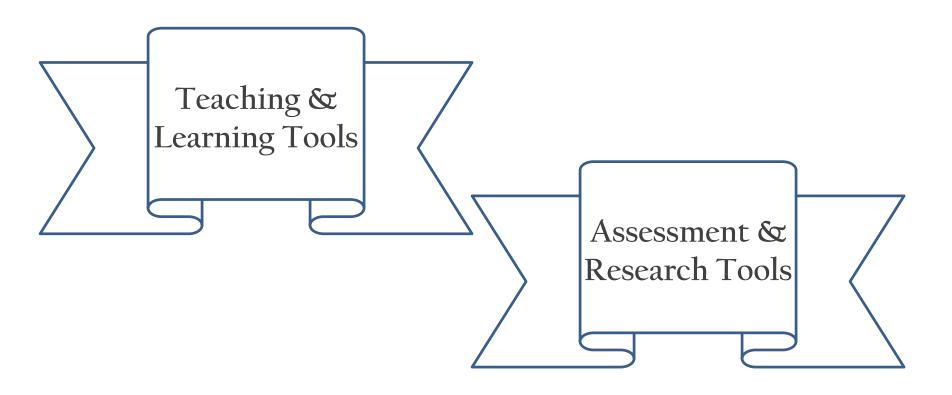


Conceptual Knowledge



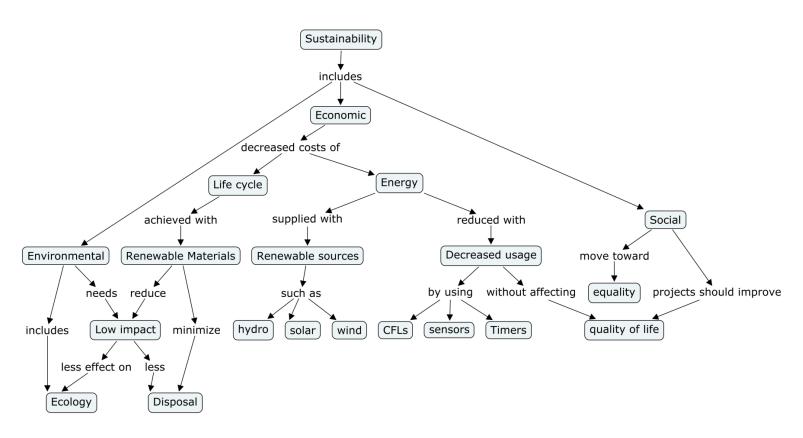
Need for Assessments

Given the role of conceptual knowledge in professional competence, there is a need for appropriate:



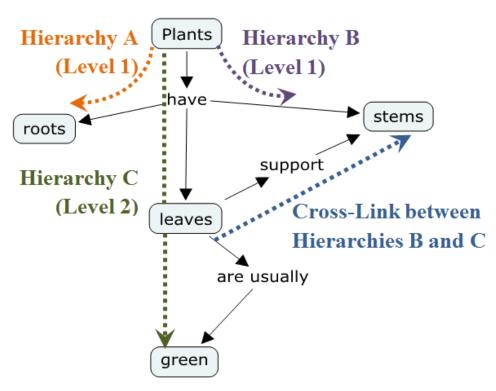
Concept Maps (Cmaps)

Cmaps are graphical tools for organizing and presenting knowledge.



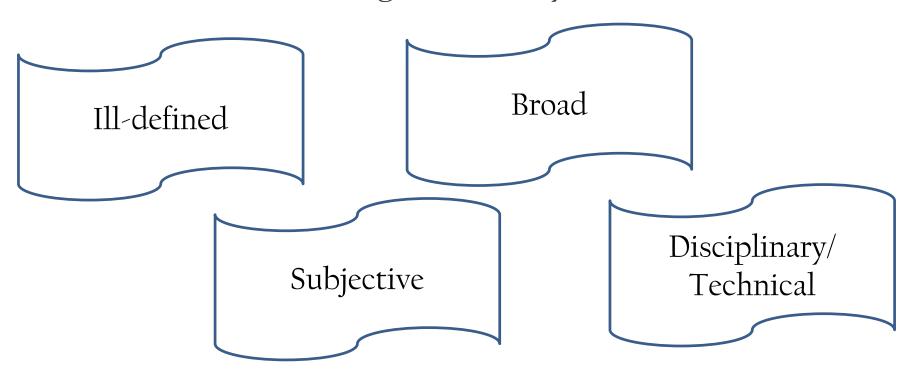
Introduction: Construction of a Concept Map

- Include concepts related to a central topic in boxes.
- Connecting lines with phrases show concept relationships.
- Cmap Components
 - Propositions
 - Hierarchies
 - Cross-links



Examples of Concept Maps in Higher Education

Cmaps can be used to promote & assess knowledge in a variety of areas:



"Serve-Learn-Sustain" Context

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Concept maps can be used to promote *learning* and assessment of SLS outcomes.

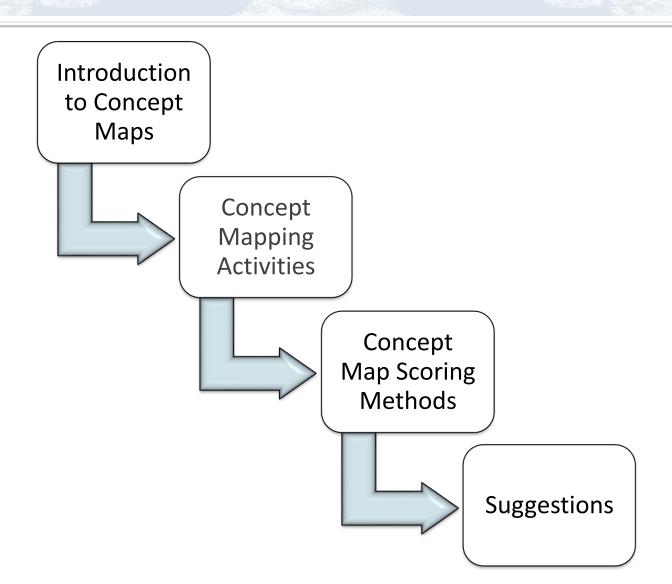
Activity #1:

Cmap Applications for "Serve-Learn-Sustain"



- Make a list of SLS topics that could be assessed using cmaps.
- Identify the SLS outcome associated with each topic.

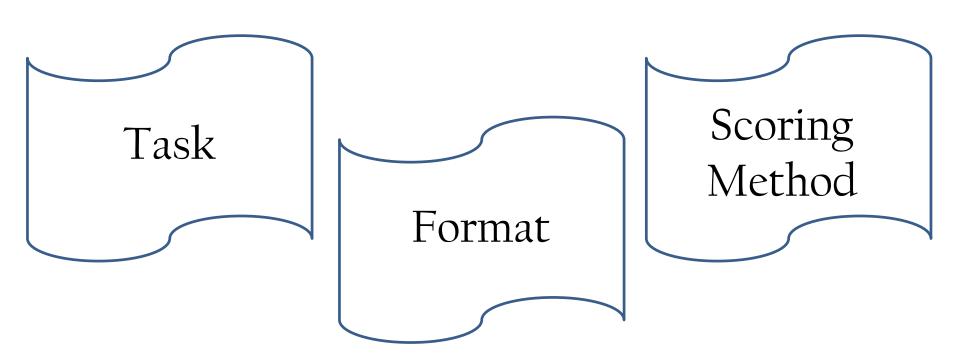
Workshop Overview



Concept Map Activities:

Key Components

Three components of a concept mapping activity/assessment:



Concept Map Activities:

Task

Several levels of task directedness:

Low Directedness

Construct-a-Map:

Students structure their own maps using original concepts and linking phrases.



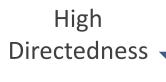
<u>Intermediate:</u>

Students create their own map structure using instructor-provided concepts and/or linking phrases.

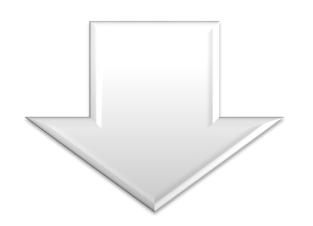


Fill-in-a-Map:

Students fill in blank structure with instructorprovided concepts and linking phrases.



Concept Map Activities: Format



By Hand:

Easy to administer

No program to learn

Difficult to organize cmap

Can be harder to score

CmapTools:

Easy to organize cmap

Can be easier to score

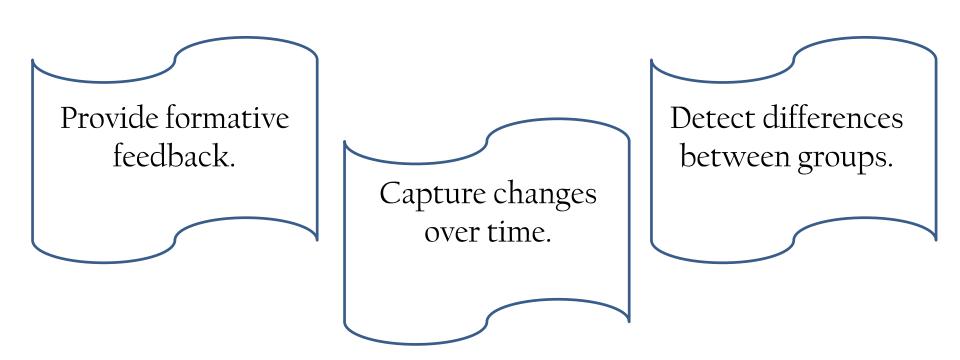
Program easy to learn

Requires computers to administer



Concept Map Activities: Scoring

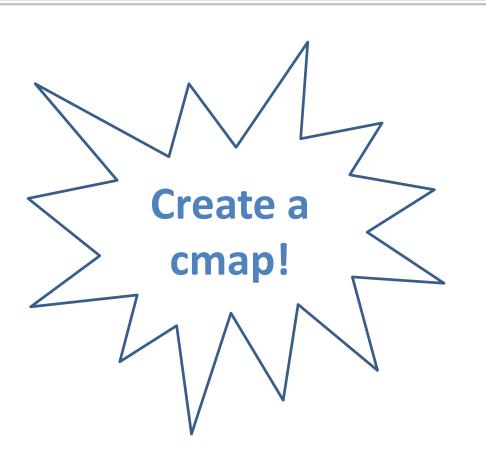
Scoring methods needed to:



Scoring is the major bottleneck in use of concept maps.

Concept Map Activities:

Activity #2



- Choose an SLS topic and create a concept map using the poster board.
- You can work individually or in groups.
- Post your concept map at the front when you are done!

Concept Map Activities:

Ready to Try in Your Classroom?

Before Pre-Assessment

Watch training video

Download CmapTools

Construct practice cmap

Pre-Assessment

Quick (5 min or less) cmap refresher

Provide focus topic/question

Allow at least 20 – 30 min for cmap activity

For CmapTools, submit .cmap file

For paper, provide large 11 x 17 paper

Post-Assessment

Quick (5 min or less) cmap refresher

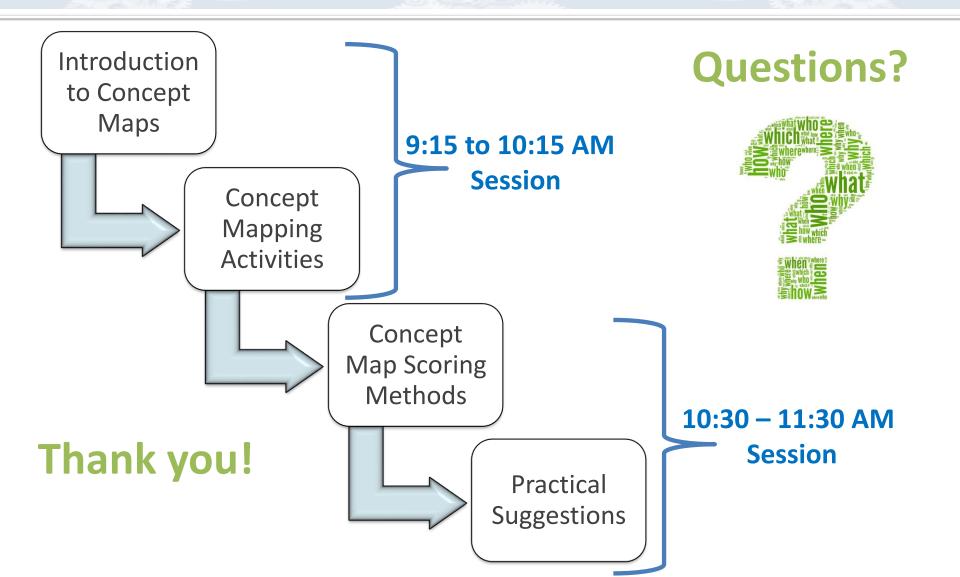
Provide focus topic/question

Allow the same amount of time as preassessment

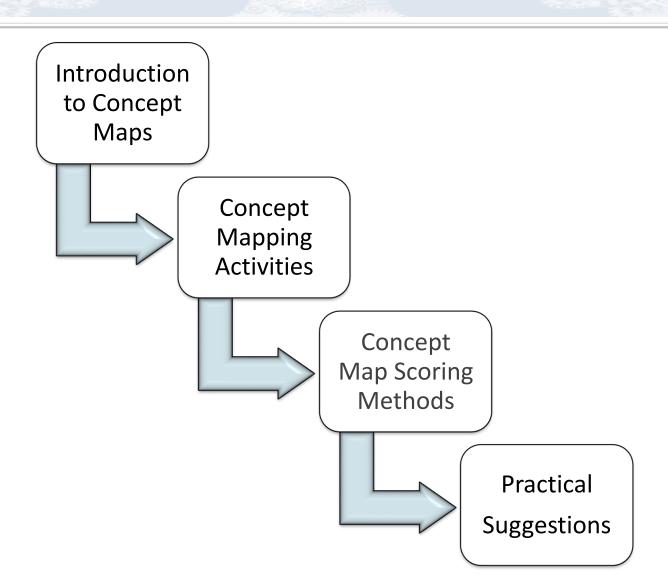
Use the same format (CmapTools or paper) as pre-assessment

Sample resources available in workshop folders.

Workshop Transition



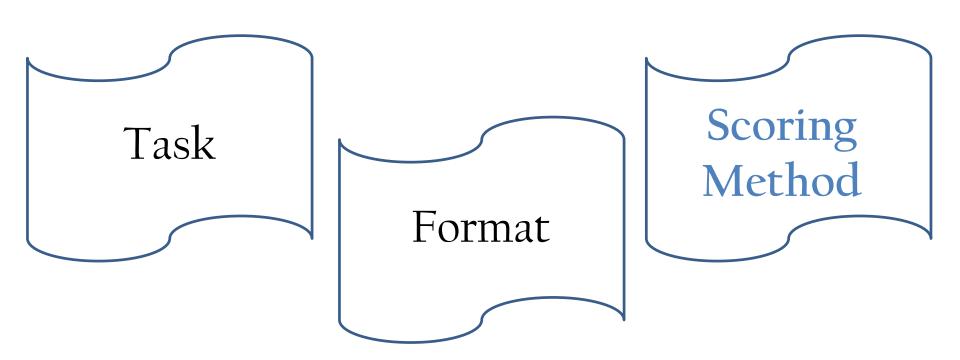
Workshop Overview



Concept Map Activities:

Key Components

Three components of a concept mapping activity/assessment:



Overview of Methods

Structure

Counting
Components
(Traditional
Method)

Content

Qualitative Concept Coding Hybrid (Structure & Content)

Interlinks & Complexity

Analytic Rubric

Overview of Methods

Structure

Counting
Components
(Traditional
Method)

Content

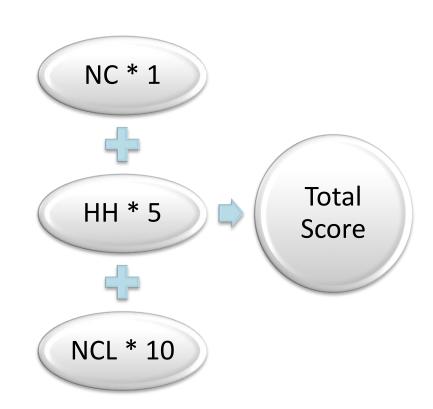
Qualitative Concept Coding Hybrid (Structure & Content)

Interlinks & Complexity

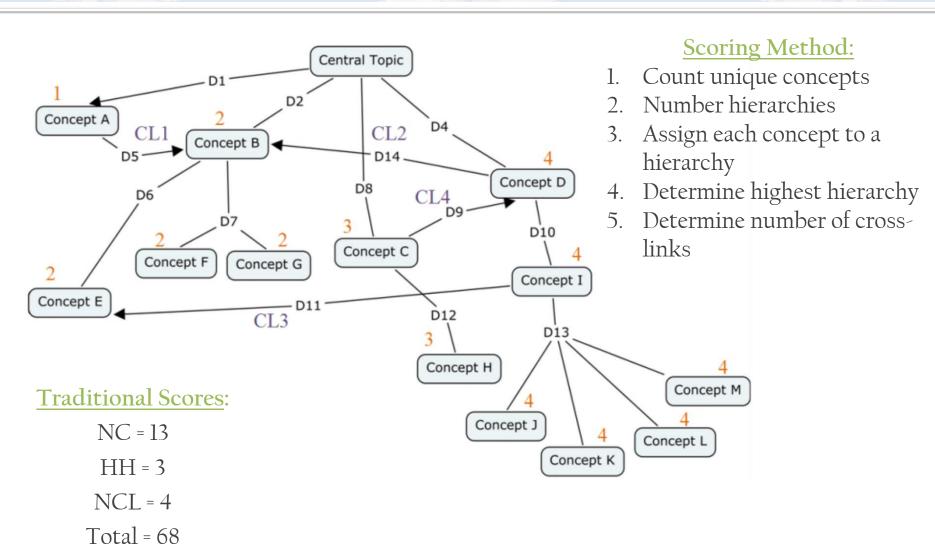
Analytic Rubric

Traditional Scoring Method

- Number of concepts (NC) represents knowledge breadth sub-score.
- Highest level of hierarchy (HH) represents knowledge depth.
- Number of cross-links (NCL) represents knowledge connectedness.



Traditional Scoring Method



Concept Map Assessments:

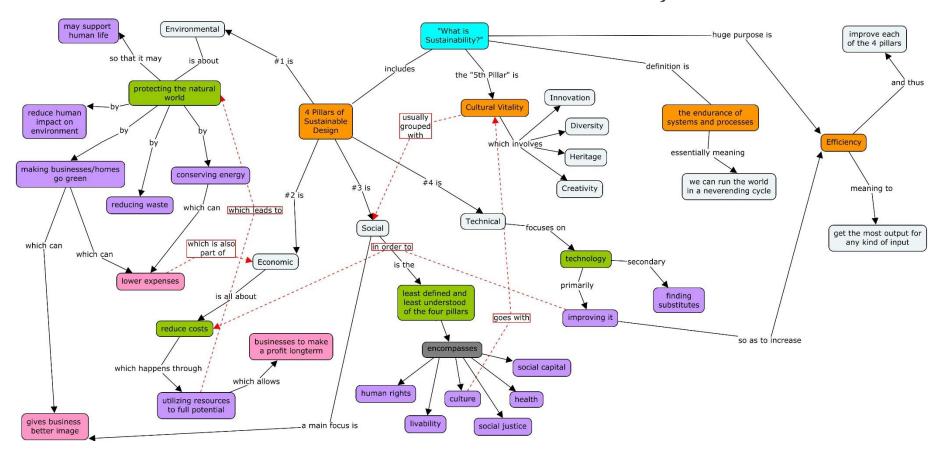
Activity #3



- Count unique concepts
- Number hierarchies
- Assign each concept to a hierarchy
- Determine highest hierarchy
- Determine number of cross-links

Traditional Scoring Method

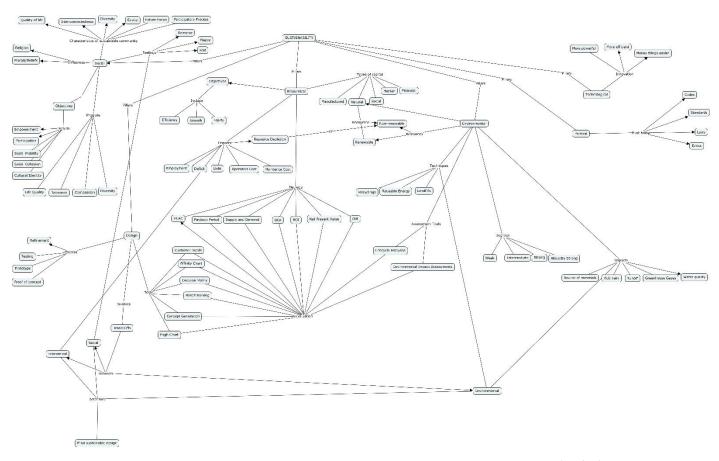
The traditional method seems easy...



But what about this one???

Traditional Scoring Method

Or this one???



A concept map scoring program is available!

Overview of Methods

Structure

Counting Components (Traditional Method) Content

Qualitative Concept Coding Hybrid (Structure & Content)

Interlinks & Complexity

Analytic Rubric

Qualitative Concept Coding

A study conducted in CEE at Georgia Tech:

Environment

Future

Resource scarcity

Unbalances (spatial)

Social impact

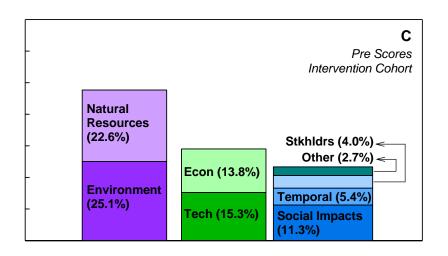
Technology

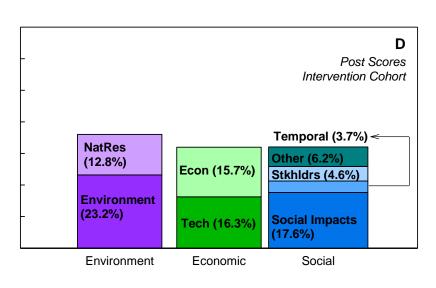
Values

Economy

Education

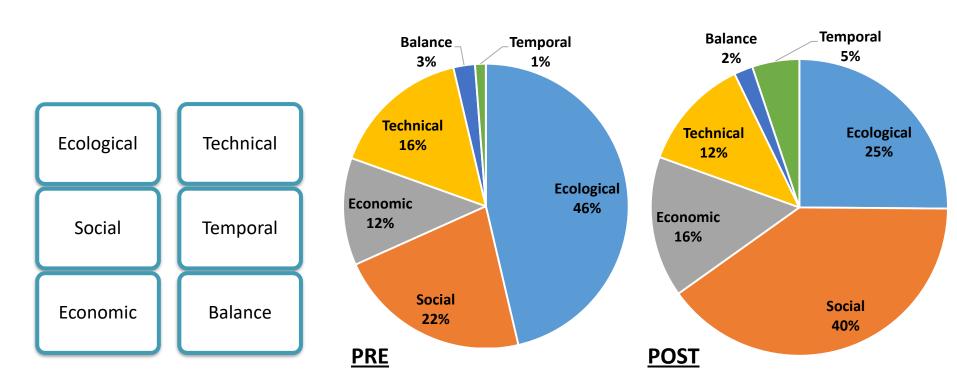
Actors/ Stakeholders





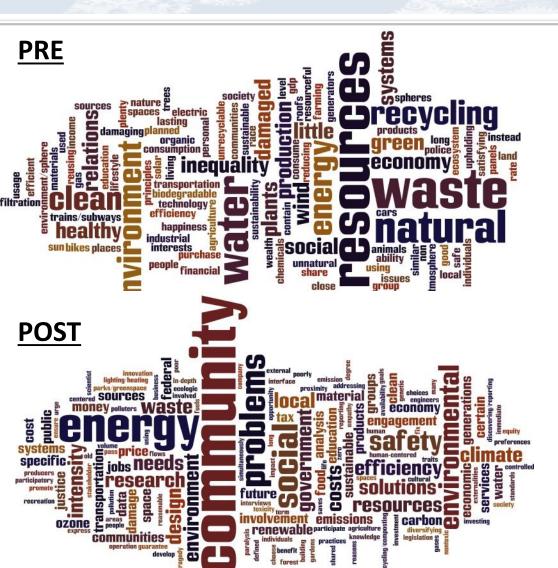
Concept Map Scoring: Qualitative Concept Coding

A study conducted in an SLS course:



You can choose any categories that are of relevance to your concept maps.

Qualitative Concept Coding



Word clouds can provide quick, easy qualitative analysis.

Try Wordle!

Overview of Methods

Structure

Counting
Components
(Traditional
Method)

Content

Qualitative Concept Coding Hybrid (Structure & Content)

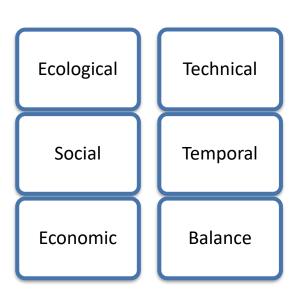
Interlinks & Complexity

Analytic Rubric

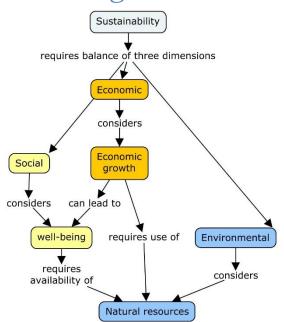
Interlinks and Complexity

STEP 1:

Categorize each concept in the concept map.



STEP 2: Count "interlinks" between concepts from different categories.



STEP 3:

Calculate complexity for each concept map.

$$CO = NC * \frac{NIL}{N_{CAT}}$$

CO = Complexity

NC = No. Concepts

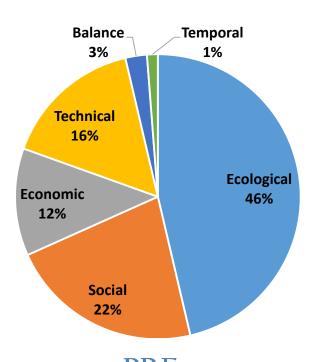
NIL = No. Interlinks

NCAT = No. Categories

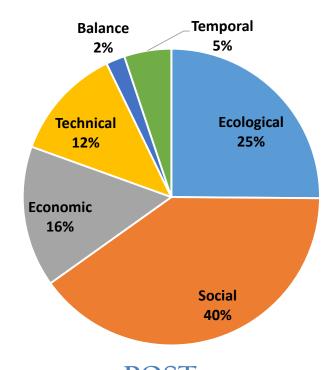
Captures content and structure of concept maps.

Concept Map Scoring: Qualitative Concept Coding

A study conducted in an SLS course:



<u>PRE</u> Avg. NIL = 5.2 Avg. CO = 23.4



<u>POST</u> Avg. NIL = 14.7 Avg. CO = 137.8

Overview of Methods

Structure

Counting
Components
(Traditional
Method)

Content

Qualitative Concept Coding Hybrid (Structure & Content)

Interlinks & Complexity

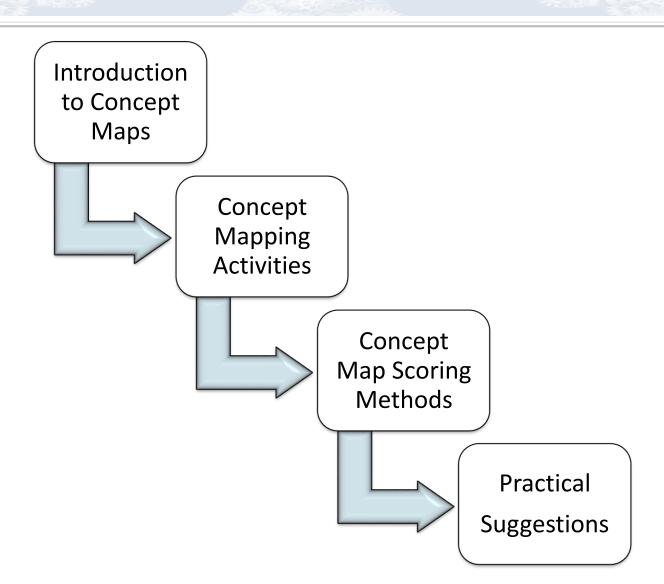
Analytic Rubric

Analytic Rubric

Besterfield-Sarce et al. 2004 Rubric

	1	2	3	
Comprehensiveness – covering completely/broadly	The map lacks subject definition; the knowledge is very simple and/or limited. Limited breadth of concepts (i.e. minimal coverage of coursework, little or no mention of employment, and/or lifelong learning). The map barely covers some of the qualities of the subject area.	The map has adequate subject definition but knowledge is limited in some areas (i.e., much of the coursework is mentioned but one or two of the main aspects are missing). Map suggests a somewhat narrow understanding of the subject matter.	than one extension area	Considers content
Organization – to arrange by systematic planning and united effort	The map is arranged with concepts only linearly connected. There are few (or no) connections	The map has adequate organization with some within/between branch connections. Some, but not complete, integration of branches is apparent. A few feedback loops may exist.	The map is well organized with concept integration and the use of feedback loops. Sophisticated branch structure and connectivity.	Considers
Correctness - conforming to or agreeing with fact, logic, or known truth	The map is naïve and contains misconceptions about the subject area;	The map has few subject matter inaccuracies; most links are correct. There may be a few spelling and grammatical errors.	The map integrates concepts properly and reflects an accurate understanding of subject matter meaning little or no misconceptions, spelling/grammatical errors.	Adaptation for sustainability-focused cmaps is available in workshop folder.

Workshop Overview



Practical Considerations

Impact of Format on Scoring

CmapTools makes scoring easier!

Cmaps are more organized & legible.

Allows for use of automated scoring.

Easy export of concepts for coding

Choice of Scoring Method(s)

Two methods can support validity of results.

Capture aspects of content and structure.

Consider whether multiple raters are needed.

Student Grades vs. Assessment Scores

Assessment scores may not be appropriate as grades.

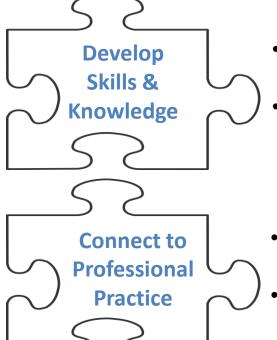
There is often no right or wrong answer.

Scoring methods may not provide timely, meaningful feedback.

Closing & Summary:

"Serve-Learn-Sustain" Context

Serve-Learn-Sustain (SLS) Learning Outcomes:

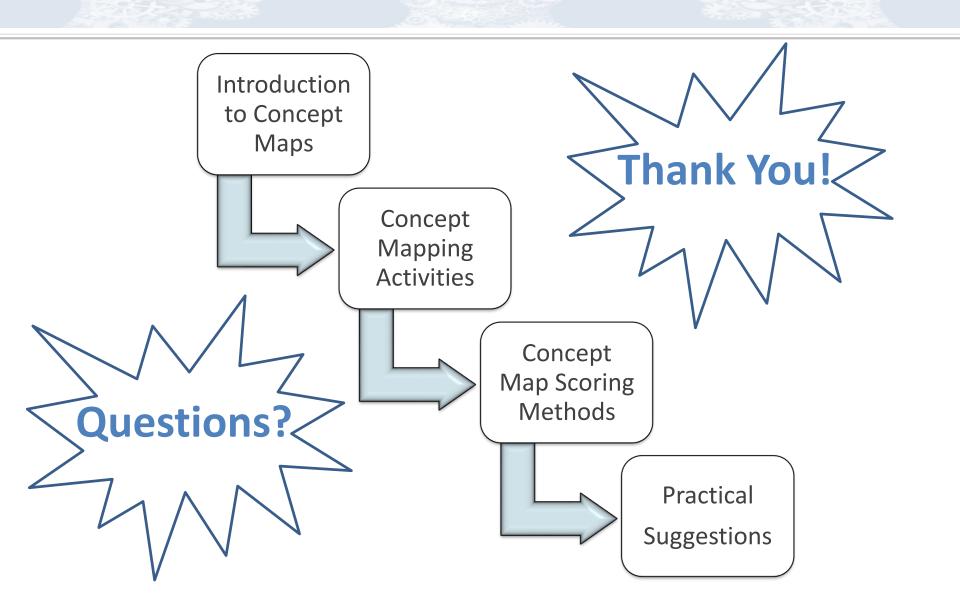


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- <u>Describe</u> how sustainability relates to their professional practice.
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Concept maps can be used to promote *learning* and assessment of SLS outcomes.

Workshop Overview



References

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- 14. Barrella, E., Henriques, J. Gipson, K. (2016). Using concept maps as a tool for assessment and continuous improvement of a first year course. Proceedings of the 2016 ASEE Annual Conference & Exposition, Atlanta, GA, June 26-29, 2016.