

# THE USE OF CONCEPT MAPS FOR ASSESSMENT

## Assessing Concept Maps

A concept map is a visual representation of knowledge. The process enables one to organize and structure information and the relationships between them. This may be done in a wholly graphical manner i.e. using images, photos, colour etc. to highlight differing concepts and their linkages or by identifying key the concepts by name or title and enclosing them in a visual box then providing connecting navigation to lesser concepts.

They have been described as:

- ‘..are graphical tools for organizing and representing knowledge. They include concepts, usually enclosed in circle or boxes of some type, and relationships between concepts indicated by a connecting linking two concepts’ (Novak & Canas, 2008, p1)

Developed in 1972, their roots are in cognitive psychology, They can be hand-written or computer tool A traditional concept provides a hierarchical representation of the information from top down, using preposition to form statements (See Figure 1), whereas a mind map may radiate from a central single concept only. Novak and Canas (2008) present a concept map of a concept map (Figure 1).

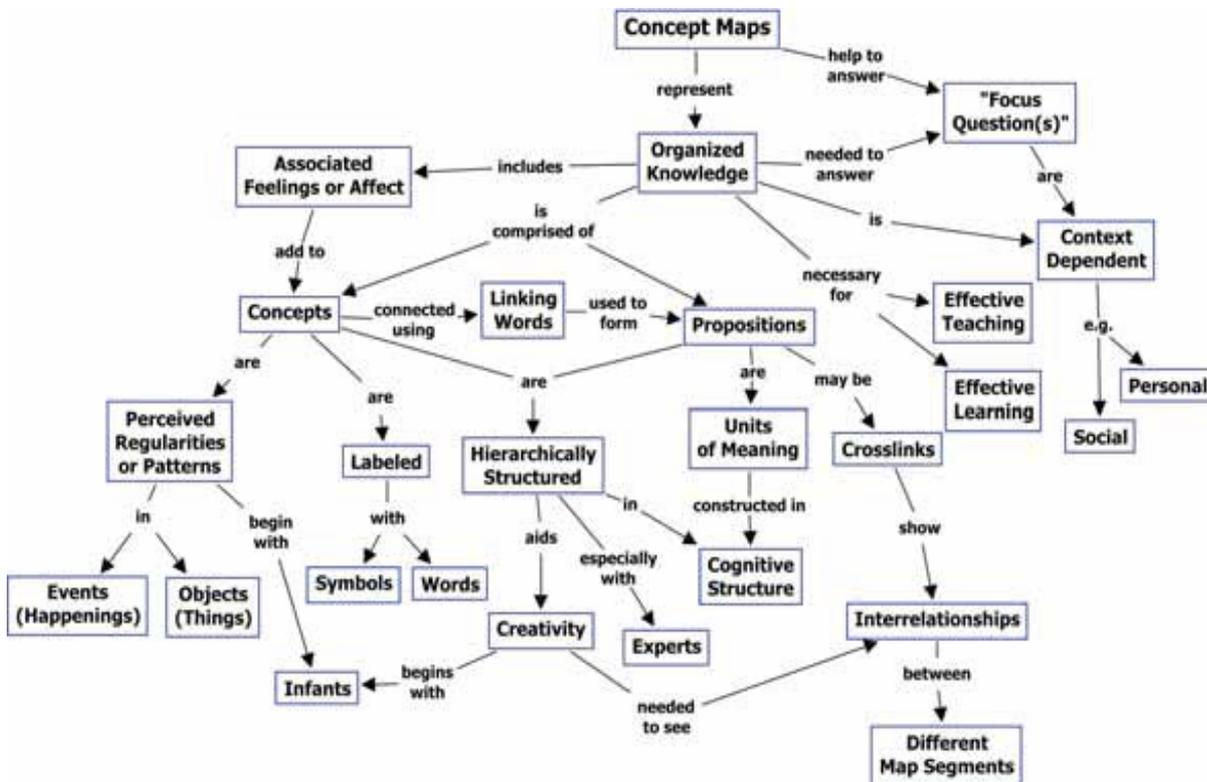


Figure 1: A concept map of a concept map Novak and Canas (2008)

## The Steps in designing a concept map are:

- Define a question (see Example Figure 2)
- Identify key concepts
- List in rank order general to specific
- Share, if able with other students,
- Construct preliminary concept map
- Build cross links
- Map revised, concepts repositioned

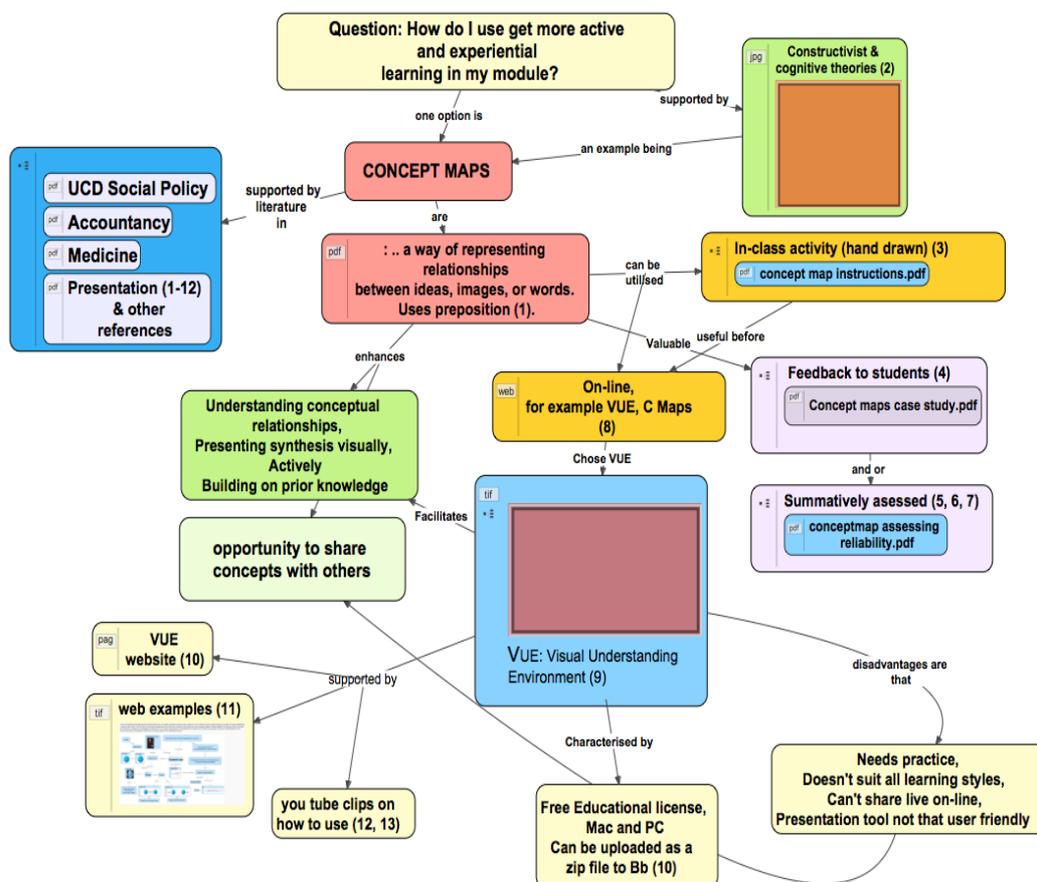


Figure 2: Example of Concept Map using VUE

## Assessment of Concept Maps

Concept maps are great tools for use in class as feedback to students on their conceptual understanding. They have a strong role to play in formative assessment. If being used for assessment the important criteria are;

- the structural nature of student knowledge,
- intrusions or distortions in students' understanding of content, and
- errors of omission (Surber, 1984, in Novak, 2008)

Reliability study maintains to use some form of relational scoring method, preferably with a master

map. (McClure, Sonak, Suen, 1999)

One method of assessing Concept Maps was developed by Besterfield et al in 2004).

Another proposed by Novak and Gowin in 1984 is based on the components and structure of the map. This system awards points for:

- Valid Propositions (1 Point Each),
- Levels Of Hierarchy (5 Points For Each Level),
- Number Of Branchings (1 Point For Each Branch),
- Crosslinks (10 Points For Each Valid Cross-Link),
- And Specific Examples (1 Point For Each Example).

A less formal approach to grading Concept Maps is to use and provide a set of assessment criteria within a rubric such as the following:	Exemplary	Good	Acceptable	Unacceptable
<b>Breadth</b>	Map includes the important concepts and describes domain on multiple levels	Map includes most important concepts; describes domain on limited number of levels	Important concepts missing and/or describes domain on only one level	Map includes minimum concepts with many important concepts missing
<b>Interconnectivity</b>	All concepts interlinked with several other concepts	Most concepts interlinked with other concepts	Several concepts linked to other concepts	Few concepts linked to other concepts
<b>Use of descriptive links</b>	Links succinctly and accurately describe all relationships	Links are descriptive and valid for most relationships	Some links unclear or vague; some invalid or unclear	Links are vague; show inconsistent relationships
<b>Efficiency of links</b>	Each link type is distinct from all others, clearly describes relationship; used consistently	Most links are distinct from others; discriminate concepts; present variety of relationships; used fairly consistently	Several links are synonymous; don't discriminate concepts well; don't show a variety of relationships; used inconsistently	Most links synonymous or vaguely describe relationships and aren't distinct from other links
<b>Layout</b>	Map is contained in a single page, has multiple clear hierarchies, is well laid out and provides a sufficient number of relevant examples with links	Map is contained in a single page, has several clear hierarchies, is fairly well laid out and provides a sufficient number of fairly relevant examples with links	Map is not contained in a single page, has unclear hierarchies, is poorly laid out and provides some fairly relevant examples with links	Map is not contained in a single page, is confusing to read with no hierarchical organization
<b>Development over time</b> (for concepts maps where a "base map" is constructed at the beginning of the course and a corresponding "final map" at the end of the course)	Final map shows considerable cognitive progression from Base map and a significantly greater depth of understanding of the domain	Final map shows some cognitive progression from Base map and a somewhat greater depth of understanding of the domain	Final map shows minimal cognitive progression from Base map and a slightly greater depth of understanding of the domain	Final map shows no significant cognitive progression from Base map and no increase in the understanding of the domain

Based on [http://cte.uwaterloo.ca/teaching\\_resources/tips/rubric%20for%20concept%20maps.htm](http://cte.uwaterloo.ca/teaching_resources/tips/rubric%20for%20concept%20maps.htm)

## Products

This table provides a brief collection of the most commonly used programs for creating concept maps, there are divided by those that one might opt to purchase and those that re free to use.

Company	Program	Platform	Web Address
Mindjet	MindManager	PC, Mac	<a href="http://www.mindjet.com">http://www.mindjet.com</a>
Buzan Online Limited	iMindMap	PC, Mac	<a href="http://www.imindmap.com">http://www.imindmap.com</a>
INSPIRATION	Inspiration	PC, Mac	<a href="http://www.inspiration.com">http://www.inspiration.com</a>
SMART Technologies	SMART Ideas	PC, Mac	<a href="http://smarttech.com">http://smarttech.com</a>
Mind Technologies	Visual Mind	PC	<a href="http://www.visual-mind.com">http://www.visual-mind.com</a>
IHMC	CmapTools	PC, Mac	<a href="http://cmap.ihmc.us">http://cmap.ihmc.us</a>
ConceptDraw	MINDMAP	PC, Mac	<a href="http://www.conceptdraw.com">http://www.conceptdraw.com</a>
CoCo Systems Ltd.	VisiMap	PC	<a href="http://www.visimap.com">http://www.visimap.com</a>
Mind Genius	MindGenius	PC	<a href="http://www.mindgenius.com/">http://www.mindgenius.com/</a>
IdeasonCanvas	Mindnode	Mac	<a href="http://www.mindnode.com/">http://www.mindnode.com/</a>
<b>Free / Open / Educational License</b>			
Freemind	Freemind	PC, Mac	<a href="http://freemind.sourceforge.net/">http://freemind.sourceforge.net/</a>
IHMC	CMAP	PC, Mac	<a href="http://cmap.ihmc.us/conceptmap.html">http://cmap.ihmc.us/conceptmap.html</a>
Bubblus	Bubblus	PC, Mac	<a href="http://www.bubbl.us/edit.php">http://www.bubbl.us/edit.php</a>
Gliffy	Gliffy	PC, Mac	<a href="http://www.gliffy.com/">http://www.gliffy.com/</a>
Xmind	Xmind	PC	<a href="http://www.xmind.net/">http://www.xmind.net/</a>
TUFTS	VUE	PC, Mac	<a href="http://vue.tufts.edu/about/">http://vue.tufts.edu/about/</a>
Compendium Institute	Compendium	PC, Mac	<a href="http://compendium.open.ac.uk/institute/">http://compendium.open.ac.uk/institute/</a>

## References and Bibliography

- Besterfield-Sacre, M., Gerchak, J., Lyons, M., Shuman, L. J., & Wolfe, H. (2004). Scoring concept maps: An integrated rubric for assessing engineering education. *Journal of Engineering Education*, 93, 105-115.
- Carlile, O. Jordan A (2005) *It works in practice but will it work in theory? The theoretical underpinnings of pedagogy* page 11
- Chiou, C. (2008). The effect of concept mapping on students learning achievements and interest. *Innovation in Education and Teaching International*, 45 (4), 375-387.
- Kennedy, P (2012) *Reducing and Diversifying Assessment in 1st Year Social Science: Case Study from UCD Assessment Redesign Project*. UCD Teaching & Learning website.
- McClure, J.R., Sonak, B., Suen, H.K. (1999) *Concept Map Assessment of Classroom Learning: Reliability, Validity, and Logistical Practicality*. JOURNAL OF RESEARCH IN SCIENCE TEACHING VOL. 36, NO. 4, PP. 475-492.
- Morton, M. (2013) *Three Concept maps tools*, Youtube <http://www.youtube.com/watch?v=PODBS-YbRc0> accessed 15th October 2013.
- Novak, J.D. & Cañas, A.J. (2008) *The Theory Underlying Concept Maps and How to Construct and Use Them*. Florida Institute for Human and Machine Cognition, Pensacola, FL. Technical Report IHMC CmapTools. Available:  
<http://cmap.ihmc.us/Publications/ResearchPapers/TheoryUnderlyingConceptMaps.pdf>
- Patel, B (2005) *Assessment workload: rationalising the marking of coursework* Accessed Feb 5th 2010  
<http://www.nottingham.ac.uk/pesl/browse/faculty/medhs/assessme108/>
- Patrick, H. (2005). *Synoptic Assessment: Report for QCA*. University of Cambridge. London: University of Cambridge
- REAP (2010) *Re-engineering Assessment Practices in Scottish Higher Education*  
<http://www.jisc.org.uk/media/documents/programmes/elearningsfc/sfcbookletreap.pdf>
- RuizPrimo, M.A. (2004). *Examining Concept Maps as an Assessment Tool*. Proc. Of the First International Conference on Concept Mapping, Pamplona, Spain. Available:  
<http://cmc.ihmc.us/papers/cmc2004c036.pdf>
- VUE (2013a) *Visual Understanding Environment Website* accessed 20<sup>th</sup> November 2013.  
<http://vue.tufts.edu/>
- VUE (2013c) : *Visual Understanding Environment Website; Physics example*. <https://vue-forums.uit.tufts.edu/posts/list/1123.page> accessed 22<sup>nd</sup> November 2013
- Walker, J.M.T. and Cordray, D.S. (2010) *Concept Mapping as a Form of Student Assessment and Instruction* <http://www.vanth.org/presentations/walkercasee02c1.pdf>
- Walker, J.M.T. and Cordray, D.S. (2010) *Concept Mapping as a Form of Student Assessment and Instruction* <http://www.vanth.org/presentations/walkercasee02c1.pdf>
- You Tube (2013a) *Working with Maps in VUE* <http://www.youtube.com/watch?v=i6baom1dff8>
- You Tube (2013b) *Map Based Searching and Semantic Analysis Screencast*  
<http://www.youtube.com/watch?v=iKuBE-J7JuU>
- Yue Y, J. Vanides, M. Araceli Ruiz-Primo, C. C. Ayala, R. J. Shavelson (2005) *Comparison of Two Concept-Mapping Techniques: Implications for Scoring, Interpretation, and Use*. JOURNAL OF RESEARCH IN SCIENCE TEACHING VOL. 42, NO. 2, PP. 166-184.
- Zeilik M. (2013) *Concept Mapping Department of Physics & Astronomy University of New Mexico*  
<http://www.wcer.wisc.edu/archive/cl1/flag/cat/conmap/conmap7.htm>