The Use of Concept Maps for Assessment

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Workbook

The aim of this workbook is to provide a series of resources in the realm of assessment and the use of concept maps to support this.

The workbook is not exhaustive, but attempts to focus on a number of core issues and needs.

Key areas covered include:

- The Psychology of Learning
- Assessment Principles
- An Introduction to Concept Maps
- Assessing Concept Maps

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Further workbooks are available, for information contact David.Jennings@ucd.ie
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</tr>
</tbody>
</table>
How we learn

Learning styles has become a somewhat contentious term used to describe the attitudes and behaviours, which ‘may’ determine an individual’s preferred way of learning. It is the ‘may’ that draws attention as it is often omitted and hence the concept becomes a deterministic approach to categorising how learners engage with information, their peers, educators and opportunities to learn. Suffice to say it is also an area where so many learning styles / preference models exist, that the marketplace is truly over-crowded (a citation search revealed over 150 articles espousing models), so where does one look to...? And how may we use them to our benefit?

If we merely take note of the range of styles and/or preferences available, we may begin to address a number of key issues that impact student interaction. The idea of learner malaise, lack of motivation, misinterpretation is not down to recalcitrant individuals alone. By adapting the way in which we teach and provide learning opportunities to reflect the potential ‘learning styles’ apparent in any cohort, we may begin to offer an open and engaging process that is directed to their (the learners) preferred style / method of interaction and engagement.

The following three tables elaborate the details of their respective models (Rose, Honey & Mumford and Gardener) and the interpretation of the implied learning styles on the individual.

### Rose 1985

- **Visual**: Learners prefer to learn with visual reinforcement such as charts and diagrams
- **Auditory**: Learners prefer to learn by listening
- **Kinaesthetic**: Learners prefer to learn through, moving, doing and touching

### Honey and Mumford 1996

- **Theoretical**: Learners prefer to learn by reading and listening to the experts
- **Pragmatic**: Learners like to be able to see the practical application of theory. They like to use deductive reasoning to focus on problems and they prefer situations where there is a single correct answer or solution
- **Reflective**: Learners tend to be imaginative and emotional. They work well in group discussions
- **Activist**: Learners are action oriented. They learn by doing
<table>
<thead>
<tr>
<th>Gardener 1993</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Visual/Spatial Intelligence:</strong> Puzzle building, reading, writing, understanding charts and graphs, a good sense of direction, sketching, painting, creating visual metaphors and analogies (perhaps through the visual arts), manipulating images, constructing, fixing, designing practical objects, interpreting visual images.</td>
</tr>
<tr>
<td><strong>Verbal/Linguistic Intelligence:</strong> Listening, speaking, writing, story telling, explaining, teaching, using humour, understanding the syntax and meaning of words, remembering information, convincing someone of their point of view, analysing language usage.</td>
</tr>
<tr>
<td><strong>Logical/Mathematical Intelligence:</strong> Problem solving, classifying and categorising information, working with abstract concepts to figure out the relationship of each to the other, handling long chains of reason to make local progressions, doing controlled experiments, questioning and wondering about natural events, performing complex mathematical calculations, working with geometric shapes.</td>
</tr>
<tr>
<td><strong>Bodily/Kinaesthetic Intelligence:</strong> Dancing, physical co-ordination, sports, hands on experimentation, using body language, crafts, acting, miming, using their hands to create or build, expressing emotions through the body.</td>
</tr>
<tr>
<td><strong>Musical/Rhythmic Intelligence:</strong> Singing, whistling, playing musical instruments, recognising tonal patterns, composing music, remembering melodies, understanding the structure and rhythm of music.</td>
</tr>
<tr>
<td><strong>Interpersonal Intelligence:</strong> Seeing things from other perspectives (dual-perspective), listening, using empathy, understanding other people's moods and feelings, counselling, co-operating with groups, noticing people's moods, motivations and intentions, communicating both verbally and non-verbally, building trust, peaceful conflict resolution, establishing positive relations with other people.</td>
</tr>
<tr>
<td><strong>Intrapersonal Intelligence:</strong> Recognising their own strengths and weaknesses, reflecting and analysing themselves, awareness of their inner feelings, desires and dreams, evaluating their thinking patterns, reasoning with themselves, understanding their role in relationship to others.</td>
</tr>
</tbody>
</table>

**Task:**

*Take a moment to undertake one of the following online tests to assess your preferred ‘learning style’, are they applicable? How might you use them to inform practice?*

- Myers-Briggs

- David Keirsey's 'Sorter' to discover one's personality type
  [http://keirsey.com](http://keirsey.com)

- Soloman & Felder Online test
  [http://www.engr.ncsu.edu/learningstyles/ilsweb.html](http://www.engr.ncsu.edu/learningstyles/ilsweb.html)
An Introduction to Assessment

Some of the key purposes of assessment are; to enable the communication of the achievement and subsequent status of students during their programme of learning; to provide a means of self-evaluation and information pertaining to such; to identify student placement within educational paths and/or programmes; to address the evaluation and effectiveness of instructional programmes; and to simply motivate the learner.

<table>
<thead>
<tr>
<th>Student Learning</th>
<th>Certification</th>
<th>Quality Assurance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provide feedback to improve student learning</td>
<td>To pass/fail a student</td>
<td>Provide feedback to lecturers</td>
</tr>
<tr>
<td>Motivate students</td>
<td>To grade/rank</td>
<td>Improve teaching</td>
</tr>
<tr>
<td>Diagnosis students strengths, weaknesses</td>
<td>To license to proceed/practice</td>
<td>Monitor standards over time</td>
</tr>
</tbody>
</table>

Figure 1: Three Purposes of Assessment

**Type and Rationale**

Formative Assessment - **Assessment for learning**

Is the assessment that provides feedback to learners in order to help them learn, and feedback to teachers to enable them to decide how a student's learning should be taken forward.

Summative Assessment - **Assessment of learning**

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Trends in Assessment

Written exams are being replaced by more continuous assessment and coursework. There is a move towards more student involvement and choice in assessment. Course outlines have become more explicit about the expectations in assessment.

Group assessment is more frequently used (in line with the shift in emphasis within the curriculum from competition between students towards collaborative learning between students.) An understanding of process is now seen as, at least, equally important to a knowledge of facts. (In line with the general shift towards a process-based, rather than product-based curriculum.) Student focused 'learning outcomes' have begun to replace more teacher orientated 'objectives'. The focus is more on what the student will learn rather than what the teacher plans to teach. (This is in line with more student led approaches in the curriculum generally).2

<table>
<thead>
<tr>
<th>From</th>
<th>Towards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Written Exam</td>
<td>Coursework</td>
</tr>
<tr>
<td>Tutor led</td>
<td>Student Led</td>
</tr>
<tr>
<td>Implicit Criteria</td>
<td>Explicit criteria</td>
</tr>
<tr>
<td>Competition</td>
<td>Collaboration</td>
</tr>
<tr>
<td>Product assessment</td>
<td>Process</td>
</tr>
<tr>
<td>Objectives</td>
<td>Outcomes</td>
</tr>
<tr>
<td>Content</td>
<td>Competencies</td>
</tr>
</tbody>
</table>

Figure 2: Trends in Assessment

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Matching Learning Outcomes To Assessment Types

Different assessments drive different types of learning, this table offers a selection of alternative modes of assessment enabling students to work to their strengths, thus providing an inclusive approach to the assessment regime.

<table>
<thead>
<tr>
<th>Types of Learning: Learning outcomes</th>
<th>What is required from students?</th>
<th>Examples of Assessment</th>
</tr>
</thead>
</table>
| Thinking critically and making judgments | Development of arguments, reflection, judgment, evaluation | Essay  
Report  
Book review |
| Solving problems / developing plans | Identify problems, define problems, analyse data, review, design experiments, plan, apply information | Problem scenario  
Group Work  
Work-based problem  
Analyse a case  
Conference paper (or notes for a conference paper plus annotated bibliography) |
| Performing procedures and demonstrating techniques | Take readings, use equipment, follow laboratory procedures, follow protocols, carry out instructions | Demonstration  
Role Play  
Make a video (write script and produce/make a video)  
Produce a poster  
Lab report |
| Demonstrating knowledge and understanding (can be assessed in conjunction with the above types of learning) | Recall, describe, report, identify, recognise, recount, relate, etc. | Written examination  
Oral examination  
MCQs  
Essays  
Reports  
Short answer questions  
Mini tests |
| Managing / developing yourself | Work co-operatively and, independently, be self-directed, manage time, manage tasks | Learning journal  
Portfolio  
Learning Contracts  
Self-evaluation  
Group projects  
Peer assessment |
| Designing, creating, performing | Design, create, perform, produce, etc. | Design project  
Portfolio  
Presentation  
Performance |
| Assesing and managing information | Information search and retrieval, investigate, interpret, review information | Annotated bibliographies  
Use of bibliographic software  
Library research assignment  
Data based project |
| Communicating | Written, oral, visual and technical skills | Written presentation  
Oral presentation  
Discussions / Debates/ role plays  
Group work |
Task:
Perform a spot check on the modes of assessment above;

- How many do you use?
- Are you over assessing?
- What else is used at a programme level (is there a broad range of modes, is it distributed reasonably)?
- Do you offer a range of assessment to account for student preference (learning style)?
- Finally review your assessment protocol [what do students avoid, from what do they learn (engage with) most, what concepts are still problematic?]

Enabling Effective Feedback\(^3\) (in three Steps...\(^4\))

Prepare Students to Receive Feedback
Helps clarify what good performance is
Facilitates development of self-assessment in learning
Delivers high quality information to students about their learning
Encourages teacher and peer dialogue around learning

- Aligning their expectations with yours
- Identifying multiple channels of feedback
- Modeling the application of feedback
- Encouraging its application
- Supporting processes of self-assessment

Reduce Emphasis on Written Feedback
Encourages teacher and peer dialogue around learning


Encourages positive motivational beliefs and self-esteem

- Explicit, written feedback is important, however...
- Written feedback rarely communicates tacit understandings
- Student engagement is enhanced if written feedback is supplemented with dialogue

Provide Timely Feedback
Provides opportunities to close the gap between current and desired performance

Provides information to teachers that can be used to shape teaching

Students engage with (and apply) feedback if they can foresee ways to apply them

- Feedback on draft assignments may engage students more effectively
- Consider giving generic feedback as soon as possible
- New technologies may reduce the time required to prepare feedback
Designing Assessments

Seven questions that lecturers might ask when designing an assignment are:

1. What are the outcomes to be assessed?
2. What are the capabilities/skills (implicit or explicit) in the outcomes?
3. Is the method of assessment chosen consonant with the outcomes and skills?
4. Is the method relatively efficient in terms of student time and staff time?
5. What alternatives are there? What are their advantages and disadvantages?
6. Does the specific assessment task match the outcomes and skills?
7. Are the marking schemes or criteria appropriate?

<table>
<thead>
<tr>
<th>Common weaknesses to avoid</th>
</tr>
</thead>
<tbody>
<tr>
<td>The tasks do not match the stated outcomes;</td>
</tr>
<tr>
<td>The criteria do not match the tasks or outcomes;</td>
</tr>
<tr>
<td>The criteria are not known to students;</td>
</tr>
<tr>
<td>Students do not understand the criteria;</td>
</tr>
<tr>
<td>Overuse of one mode of assessment such as written examinations, essays, or closed problems;</td>
</tr>
<tr>
<td>Overload of students and staff;</td>
</tr>
<tr>
<td>Insufficient time for students to do the assignments;</td>
</tr>
<tr>
<td>Too many assignments with the same deadline;</td>
</tr>
<tr>
<td>Insufficient time for staff to mark the assignments or examinations;</td>
</tr>
<tr>
<td>Absence of well defined criteria so consistency is difficult to achieve;</td>
</tr>
<tr>
<td>Unduly specific criteria which create a straitjacket for students and make marking burdensome for lecturers;</td>
</tr>
<tr>
<td>Inadequate or superficial feedback provided to students;</td>
</tr>
<tr>
<td>Wide variations in marking between modules and assessors and within assessors (self-consistency);</td>
</tr>
<tr>
<td>Variations in assessment demands of different modules</td>
</tr>
</tbody>
</table>

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Impact of Concept Maps

Learning
Reduce the high volume impact / information overload. Approach study, revision and exams with confidence. Refine your learning abilities.

Overview
Visualise entire concepts, gain oversight of complex issues, capture a global view. Define and synthesise links, connections, approaches, diagnosis etc.

Concentration
Provide focused study, review, reflection and learning.

Memorisation
Aids easy recall of key concepts, structures and approaches.

Organisation
Provides clear pathways / plans for essays, projects, presentations etc.

Presentation
Offers focused elements, free form approach, natural aid to speech.

Communication
Provides clarity and conciseness.

Planning
Orchestrates all details and aspects – from beginning to end – on one piece of paper.

Meetings
Initiates and captures effective structure.

Reflection
Provides a method to analyse one’s thoughts.

Negotiation
Highlights issues, dilemmas and pathways for discussion and decision

Brain Storming
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. A traditional concept provides a hierarchical representation of the information from top down, whereas a mind map may radiate from a central single concept only. Suffice to say, when creating a spider map, systems map, concept map, mind map, flow chart, visual plan etc each performs a task that no ordinary collection of notes may encompass in a single sheet – a personal visualization of knowledge – and for our and the students perspective their key ‘learning gaps’ i.e. what it is they may wish to focus on, reflect, review and develop. In this way they may be used for as a tool to support and enhance learning.

A method of assessing Concept Maps 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).

<table>
<thead>
<tr>
<th>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:</th>
<th>Exemplary</th>
<th>Good</th>
<th>Acceptable</th>
<th>Unacceptable</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Breadth</strong></td>
<td>Map includes the important concepts and describes domain on multiple levels</td>
<td>Map includes most important concepts; describes domain on limited number of levels</td>
<td>Important concepts missing and/or describes domain on only one level</td>
<td>Map includes minimum concepts with many important concepts missing</td>
</tr>
<tr>
<td><strong>Interconnectivity</strong></td>
<td>All concepts interlinked with several other</td>
<td>Most concepts interlinked with other concepts</td>
<td>Several concepts linked to other concepts</td>
<td>Few concepts linked to other concepts</td>
</tr>
</tbody>
</table>
## Use of descriptive links

| 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 |

## Efficiency of links

| 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 |

## Layout

| 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 |

## Development over time (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.html](http://cte.uwaterloo.ca/teaching_resources/tips/rubric%20for%20concept%20maps.html)
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 are free to use.

<table>
<thead>
<tr>
<th>Company</th>
<th>Program</th>
<th>Platform</th>
<th>Web Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mindjet</td>
<td>MindManager</td>
<td>PC, Mac</td>
<td><a href="http://www.mindjet.com">http://www.mindjet.com</a></td>
</tr>
<tr>
<td>Buzan Online Limited</td>
<td>iMindMap</td>
<td>PC, Mac</td>
<td><a href="http://www.imindmap.com">http://www.imindmap.com</a></td>
</tr>
<tr>
<td>INSPIRATION</td>
<td>Inspiration</td>
<td>PC, Mac</td>
<td><a href="http://www.inspiration.com">http://www.inspiration.com</a></td>
</tr>
<tr>
<td>SMART Technologies</td>
<td>SMART Ideas</td>
<td>PC, Mac</td>
<td><a href="http://smarttech.com">http://smarttech.com</a></td>
</tr>
<tr>
<td>Mind Technologies</td>
<td>Visual Mind</td>
<td>PC</td>
<td><a href="http://www.visual-mind.com">http://www.visual-mind.com</a></td>
</tr>
<tr>
<td>IHMC</td>
<td>CmapTools</td>
<td>PC, Mac</td>
<td><a href="http://cmap.ihmc.us">http://cmap.ihmc.us</a></td>
</tr>
<tr>
<td>ConceptDraw</td>
<td>MINDMAP</td>
<td>PC, Mac</td>
<td><a href="http://www.conceptdraw.com">http://www.conceptdraw.com</a></td>
</tr>
<tr>
<td>Mind Genius</td>
<td>MindGenius</td>
<td>PC</td>
<td><a href="http://www.mindgenius.com/">http://www.mindgenius.com/</a></td>
</tr>
<tr>
<td>IdeasonCanvas</td>
<td>Mindnode</td>
<td>Mac</td>
<td><a href="http://www.mindnode.com/">http://www.mindnode.com/</a></td>
</tr>
</tbody>
</table>

**Free / Open / Educational License**

| Freemind              | Freemind   | PC, Mac  | http://freemind.sourceforge.net/|
| IHMC                  | CMAP       | PC, Mac  | http://cmap.ihmc.us/conceptmap.html|
| Bubblus               | Bubblus    | PC, Mac  | http://www.bubbl.us/edit.php   |
| Gliffy                | Gliffy     | PC, Mac  | http://www.gliffy.com/         |
| Xmind                 | Xmind      | PC       | http://www.xmind.net/         |
| TUFTS                 | VUE        | PC, Mac  | http://vue.tufts.edu/about/    |
| Compendium Institute  | Compendium | PC, Mac  | http://compendium.open.ac.uk/institute/|
Select Bibliography (URLs accessed 03.12)


Creanor, L. 2004, Activities for E-Learning, E-Learning Guides, Glasgow Caledonian University


Gibbs, G 1995 “Structures for fostering discussion in larger groups” Oxford Centre for Staff Development.


Notes:

End of Workbook