Sustainable Learning with Concept Maps

Elisabeth Riebenbauer & Michaela Stock
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Overview

Concept Maps

• Definition and theoretical background
• Benefits and potentials
• Process of construction
• Possible applications in business classes with didactical variations
• Empirical findings of learning effectiveness and limitations
• Questions and discussion
Definition Concept Maps

- Concept map or network to visualize correlations and cross connections
- Consist of concepts of a particular subject to show interrelations
- Mind Map vs. Concept Map
Concepts + Links → Propositions

cf. Nestor 2015
Benefits of Concept Maps

- *The map in mind* – visualizing hierarchical structures and their correlations
  
  (Novak 1990, 2010)

- Meaningful learning by integrating new ideas into students‘ previous knowledge
  
  (Ausubel 1968)

- Encourage analytical and reflective thinking about a particular topic

- Intensive discussion of knowledge and cross-linking

- Show own learning progress

- Show false concepts and learning difficulties

- Facilitate learning and improve memory performance
Constructing a Concept Map

Cognitive process:

1. Reduction
   Identify key concepts of topic

2. Structuring
   Synchronic – spatial layout: below, above and side by side, far apart or close together

3. Visualizing
   
4. Elaboration
   Detailed labeling of arrows

Diagram:

- Privat persons
  - Consist of: as employees earn, buy
- Households
  - Consists of: Wages/Salaries, Goods/Services
- Wages/Salaries
- Goods/Services
- Economy
  - Consists of: Households, Business companies
- Business companies
  - Consists of: Taxes
- Taxes
  - Are paid to: State
  - Calculate and pay
How do I support sustainable learning in my business class?
Possible Applications in Business Classes

Possible applications:  
(Stracke 2004, Nesbit/Adesope 2006, Fürstenau 2011)

• Planning tool e.g. curriculum and lesson preparation
• Teaching tool for organizing and structurizing content (advanced organizer)
• Learning tool, learning strategy, meta-cognition
• Diagnosis of knowledge

Design:  

• Level of learners’ individual activity
• Individually or as a team
• Reference-Map
• Static/dynamic, gaps, forms/colors, Cmap-Tool
Didactical Variations of Concept Map I

- Determining individual previous knowledge
- Dokumenting and supplementing own learning progress
- Summarizing course unit or topic
Support cognitive learning in Personnel Accounting
Didactical Variations of Concept Map II

- Constructing maps on given concepts
- Constructing maps with focus questions
- Completing maps with given questions
Didactical Variations of Concept Map III

- Expert or Reference Map for overview
- Interpreting a Reference Map/Master Map
- Completing a Concept Map with gaps
- Correction of false or inaccurate maps
- Diskussion of individual maps in small groups and construction of a team map
- Constructing maps for projects/presentations/case-studies
- Application of software (z.B. Cmap Tools: http://cmap.ihmc.us/)
- For assessment of knowledge
- …
Example: Concept Map with Gaps

Concept-Map: Personalverrechnung

Dienstnehmer
- bekommt Gehalt lt. Kollektivvertrag
- macht Überstunden

Dienstgeber
- zahlt Gemeindesteuer an
- zahlt SV-DGA

Finanzamt
- ist Netto

Kollektivvertrag
- geregelt nach

Überstunden
- gemacht
- verdient

Summe
- extraSV für
- Sozialversicherung
- Sonderzahlungen
- Pendlerpauschale
- Lohnsteuer
- Vermindert BmGl
- Verkehrsabsetzbetrag
- Vermindert BmGl
- Vermindert BmGl

Petra Bruchmann 0710450
KS Didaktik des RW mit Computerunterstützung
Empirical Study: Objectives and Design

- **Question:** How to support cognitive and reflective learning with self-constructed concept maps?
- **Two different approaches:** Accounting and Project Management

Diagram:

- **Concept Map Creation** → **Input Accounting (Personnel Accounting)** → **Project Planning & Realization (Service-Learning-Projects)** → **Concept Map Adaptation**
## Empirical Study: Overview

<table>
<thead>
<tr>
<th></th>
<th>Accounting</th>
<th>Project Management</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Already constructed at least one CM before?</strong></td>
<td>20.4%</td>
<td>88.1%</td>
</tr>
<tr>
<td><strong>N</strong></td>
<td>54</td>
<td>42</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td>26.7</td>
<td>28.5</td>
</tr>
<tr>
<td><strong>Satisfaction with their own CM</strong></td>
<td>3.11</td>
<td>1.95</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Difficulty to construct CM</strong></td>
<td>3.09</td>
<td>2.52</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>How useful is CM for their own learning progress</strong></td>
<td>2.70</td>
<td>2.56</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Want to use CM in their own lessons/teaching</strong></td>
<td>2.52</td>
<td>2.24</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Empirical Study: Learning Progress in Personnel Accounting (PA)

<table>
<thead>
<tr>
<th>Area</th>
<th>Assessment</th>
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</thead>
<tbody>
<tr>
<td>Identifying of hierarchical structures in PA</td>
<td>2</td>
</tr>
<tr>
<td>Identifying of false concepts</td>
<td>2.5</td>
</tr>
<tr>
<td>Identifying of interrelation in PA</td>
<td>3</td>
</tr>
<tr>
<td>Visualize previous knowledge of PA</td>
<td>3.5</td>
</tr>
<tr>
<td>Visualizing own learning progress</td>
<td>4</td>
</tr>
<tr>
<td>Identifying of central PA areas</td>
<td>4.5</td>
</tr>
<tr>
<td>Identifying of correlations in PA</td>
<td>4.5</td>
</tr>
<tr>
<td>Cross-linking previous knowledge with new...</td>
<td>4.5</td>
</tr>
<tr>
<td>Identifying knowledge gaps</td>
<td>4.5</td>
</tr>
</tbody>
</table>

How do you assess your learning progress in the following areas?
Empirical Study: Learning Progress in Project Management (PM)

How do you assess your benefit in the following areas?

- Visualizing division of labour
- Identifying own role in the project
- Identifying interests of the parties
- Identifying of hierarchical structures
- Identifying critical paths
- Identifying of central project-areas
- Project overview
- Identifying of correlations

No benefit --- large benefit

Planning phase

Implementation phase
## Empirical Study: Cross Table of Benefit and future Application

<table>
<thead>
<tr>
<th>Use CM in own lessons/ future teaching</th>
<th>How useful is CM for their own learning progress</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(very) usefull</td>
<td>(partly, less, not) usefull</td>
</tr>
<tr>
<td>yes (of course)</td>
<td>Acc. 78,3% (18)</td>
<td>29,0% (9)</td>
</tr>
<tr>
<td></td>
<td>PM 90,5% (19)</td>
<td>30,0% (6)</td>
</tr>
<tr>
<td>maybe (not), no</td>
<td>Acc. 21,7% (5)</td>
<td>71,0% (22)</td>
</tr>
<tr>
<td></td>
<td>PM 9,5% (2)</td>
<td>70,0% (14)</td>
</tr>
<tr>
<td>Total</td>
<td>Acc. 100,0% (23)</td>
<td>100,0% (31)</td>
</tr>
<tr>
<td></td>
<td>PM 100,0% (21)</td>
<td>100,0% (20)</td>
</tr>
</tbody>
</table>
Empirical Study: Conclusion

- Pre-training of the mapping technique
- New topic: problems with meaningful structure → better to draw a new Concept Map to see learning process/use summary
- Experienced learner: overworking the first map is possible, but lots of space is needed
- Good tool for project planning
- Comparision with group members is beneficial to understand different views/perspectives, to see more details
- Feedback is important to understand mistakes/missing concepts
- Compare with Expert Map
- Positive experience is necessary for further use as a teacher
Other Empirical Results concerning Learning Effectiveness of Concept Maps

- Generally positive effect on learning performance
- Greater effects in subjects with high verbal learning performance
- Level of autonomy:
  - Self-constructed maps > preconstructed maps
  - Concept Maps with gaps > completely preconstructed maps
- Basic knowledge of concept-mapping required
- Minor benefits of Concept Maps to taking notes and individual summaries
- Effective for learners with few cognitive, verbal skills or with very little previous knowledge
- Effective as complementary strategy for business games
- Animated maps more effective than static ones, forms and colors enhance content information
Conclusion Concept Map

• Limitations:
  – No information on ability to apply knowledge or to solve problems
  – Problems with Concept Maps that are too large
  – Concept Maps remain unfinished

• Potentials:
  – Reduction of complexity
  – Meaningful learning
  – Promoting the deep understanding of corelations
  – Increase of activity and motivation
  – Tool for learning, structuring and organizing
How can Concept Mapping support my teaching for sustainable learning?
Questions & Discussion

Maps show dead ends, side routes & roads leading off map.

i. mind mapping
ii. writing web

linear outlines can lead to a non-linear outline
the flow is visible and can be changed

is also called is purposeful because
ought to be helps you

i. process with steps
ii. free flowing

organized ideas can emerge

i. messy
maps get you somewhere

_can be refined_

writing tool links can be made

discussion tool that can be informal & democratic (people’s ideas are included)

http://elinasmill.com/2013/02/25/concept-mapping/

Kontakt:
Elisabeth Riebenbauer & Michaela Stock
elisabeth.riebenbauer@uni-graz.at
Selected Reference