

Organisation, representation and localisation of knowledge with concept mapping tools

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Learning situation has changed

- > Explosion of knowledge and knowledge resources
- > Change in learning and ID-theories
- > Change in learning and teaching styles
 - Constructivist learning
 - Resource-based learning
 - Problem-based learning
 - Goal-based scenarios

Problems for learners:

- Limited memory capacity
- Cognitive overload

Learning strategies and representational capabilities of learners have to be adapted

General requirements:

- Need for more effective organisation and representation of knowledge
- Need for tools supporting self-regulated resource-based learning
- Use of external representations as ...
 - > extensions of individual memories (augmenting memory capacities)
 - > individual content and resource repositories
 - > cognitive tools for enhancing learning, reducing cognitive load, managing knowledge, ...

Need for cognitive tools for enhancing the capacity of the human brain

Tools are needed ...

- for support coping with requirements of self-regulated resource-based learning
- for facilitating the coherent organisation and representation of both conceptual and resource knowledge
- for fostering comprehension of complex subject-matter domains
- for helping constructing task-appropriate mental models
- for reducing task complexity and cognitive load (Sweller, 1994)
- for facilitating locating content knowledge and knowledge resources with the help of structured conceptual knowledge about the domain
- which function as an extension of the human memory

Spatial representation of knowledge with maps

Surveys on mapping technologies:

- Jonassen et al., 1993;
- Jüngst & Strittmatter, 1995
- Fischer, 1998
- Mandl & Fischer, 2000
- O'Donnell, 2003

Concept maps / knowledge maps: most used approaches in teaching and learning

Assumed advantages of spatial representations (1)

Spatial representations ...

- are configurations or ways ideas are „spread out“ on a page or a display
- provide a framework to structure and organise information (O'Donnell, 2003).
- match the central tendency of the brain for structuring and visualising knowledge in mental images and mental models (Kosslyn, 1980; Johnson-Laird, 1993; Kintsch, 1998)

Assumed advantages of spatial representations (2)

Spatial representations ...

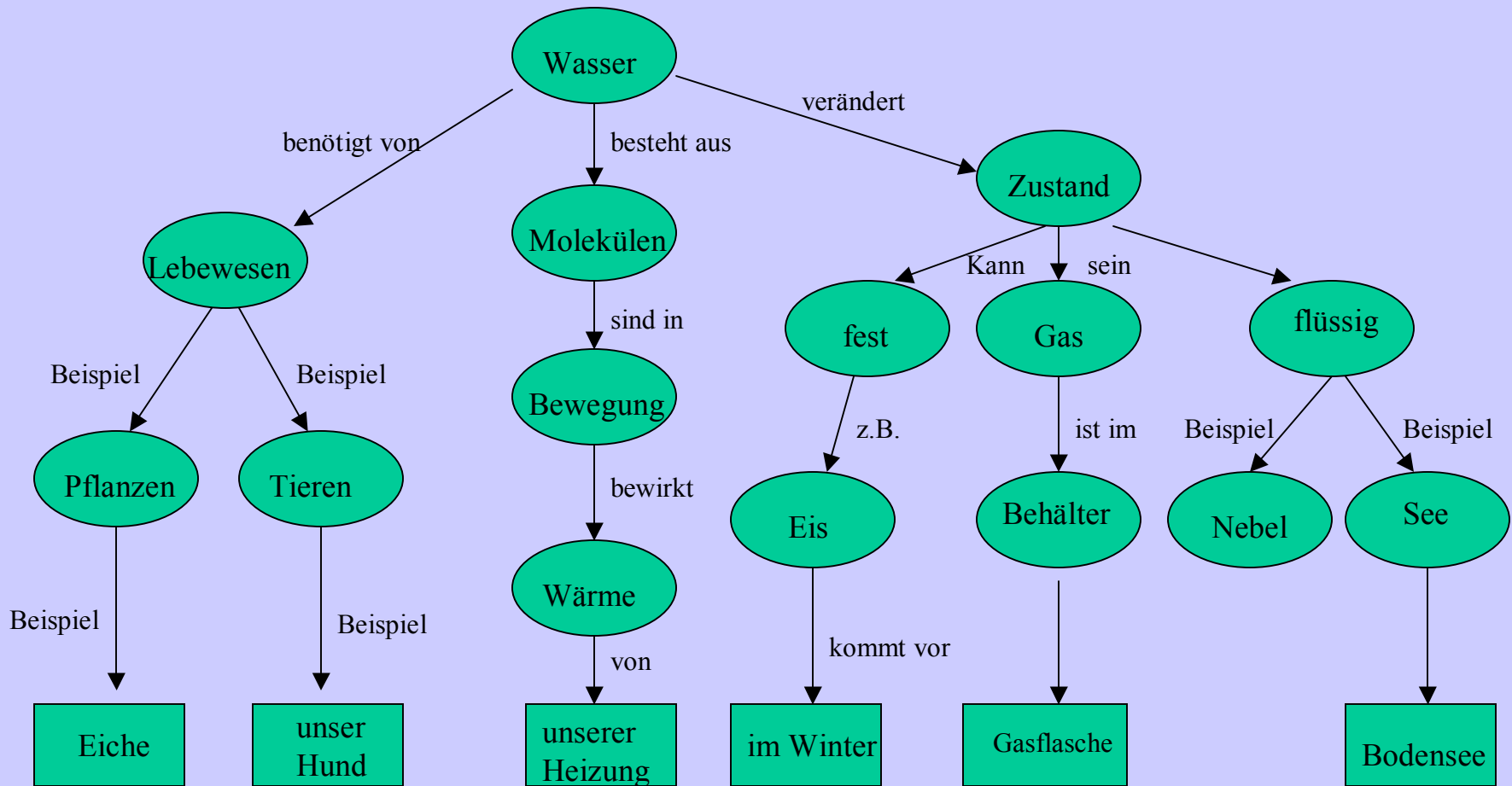
- facilitate cognitive processing by allowing for artifact-based reasoning (Norman, 1991)
- are easier to search and navigate than traditional text displays (Larkin & Simon, 1987)
- can provide spatial and verbal cues that aid both storing and remembering information (Paivio, 1986)

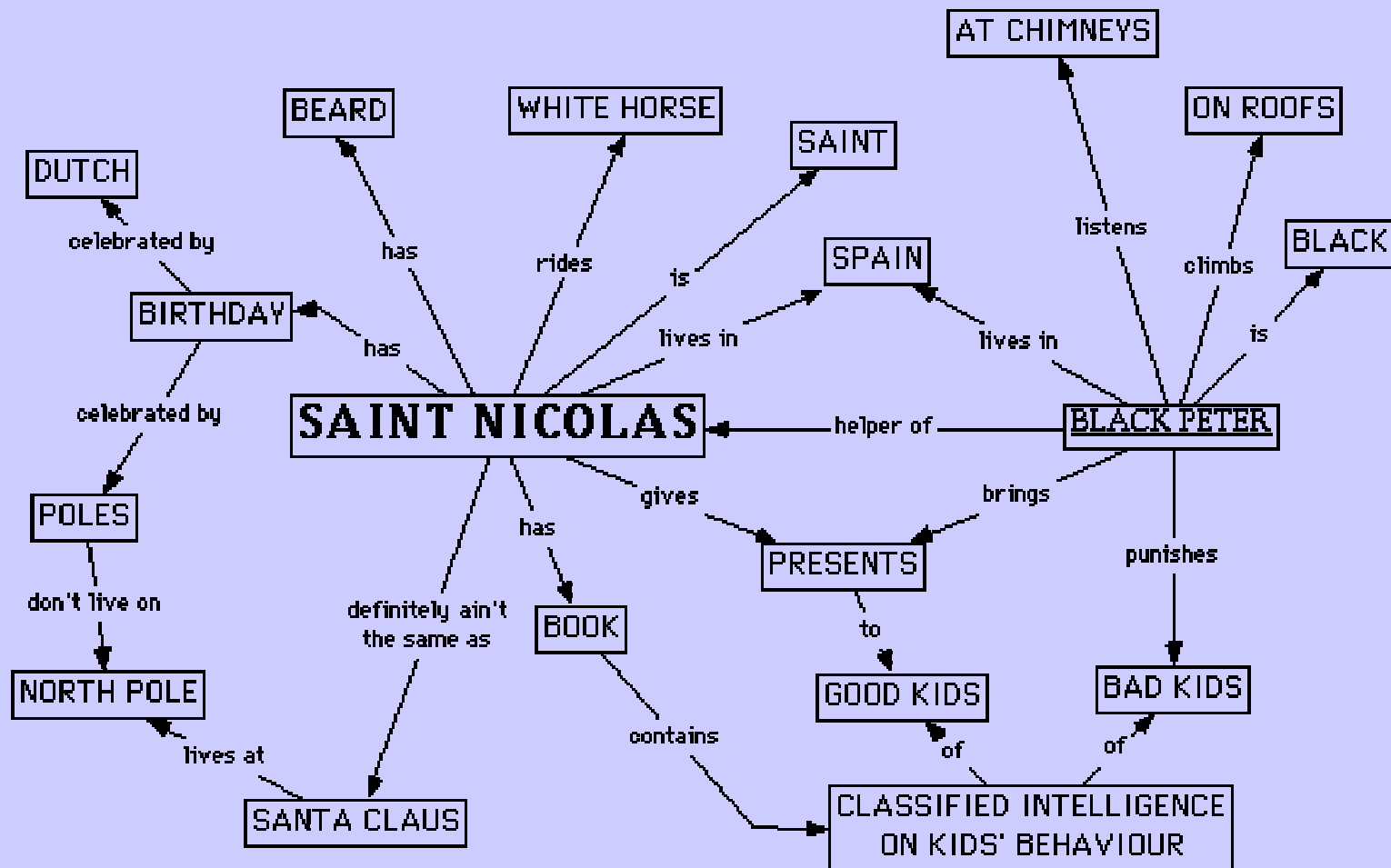
What are concept / knowledge maps?

Definition:

Concept / Knowledge Maps are spatial arrays of nodes and links, the nodes representing knowledge elements and the links relations between elements (Wiegemann, Dansereau et al., 1992)

Hierarchical concept map





Example concept map

Concept mapping homepage - http://users.edte.utwente.nl/lanzing/cm_home.htm



Knowledge Manager

Italiano

Español

Concept maps

Bookmark
this Site

An advanced concept of concept maps



Active concept maps!! Accelerate the knowledge acquisition process!!

Concept maps are a simple and intuitive model to communicate ideas and for the visual organization and representation of knowledge.



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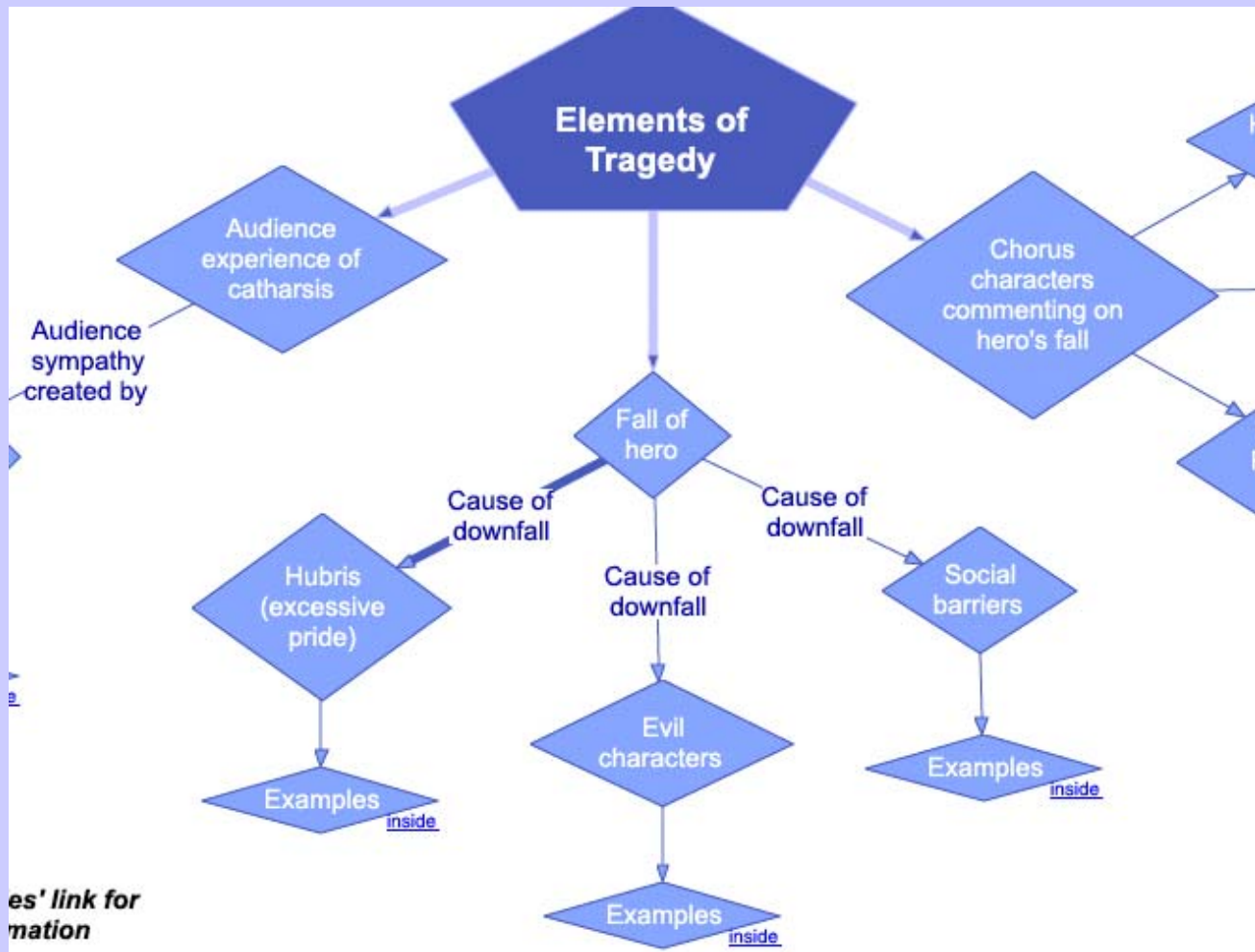
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Smart Ideas



es' link for
mation

Smart Technologies



Expert Concept map with PreSERVe (Coffey et al., 2002)

Pattern notes / Mind Mapping

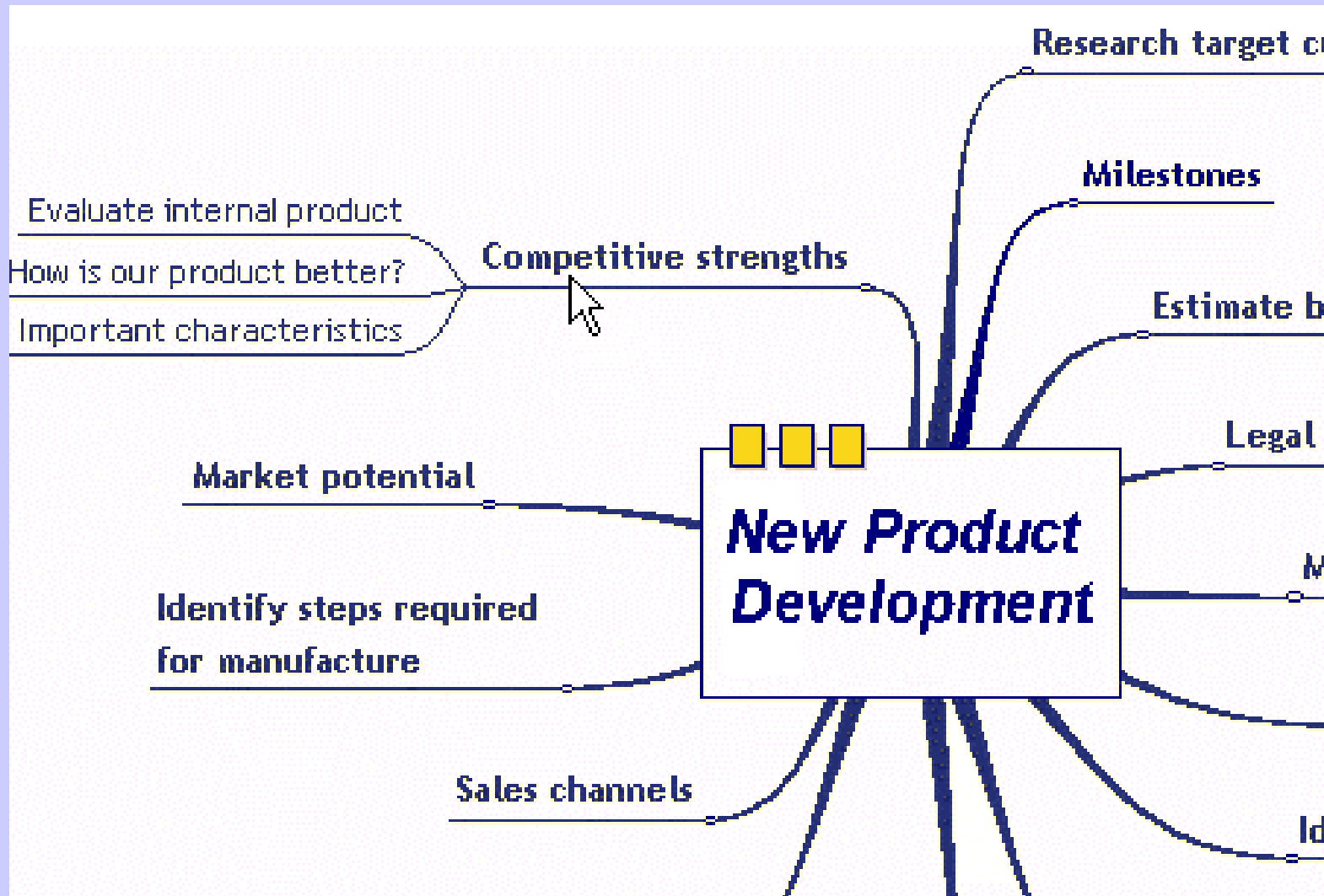
Pattern notes (Buzan, 1974)

Starting from a main idea (a central node) other associated ideas (either nodes or relations) may be put down by drawing and labeling lines

Mind Mapping (Mind Manager)

Mind Maps are used to organise ideas hierarchically in a tree-like structure. There is one central node.

Mind Map created with „Mind Manager“

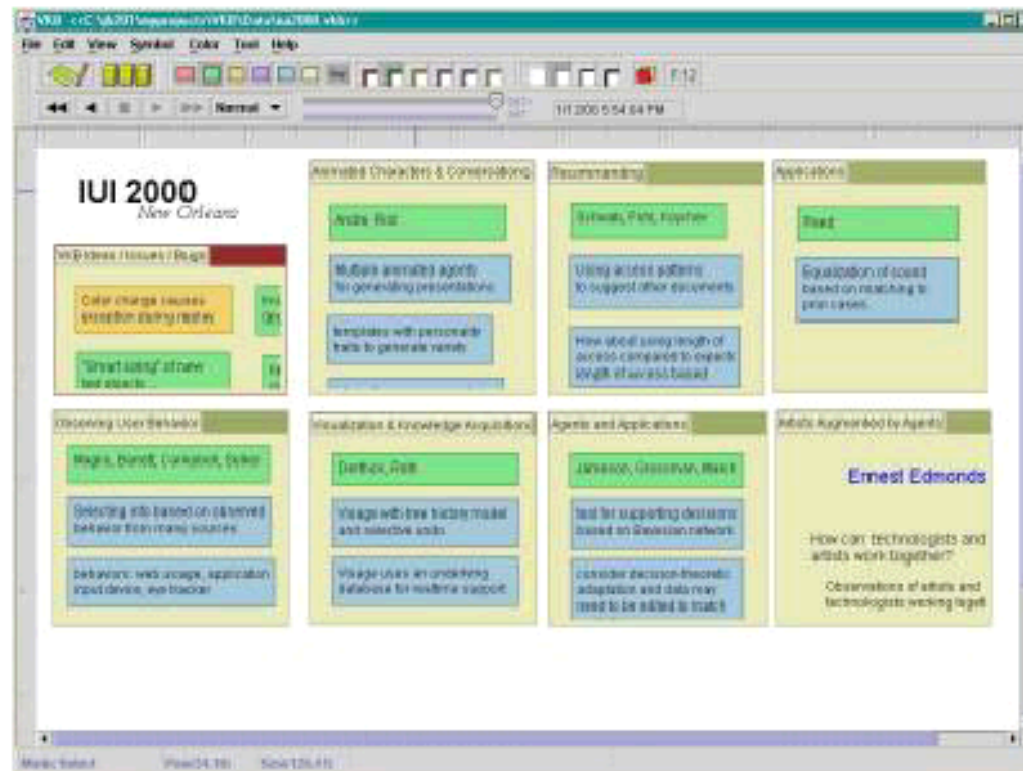


Virtual Knowledge Builder

VKB Sample Data Files

- [iui2000.zip](#)

These are the notes taken at IUI2000 (Intelligent User Interface) conference.



Reviewed mapping Tools

Mind Manager

Inspiration

Visual Knowledge Builder (VKB)

Smart Ideas

Knowledge Manager

Axon

cMap Tools

SmartDraw

MindMapper

Visual Mind

The Brain

Mindjet

Inspiration Software Inc.

Texas A&M University

Smart Technologies

Hypersoft

Axon Research

Institut for Human and Machine

Cognition , Univ. West Florida

SmartDraw.com

SimTech USA Corp.

Norcan Data

The Brain Technologies Corp.

Organisation of knowledge in concept maps

The term „organisation“ focuses on the basic rationale for the spatial configuration of knowledge elements

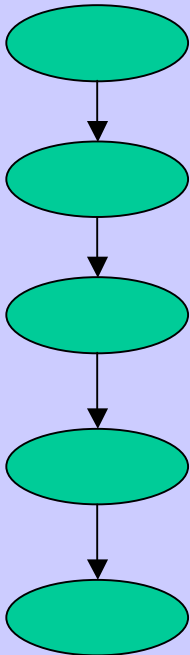
Spatial configurations

(Wiegmann, Dansereau et al., 1992)

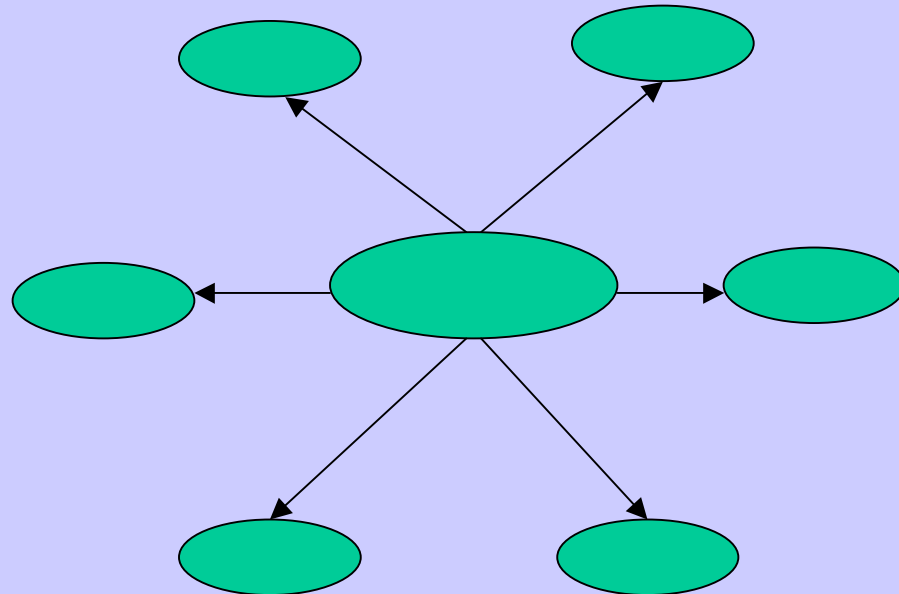
- Chain structures
- Cluster structures
- Hierarchical structures
- Web-like structures
- Web-structures

Types of spatial configuration (1)

Chain structure

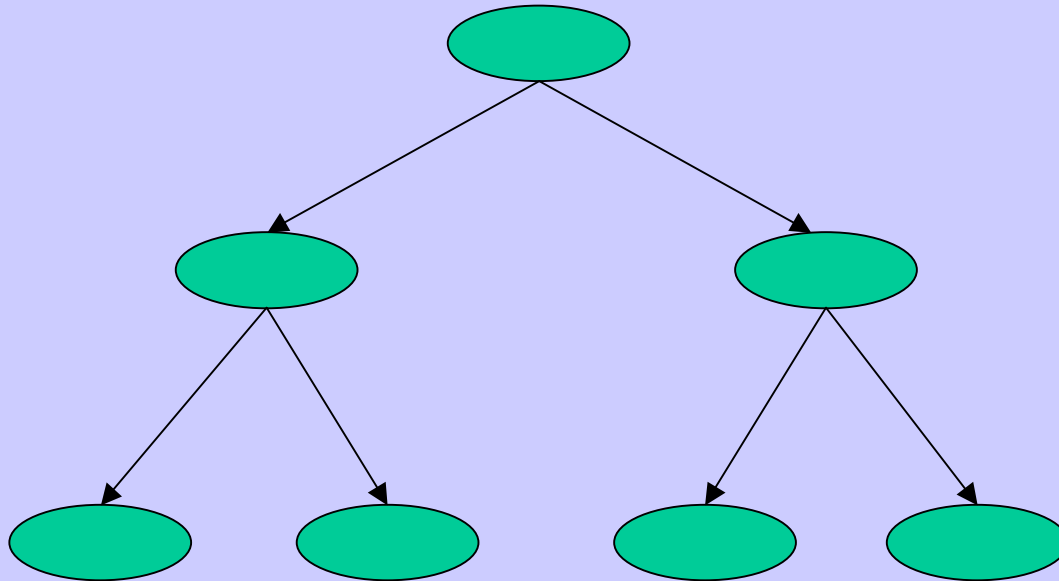


Cluster structure



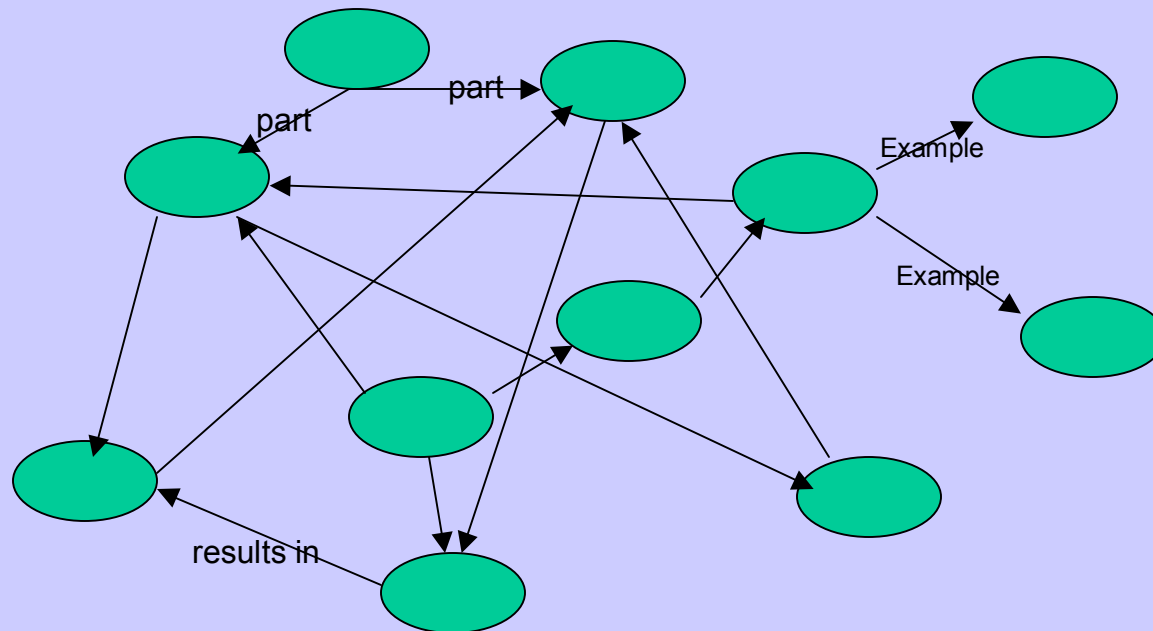
Types of spatial configuration (2)

Hierarchy



Types of spatial configuration (4)

Web-representation



Representation of knowledge in concept maps

The term „**representation**“ focuses on:

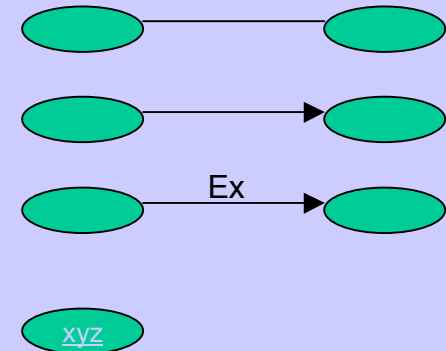
...the kind of knowledge elements

- conceptual knowledge
- multi-media content knowledge
- annotations
- knowledge resources (URLs)

Representation of knowledge in concept maps

... the kind of relation between knowledge elements

- single lines connecting two nodes
- lines with arrowhead
- semantic links (labeled links)
- hyperlinks



Representation of knowledge in concept maps

... the manner and means used for depicting and highlighting ...

- the kind of knowledge elements
- The links between nodes
- the relevance and semantic properties of knowledge elements

Representation of knowledge in concept maps

... the way of making accessible and
locating knowledge for individual use by
means of

- browsing (visual search)
- interactive access (hyperlinks)
- Searching
- Backtracking with playback-mode (SmartIdeas)

Additional features

- Interactive access to ...
 - annotations
 - local and web-based resources (text, graphics, audio, video) by means of hyperlinks
- Use of submaps
- History
- Export-functions (a.o. jpg, html)

Use of concept mapping techniques in learning and instruction

Concept-mapping techniques are being used as:

- Instructional strategy (lecture aid)
- Instructional strategy for fostering complex problem solving
- Learning strategy for fostering comprehension, knowledge acquisition, self-regulated learning
- Tool for knowledge diagnosis and evaluation of learning success
- Navigational tools in hypermedia-based programs (Gaines & Shaw, 1995)

Use of concept mapping techniques for knowledge management

Concept mapping techniques are being used:

- for comprehensive modeling of knowledge (Alpert & Gruenenberg, 2000)
- for capturing and retaining knowledge of an enterprise (Canas, Leake & Wilson, 2003)
- for knowledge communication and knowledge sharing in collaborative work (Mandl & Fischer, 2000)
- for providing direct interactive access to knowledge and knowledge resources (Coffey et al., 2002)
- for maintaining and updating knowledge (Coffey et al., 2002)

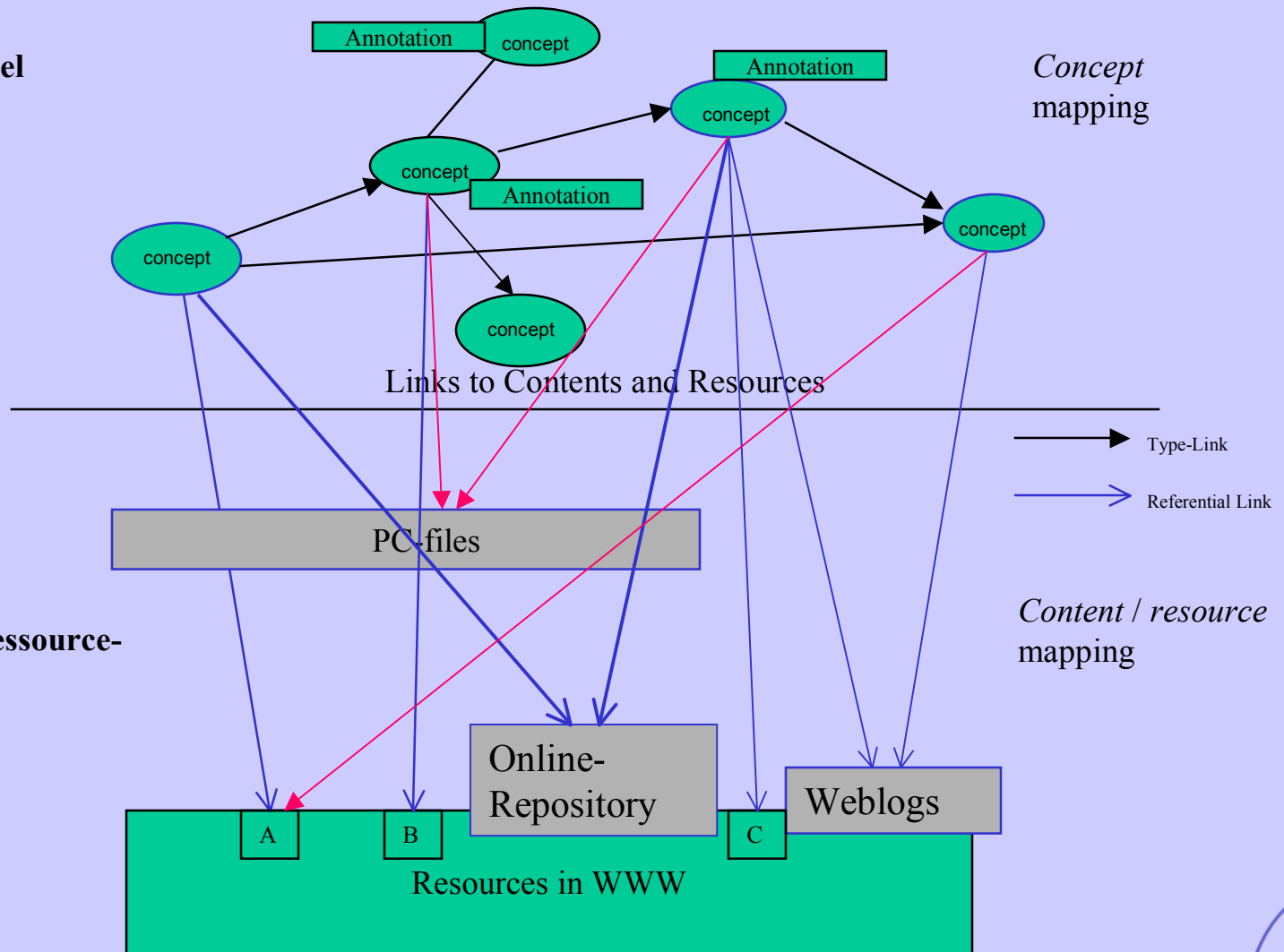
General research questions

- > Are mapping techniques effective for fostering resource-based self-regulated e-learning ?
- > What kind of features contribute to fostering comprehension, knowledge acquisition, and localisation of knowledge resources?
- > What kind of preconditions and scaffoldings are necessary in self-regulated resource-based learning with concept maps?

Concept, content and resource mapping

Cognitive level

Concept mapping



Specific research questions

(Experiment in progress)

1. What effects has the semantic labelling of relations in a concept map on the comprehension of subject-matter content, mental model construction, and location of resources?
2. What effects has the concept-based resource access on the comprehension of subject-matter content, mental model construction, and location of resources?
3. What effects have individual prerequisites like domain pre-knowledge, verbal ability, spatial ability?

Research design

Map-based resource access

Yes

No

Yes

Concept map
plus resources

- organisation
- labelled links
- hyperlinks

Concept map only

- organisation
- labelled links

**Semantic
labelling
of links**

No

Resources only

- organisation
- hyperlinks

Node map only
organisation only

Research design

| | | Map-based resource access | |
|-----------------------------|-----|--|---|
| | | Yes | No |
| Semantic labelling of links | Yes | Concept map plus resources <ul style="list-style-type: none">- organisation- labelled links- hyperlinks | Concept map only <ul style="list-style-type: none">-organisation-labelled links |
| | No | Resources only <ul style="list-style-type: none">- organisation- hyperlinks | Node map only <ul style="list-style-type: none">- spatial organisation only |

Group 1: Concept map plus resources

File Bearbeiten Anzeigen Gehe Lesezeichen Extras Fenster Hilfe 13:09 Uhr Netscape

Tergan: admin -Netscape

zugriffe_g1_a1_up1.txt -Netscape

http://www.iwm-kmrc.de/intern/staff/groteloh/tergan/aufgabe_g1.php

Suchen

mailto: eMail AIM Anfang Radio Netscape.de Suche Shop@Netscape Lesezeichen

zugriffe_g1_a1_up1.txt

persönlicher Computer

ISDN

Modem

Dial-In

Standleitung

Glasfaser

Funk

Satellit

Internetzugang

Provider

AOL

T-Online

MSN

IP-Adresse

Internetdienst

E-Mail

File Transfer

IRC

WWW

E-Mail-Client

POP3

SMTP

FTP-Client

FTP

IRC-Client

IRC-Protokoll

HTTP

WWW-Client

WWW-Server

E-Mail-Server

FTP-Server

IRC-Server

Server

Client

Server

Protokoll

E-Mail

Dateien

IRC-Messages

Web-seiten

- ✓ Client
- ✓ Dial-In-Verbindung
- ✓ E-Mail
- ✓ E-Mail-Client
- ✓ E-Mail-Server
- ✓ File Transfer
- ✓ FTP
- ✓ FTP-Client
- ✓ FTP-Server
- ✓ HTTP
- ✓ Internetdienste
- ✓ Internetzugang
- ✓ IP-Adresse
- ✓ IRC
- ✓ IRC-Client
- ✓ IRC-Protokoll
- ✓ IRC-Server
- ✓ Persönlicher Computer
- ✓ POP3
- ✓ Protokoll
- ✓ Provider
- ✓ Server
- ✓ SMTP
- ✓ Standleitung
- ✓ T-Online
- ✓ World Wide Web

Group 4: Node map only

The screenshot shows a Netscape browser window displaying a node map. The browser's address bar shows the URL: http://www.iwm-kmrc.de/intern/staff/groteloh/tergan/aufgabe_g4.php. The page content is a network diagram with the following nodes and connections:

- Client (Red box):** Includes a "persönlicher Computer" (light blue box) and a vertical stack of clients: E-Mail-Client, FTP-Client, IRC-Client, and WWW-Client.
- Server (Yellow box):** Includes a vertical stack of servers: E-Mail-Server, FTP-Server, IRC-Server, and WWW-Server.
- Internetzugang (Orange box):** Connected to "Dial-In" (yellow box) and "Internetdienst" (light blue box).
- Standleitung (Yellow box):** Connected to "Dial-In" and "Internetzugang".
- Provider (Green box):** Connected to "Internetzugang" and "Internetdienst".
- Internetdienst (Light blue box):** Connected to "Provider" and "Internetzugang".
- Transmission Media (Yellow ovals):** "ISDN", "Modem", "Glasfaser", "Funk", and "Satellit".
- Services (Light green ovals):** "E-Mail", "File Transfer", "IRC", and "WWW".
- Protocols (Light blue ovals):** "POP3", "SMTP", "FTP", "IRC-Protokoll", and "HTTP".
- Other (Light green ovals):** "AOL", "T-Online", and "MSN".
- Bottom Nodes (Light green ovals):** "E-Mail", "Dateien", "IRC-Messages", and "Web-seiten".
- Protokoll (Light blue box):** Located above the bottom nodes.

A search bar on the right side of the page lists the following nodes:

- [Client](#)
- [Dial-In-Verbindung](#)
- [E-Mail](#)
- [E-Mail-Client](#)
- [E-Mail-Server](#)
- [File Transfer](#)
- [FTP](#)
- [FTP-Client](#)
- [FTP-Server](#)
- [HTTP](#)
- [Internetdienste](#)
- [Internetzugang](#)
- [IP-Adresse](#)
- [IRC](#)
- [IRC-Client](#)
- [IRC-Protokoll](#)
- [IRC-Server](#)
- [Persönlicher Computer](#)
- [POP3](#)
- [Protokoll](#)
- [Provider](#)
- [Server](#)
- [SMTP](#)
- [Standleitung](#)
- [T-Online](#)
- [World Wide Web](#)

Research cooperation

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der Naturwissenschaften (IPN)
Kiel, Germany

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Augsburg, Germany

Penn State University –
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**Thank you
for your
attention**

!!

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