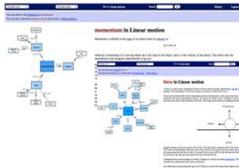


Dynamic Digital Text: An Innovation in STEM Education

Knowledge Representation and Visualizations

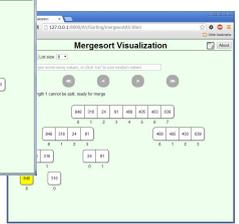
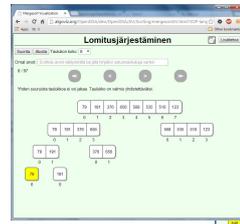
CoPASS: A Digital Text for Science Education in Schools

- Two representations: Concept map visualizations and text
- Conceptual representation and textual representation - change dynamically
- Representations support making connections between concepts
- Maps are dynamic and zoom in and out in the form of a fisheye
- The most related concepts are closest to the focus



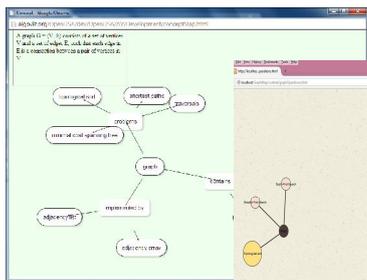
OpenDSA: A Digital Text for Computer Science Education in Colleges

- Integrates content, algorithm visualizations, and interactive exercises to teach Data Structures and Algorithms topics
- Visualizations allow better presentation of dynamic content such as algorithms
- Rich collection of exercises allows students to assess their understanding
- OpenDSA now has extensive support for internationalization: book instances can be compiled in a selected language (if the content has been made available in that language).
- It is now easy to create translations for visualizations to any language by supplying the translations for a specified list of text strings.
- Displayed program examples can easily be changed to another programming language.



Dynamic Digital Text: An Innovative eTextbook Architecture under Development

- Integrates key features from CoPASS and OpenDSA
- Multiple modes of navigation:
 - Nonlinear navigation via dynamically changing concept maps built from a glossary of concepts
 - Linear navigation via chapters and sections
- Multiple modes of information presentation and interactions:
 - Concept maps function as visualizations that make visible the underlying structure of information
 - Textual content, such as definitions and examples appear side-by-side with concept maps
 - Context specific menus integrate additional content, visualizations and interactive exercises
- We envision an open source, web-based eTextbook service that will support instructors in producing their own customized eTexts by downloading and integrating selected topics, which then will be accessible on a variety of mobile platforms



Research leaders:

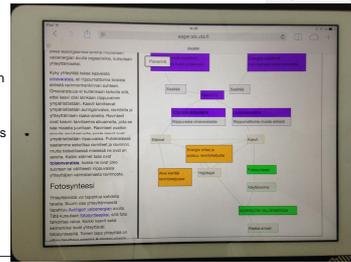
Finland: Dr. Ari Korhonen (Senior Research Scientist in Computer Science, Aalto University), Dr. Mirjamajja Mikkilä-Erdmann (Professor of Education, University of Turku), Dr. Mika Kortelainen (Principal Economist, Government Institute for Economic Research), and Dr. Roope Raisamo (Professor of Information Sciences, University of Tampere).

USA: Dr. Hari Narayanan (Professor of Computer Science & Software Engineering, Auburn University), Dr. Sadhana Puntambekar (Professor of Learning Sciences, University of Wisconsin Madison) and Dr. Cliff Shaffer (Professor of Computer Science, Virginia Tech).

eTextbooks with computer science content will be evaluated in undergraduate US classrooms in summer & fall 2014

eTextbooks with biology content in Finland

- E-textbooks are still an unexplored resource in supporting learning of complex science phenomena in higher education
- Two different e-text designs for iPad on photosynthesis are tested (index vs. concept map)
- 99 student teachers in the university were participants
- Pre-test-post-test design is used, log-files during navigating the text are recorded, usability experienced by students is measured
- The results indicate that the effects of the index and concept map designs on learning are highly similar. However, some weak evidence of the concept map outperforming the index is found in one of the student exercises.
- New technological solutions and pedagogical consequences are discussed.



- There is a need for mobile solutions for eTextbooks which are empirically tested.

- Digital textbooks are now widely used, but are mostly clones of print counterparts
- Students need better ways to access information in the content
- Students need self-directed practice and assessment of their understanding

- Novel methods of knowledge representation based on how people learn
- Interactive visualizations
- Interactive exercises

NABC

- Digital textbooks
- Cheaper and more portable
- Can become interactive
- Can be updated or reconfigured easily
- Can be downloaded as needed

- Most commercial publishers are still digitizing textbooks and providing multiple choice question banks. However, pedagogically driven research is missing. This project aims to develop a novel design and architecture for dynamic digital textbooks for science and subject them to rigorous tests.

