ACM SIGCSE 2007

Doctoral Consortium

InfoTraffic –
Concepts, Theses
and Contributions

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Project InfoTraffic

InfoTraffic is a **collection of learning environments** for teaching important concepts of computer...
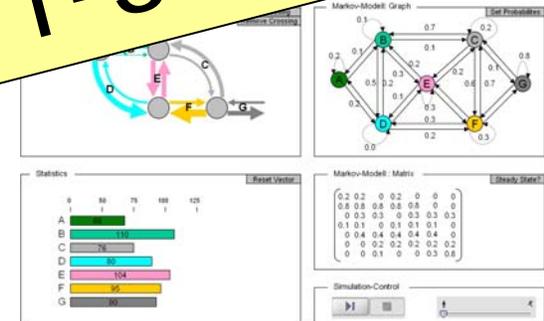
– Motiv...

in...

LogicTraffic   QueueTraffic   (DynaTraffic)

Main Didactical Concepts

- **Choice of content**
  - Fundamental Ideas [1]
- **Design of learning environment**
  - Different representations [2], in particular virtual-enactive [3]
  - Level of Interactivity [4]
  - Addressing of the "Nintendo Generation" [5]
- **Use in class**
  - eg-rule-eg-rule [6]
  - "Advance Organizer+" [7]

[1] A. Schwill. Fundamental ideas of computer science. EATCS-Bulletin, 53:274-295, 1994.

[2] J. S. Bruner, R. R. Oliver, and P. M. Greenfeld. Studies in Cognitive Growth. John Wiley and Sons, New York, 1966.

[3] W. Hartmann, M. Naef, and R. Reichert. Informatikunterricht planen und durchführen. Springer, 2006.

[4] R. Schulmeister. Taxonomy of Multimedia Component Interactivity. A Contribution to the Current Metadata Debate. Studies in Communication Sciences. Studi di scienze della communicazione., 3(1):61-80, 2003.

[5] M. Guzdial and E. Soloway. Teaching the nintendo generation to program. Communications of the ACM, 45(4):17-21, 2002.

[6] D. A. Bligh. What is the Use of Lectures? Penguin Books, 1972.

[7] D. P. Ausubel. The use of advance organizers in the learning and retention of meaningful verbal material. Journal of Educational Psychology, 51:267-272, 1960.

Thesis Contributions

1. **Logic should be part of General Education**
   - Importance of Logic
   - Current state in Swiss/German High Schools…

2. **Virtual-enactive learning environments for abstract topics**
   - Operation "thinking" can happen in different media…
   - Our approach makes sense

3. **Extending the rule-eg-rule Technique**
   - A way to introduce new abstract topics:
     Begin with elaborate example known from everyday life

A Fourth Contribution of my Thesis: Evaluation vs. Impact

- Proper scientific evaluation of usefulness of learning environments such as InfoTraffic is (at least) difficult [8]
  - "Land of Null Hypotheses" [9]
  - What would such evaluation look like??
    - It's e.g. not just about usability...

- For implementation of learning environments such as InfoTraffic we suggest an **engineering science** approach:
  - Consideration and application of general knowledge (e.g. from cognition science, multimedia research, CSE...)
  - Interdisciplinary cooperation with 3 partners:
    - Experienced Teachers (topics, exercises, scenarios)
    - Computer Science (software engineering)
    - Educational science (methods)

[8] Gabi Reinmann. Nur "Forschung danach"? Vom faktischen und potentiellen Beitrag der Forschung zu alltagstauglichen Innovationen beim E-Learning. Arbeitsbericht Universität Augsburg, Nr. 14, 2006.
[9] Rolf Schulmeister. Grundlagen hypermedialer Lernsysteme. Theorie - Didaktik - Design. Oldenbourg Verlag München 1997.

10 Pragmatic recommendations...

...for the development of interactive learning environments [10]:

1. Computer needed?
2. Topic relevant in 10 years?
3. Use-Cases: Is interactivity possible?
4. Paper based prototyping
5. Rapid prototyping
6. Technical requirement: as simple as possible
7. Early testing
8. Economical GUI
9. Spreading of the learning environment
10. Securing maintenance and continuity

[10] R. Arnold and W. Hartmann. Pragmatische Empfehlungen zur Entwicklung von interaktiven Lernumgebungen. Submitted for publication.

Provocative Theses

- **Proper scientific evaluation of usefulness of interactive learning environments (such as InfoTraffic) is not possible.**

- **For implementation of learning environments follow our pragmatic interdisciplinary engineering approach: it will have more practical impact** (e.g. in high schools).
    - How to state this scientifically?

My experience:
    - Area of conflict between educational and computer science…
    - Design of environments often not considered "scientific"…
    - Designing such learning environments is a tightrope walk…

InfoTraffic – THE END

- **Underway: DynaTraffic**
  - Dynamic Systems, Markov chains

Remarks?
Questions?

Thanks for Feedback! ☺

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Project page: http://people.inf.ethz.ch/rarnold/infotraffic/

SW & teaching material: http://swisseduc.ch/compscience/infotraffic/ 8