A System for Exploring Open Issues in VR-based Education

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http://cid.nada.kth.se/
http://www.nada.kth.se/~gustavt/cybermath/
Personal views on "E-learning"

- Knowledge requirements change rapidly, so learning must be fast (at least in many professions)

- E-learning solution: Minimize teacher-student communication through
  - "Knowledge packaging": CD-ROMs, websites, modules, games ("edutainment")
  - Limiting the bandwith: automated replies, question databases
But...

• Constructivist learning theory:
  • We construct our own understanding of the things we study.
  • Knowledge construction is a collaborative process.
  • So efficient learning requires communication between teachers and students.
We should use computer and web technology to bring people together in more efficient ways!

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Question-driven learning: Teacher roles

• Preacher
  Explains and excites

• Coach
  Generate questions & guide

• Plumber
  Maintaining communication channels

• Student ↔ teacher
Cybermath project background:

- Advanced visualization techniques
- Mathematics
- Shared virtual environments
- Schools and museums

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VR in education has been proved successful

Some open issues:

- Immersive vs. fishbowl VR
- Collaboration techniques (mainly teacher-student)
- Pros and cons of visual richness (realism)
- Mathematical content
Cybermath

• Shared virtual environment for mathematics exploration
• Virtual museum metaphor
• Four exhibitions on geometry and calculus
• Support range of teaching styles: lecturing, teacher-guided projects, workshops, individual exploration & play

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The DIVE platform
http://www.sics.se/dive/

- Distributed scenegraph with avatars
- Live audio transfer between participants
- Alternative display devices: monitor, HMD, CAVE
- Rapid prototyping through Tcl/Tk
- Runs on low-range hardware

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DEMO

Installed in the CAL.

Cybermath files available on request.

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Evaluation study

- 14 participants:
  - Students (undergraduates) at the University of Uppsala
  - Teacher in Stockholm
- Guided tour through the cylinders exhibition
- Questionnaire

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Study results

- Favorable ratings for
  - Perceived level of immersion
  - Awareness of other participants in the VE
- Average ratings for
  - User interface
  - Collaboration aspects

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Drawbacks of the DIVE platform

- Unstable
- Poorly documented
- Dated graphics engine
- Questionable distribution model
- Hard to write non-trivial applications in Tcl/Tk
Our requirements for large-scale deployment

- Robust
- Easy to use and set up
- Flexible for application programmers
- Support rapid prototyping (eventually by teachers & students)
- High visual quality

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Wasa: A set of portable programming libraries

• Dynamic scenery: OpenInventor-style scenegraph
• Static scenery: Quake II-style
• Independent of distribution model
• Tools
  • Lighting (radiosity, sunlight/skylight simulation)
  • Import objects from ActiveWorlds, Mathematica, Maya

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DEMO

Download from
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Why Yet Another "Game Engine"?

- Control over source code & documentation
- GNU license
- Light-weight & well-documented
- Easy to integrate new rendering algorithms & distribution models
- Extend with new node types without recompile (or at run-time)

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Planned activities

- Study: Evaluate Cybermath in schools, is it useful?
- Study: How important is visual richness?
- Study: What’s the difference in retained knowledge (if any) for fishbowl VR, HMD and CAVE?

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Acknowledgements

• Ambjörn Naeve
  Mathematics, education/teaching strategies

• Sören Lenman
  Project leader

• Pär Bäckström
  Virtual architecture, 3D design

• Olle Sundblad
  Networking

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Thank you for your attention!

(And please let us know what you think of the demo!)