Educational Technologies
WS2008/9

Collaborative Learning and Collaborative Learning Technologies

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Review of Syllabus

http://www.activemath.org/Teaching/edtechws0809/

28.10.2008: Introduction
04.11.2008: Intelligent tutoring systems (1) - Cognitive Tutors
11.11.2008: Intelligent tutoring systems (2) - ActiveMath
18.11.2008: Student modelling (1)
25.11.2008: Student modelling (2)
02.12.2008: Pedagogical components, instructional planning
09.12.2008: Meta-cognitive support (1) - Help
16.12.2008: Error diagnosis and feedback
06.01.2009: Error diagnosis and feedback
13.01.2009: Collaborative learning technologies
20.01.2009: Multi-Media Learning principles
27.01.2009: Web-based systems
03.02.2009: Educational data mining
23.02.2009: Project presentations by students
Today’s Lecture

- Computer-Supported Collaborative Learning – What is it and Where did it come from?

- Theoretical Underpinnings and Research Issues

- A little exercise in collaboration …

- Example Collaborative Learning Technologies
Computer-Supported Collaborative Learning – What is it?

• Learning from cooperation / collaboration

• CSCL definition:
  • “How people can learn together with the help of the computer” (Stahl, Koschmann, & Suthers, 2007)
  • “The words ‘collaborative learning’ describes a situation in which particular forms of interaction among people are expected to occur, which would trigger learning mechanisms, but there is no guarantee that that the expected interactions will actually occur.” Dillenbourg (1999)

• Brings together:
  • Ed Psych Ideas (e.g., Johnson & Johnson, 1990, Slavin,1992)
  • Computer Supported Collaborative Work (CSCW): technical support of group work (not learning context)
  • e-Learning: (individual) computer-enhanced learning organization of instruction across computer networks
Computer-Supported Collaborative Learning – What is it?

Computer mediated

>> no face-to-face-communication
>> web-based collaboration
>> techniques to intervene

Computer support

>> face-to-face-collaboration
>> scaffolds for effective collaboration
>> techniques to intervene
Computer-Supported Collaborative Learning – What is it?

- General purpose tools for mediating communication that are sometimes used for collaborative learning
  - Email
  - Chat tools
  - Electronic bulletin boards
  - Application sharing tools
  - Simulations
  - e-Phone & Video conferences

- Special-purpose software tools for:
  - Argumentation
  - Problem solving
  - Exploration
Computer-Supported Collaborative Learning – Where did it come from?

Historical sequence of approaches (Koschman, 1996):

1. Computer-assisted instruction
2. Intelligent tutoring systems
3. Logo Learning
4. CSCL
Computer-Supported Collaborative Learning – Where did it come from?

Historical sequence of approaches (Koschman, 1996):

(1) Computer-assisted instruction
   - 1960s: Behaviorist approach
   - Skinner: programmed instruction
   - Learning = Memorization of facts, drill and practice
   - Domain knowledge broken down into elemental facts, presented to students in a logical sequence
   - Many commercial educational software products take this approach

(2) Intelligent tutoring systems

(3) Logo Learning

(4) CSCL
Computer-Supported Collaborative Learning – Where did it come from?

Historical sequence of approaches (Koschman, 1996):

(1) Computer-assisted instruction

(2) Intelligent tutoring systems
   - 1970s: Cognitivist philosophy
   - Carbonell, Anderson, Koedinger, Van Lehn, et al
   - Learning = Development of mental representations / mental models
   - Computer models of expert and student knowledge
   - Respond to typical errors
   - Limited to domains where mental models can be clearly defined

(3) Logo Learning

(4) CSCL
Intelligent Tutoring Systems

Source: Bruce McLaren, Nikol Rummel, Martin Mühlenbrock
Computer-Supported Collaborative Learning – Where did it come from?

Historical sequence of approaches (Koschman, 1996):

1. Computer-assisted instruction
2. Intelligent tutoring systems
3. Logo Learning
   - 1980s: Learn LOGO programming; explore the power of reasoning (MIT, Papert)
   - Constructivist approach: students must build knowledge themselves
   - Idea: provide stimulating environments for students to promote their thinking
4. CSCL
Computer-Supported Collaborative Learning – Where did it come from?

Historical sequence of approaches (Koschman, 1996):

1. Computer-assisted instruction
2. Intelligent tutoring systems
3. Logo as Latin
4. CSCL
   - 1990s till now: explore how computers can bring students together to learn collaboratively in small groups and learning communities
   - Motivated by social constructivist and dialogical theories
   - Background: Recent technological developments (CSCW)
   - Role of the computer shifts from providing instruction to providing a medium of communication and scaffolding student interaction
Computer-Supported Collaborative Learning – Where did it come from?

- 1983: Workshop on “joint problem solving and microcomputers” in San Diego, USA
- 1989: NATO-sponsored workshop entitled “computer-supported collaborative learning” in Maratea, Italy
- 1995: First CSCL conference at Indiana University, USA
- 1997: CSCL conference Toronto, Canada
- 1999: CSCL conference Stanford University, California, USA
- 2001: E-CSCL conference Maastricht, NL
- 2002: CSCL conference Boulder, Colorado, USA
- 2003: CSCL conference Bergen, Norway → CSCL community becomes part of the International Society of the Learning Sciences (ISLS)
- 2005: CSCL conference Taipeih, Taiwan
- 2007: CSCL conference New Brunswick, NJ, USA
- Next CSCL conference: 2009 Rhodes, Greece

Source: Bruce McLaren, Nikol Rummel, Martin Mühlenbrock

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Theoretical Underpinnings and Research Issues

“All cognition is fundamentally situated and distributed.” (Hewitt & Scardamalia, 1998, p.77)

- **Distributed Cognition (Edwin Hutchins)**
  - cognitive processes are distributed over individuals and the (social) environment >> one cognitive system
    - individuals: mind & activity
    - environment: tools, symbols, standards, social processes, articles...
  - shared cognition
  - off-loading

- **Situated Cognition (J. Greeno) / Situated Learning (J. Lave & E. Wenger)**
  - knowledge exists in and results from social practices
  - knowledge means acting in the community
  - central: communication, symbols, tools
  - legitimate peripheral participation: from "newcomer" to "old timer"
Research Issue: How Can We Support Collaboration in a Computer-Mediated Situation?

- Fruitful collaboration does not occur spontaneously
  (Dillenbourg et al, 1995; Rummel & Spada, 2005)

- Approaches to foster collaboration
  ▶ Software coach (Constantino-Gonzalez & Suthers, 2002)
  ▶ Artificial student (Vizcaíno, 2005)

- Structure by *scripts*
Research Issue: How Can We Support Collaboration in a Computer-Mediated Situation?

Educational Psychology:

- Collaboration scripts provide specific instructions about task-related interaction (Kollar et al., 2006)
  - sequencing of learning activities
  - distribution of roles among learners
  - specification of interaction tasks

>> enhanced cognitive, meta-cognitive and social learning processes
Example: Scripted Collaboration (F2F)

Scripted collaboration (O’Donnell & Dansereau, 1992)

- Interaction of two partners learning from a text
  - divide text into paragraphs
  - each learner reads first paragraph individually
  - distribution of roles: “recaller” and “detector”
  - one student tries to recall information in text
  - partner tries to detect misconceptions and missing information
  - joint elaboration on text
  - switch roles for next paragraph

- Learning objectives:
  - Content of text
  - Text-learning strategies
    - cognitive (e.g. explaining, elaboration)
    - meta-cognitive (e.g. detect missing information monitoring of understanding)
### Types of Scripted Collaboration

<table>
<thead>
<tr>
<th>Schema</th>
<th>Split</th>
<th>Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jigsaw</td>
<td>distribution of knowledge</td>
<td>exchange of information</td>
</tr>
<tr>
<td></td>
<td>(e.g. expert groups &amp; teams)</td>
<td></td>
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<tr>
<td>Conflict</td>
<td>conflicting opinions</td>
<td>argumentation</td>
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<tr>
<td></td>
<td>(e.g. pro &amp; contra-roles)</td>
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<tr>
<td>Reciprocal</td>
<td>cognitive &amp; metacognitive tasks</td>
<td>mutual regulation</td>
</tr>
<tr>
<td></td>
<td>(e.g. recaller &amp; detector)</td>
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</tbody>
</table>

View of **distributed cognition**: learners and tools (=scripts) are seen as one cognitive system (and interaction provides the cognitive processes of that system).

>> Core Script defines the organization of the system
Today’s Lecture

- Computer-Supported Collaborative Learning – What is it and Where did it come from?

- Theoretical Underpinnings and Research Issues

- A little exercise in collaboration …

- Example Collaborative Learning Technologies
A little exercise in collaboration ...

Take 5 minutes on your own to solve the following problem:

- A certain book was printed using a total of 225 digits for page numbers (e.g., page 42 uses 2 digits). If the first page is numbered 1, how many numbered pages does the book have?*

Now, take another 5-10 minutes with one partner to solve the following problem:

- Mr. Newton drives to and from work over the same route each day. On Friday, he drives at an average rate of 52 km/hr and is one minute late to work. On Monday, he drives at an average rate of 60 km/hr and is one minute early to work. If he left home at the same time each day, what is the distance Mr. Newton travels from home (one way) to work?*

* - Courtesy of Columbus State University – Brain Teasers
A little exercise in collaboration …

- What did you notice about how problem solving changed when you worked with a partner?

- Which style of problem solving did you prefer? Why?

- What are the advantages of working with a partner?

- What are the disadvantages or working with a partner?
Some Phenomenon That Have Been Observed in Collaborative Learning

- **Free-rider effect**
  - the weakest learners leave the work to the high-performers of the group, social loafing

- **Sucker effect**
  - the high-performers feel exploited & therefore reduce their effort

- **Ganging up effect**
  - the group ends up with a solution that demands the least effort

- **Status dependent effect**
  - the learning-oriented interaction of low-status group members is reduced

- **Information pooling effect**
  - groups pool much less of their unshared information during open group discussion than they do of their shared information

>> In other words, collaborative doesn’t always work…
>> Or at least it needs to be supported to avoid the above problems.
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Characterization of Collaborative Learning Tools
(Jermann, Soller, & Mühlenbrock, 2001)

Mirroring Tools
- collect and aggregate data about the students’ interaction
- reflect this information back to the user, for example, as graphical visualizations
- raise students’ awareness about their actions and behaviors
Collaborative Learning Tools – Belvedere

(Suthers et al)

GLOBAL CLIMATE CHANGES
climate change could have killed all of the plants because the weather change

GLOBAL CHANGES COULD HAVE CAUSED THE MASS EXTINCTIONS BECAUSE THE ORGANISMS WEREN'T USED TO THE CHANGE IN THE WEATHER

METEORITE IMPACT CAUSED MASS EXTINCTION

CRATERS WERE FOUND TO BE AS OLD AS WHEN THE MASS EXTINCTION WAS AROUND

CRATERS ARE FOUND ALL OVER THE WORLD

18+ meter deep meteorite crater found in earth dating back to the mesozoic era, abundance of dinosaurs

Gives you ideas on how to improve your argument

You've done a nice job of finding data that is consistent with this hypothesis.

However, in science we must consider whether there is any evidence *against* our hypothesis as well as evidence for it. Otherwise we risk fooling ourselves into believing a false hypothesis.

Is there any evidence against this hypothesis?
Collaborative Learning Tools –  
**Digalo** *(Kochan, 2006)*, **Free Styler** *(Hoppe & Gaßner, 2002)*
Collaborative Learning Tools – ARGUNAUT (1)
(DeGroot et al, 2007; Hever et al, 2007; McLaren et al, 2007)

• Concept:
  • Value of students arguing / discussing contentious issues
  • Support needed from the teacher for the collaboration to be fruitful

• Collaboration Context:
  • Students work in small groups in a classroom, each student on their own computer
  • Teacher mediates the discussions

• System Functions:
  • Moderator’s Interface
  • Awareness Indicators and Alerts
    • Simple indicators (e.g. # of contr. per student) → Shallow Loop
    • Complex indicators (e.g. critical reasoning?) → Deep Loop
Collaborative Learning Tools – ARGUNAUT (2)
(DeGroot et al, 2007; Hever et al, 2007; McLaren et al, 2007)
Collaborative Learning Tools – ARGUNAUT (3)
(Scheuer & McLaren, 2008; Miksatko & McLaren, 2008)
Collaborative Learning Tools – WISE (1)
(Linn & Slotta)

Web-based Inquiry Science Environment

• Concept:
  • Making science accessible
  • Making thinking visible

• Collaboration Context:
  • 2 students on one PC

• System Functions:
  • Inquiry Map
  • Hints
  • Notes
Collaborative Learning Tools – WISE (2)

(Linn & Slotta)
Collaborative Chemistry Experimentation

• Concept:
  • Conceptual Chemistry learning through experimentation and (scripted) collaboration

• Collaboration Context:
  • 2 students work on separate PCs

• System Functions:
  • *Scripted* experimentation steps
  • Shared workspace
  • Virtual Laboratory - VLab
  • Argument space
  • Adaptive hints
Collaborative Learning Tools – CoChemEx (2)
(McLaren, Rummel, Harrer, Pinkwart, Tsovaltzi et al)
Collaborative Learning Tools – Soller’s Sentence Opener System (1) (Amy Soller)

Interaction Types
- Request
- Inform
- Motivate
- Task
- Acknowledge
- Discuss
- Maintenance
- Mediate

Example Exercise: Prepare a diagram using the Object Modeling Technique (OMT) showing relationships among the following object classes: employee, company, office, library, work contract, computer, supplies.

Source: Bruce McLaren, Nikol Rummel, Martin Mühlenbrock
Collaborative Learning Tools – Soller’s Sentence Opener System (2) (Amy Soller)

Trained Hidden Markov Model for Effective Knowledge Sharing
The End

Any Questions?