Supporting Collaborative Reflection for Knowledge Integration:

Computer Support for Building a Collaborative Learning Community in Undergraduate Cognitive Science Courses

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Self-introduction

• 1977-1982 at UCSD to witness the birth of cognitive science
• 1982 Ph.D. on “Constructive interaction”
• 1984-1991 InterCultural Learning Network
• 1991 Department of Cognitive Science in Japan
• …Developing collaborative learning courses at college-level cognitive science…
Cognitive science view on collaboration

• What is it?
• How does it work?
• What are the conditions for it to work right?
• How to implement such conditions into effective supports? (with technology, sometimes)
• Our current model course and its evaluation (qualitative).
Collaborative Knowledge integration

• An illustrative case: “Ice-making story”
  – Nursery school kids found out how to make ice collaboratively
Ice-making story

• Playing with ice is fun. Let’s have ice everyday.
• “Does the pool freeze on rainy day?”
• “Put a bucket with water at your choice of location, and check and report next morning.”
• Lots of positive and negative “answers.”
• Lots of “Now I think water freezes when…”
• “Maybe temperature, maybe weather…”
What’s special with this class?

• Children’s self-knowledge construction.
• Children seem to have started to gain some conceptual understanding.
What is Conceptual understanding and why is it important?

- Abstracted knowledge
  - Of reasons, underlying mechanisms, conditions for application...
- Usable
- Sustainable
- Portable (transferable)
- Restructure-able
Hard to reach…

• Giving verbal explanations does not work.
  – At least, not sustainable or not much usable.

• Experiential knowledge does not form itself into an abstracted piece of knowledge.
What happened at the ice-making class...?

- The goal was shared.
- Kids could easily have different “initial hypotheses.”
- There were lots of different answers.
  - They were variations of the answer to the same question.
- All the answers were sharable for comparison.
- The answers required integration.
- The integration required abstraction.
- The abstracted “theory” was testable and tested.
Ice making class: What caused the abstraction?

- There were variations of the answer to the shared problem.
- There was motivation for integrating these variations.
- Integration requires abstraction.
- Chances for evaluating such abstracted “theories.”
Ice making class: What caused the abstraction?

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Conditions for effective collaboration

• Shared goal
• Individual initial hypotheses
• Variations of solutions
• Integration
Implementing support for each condition
Shared goal/Initial hypotheses

• The internet
  – For forming virtual community of shared interest
  – For bringing in real world problems into classrooms

• The jigsaw method
First one-third

A

A

Second one-third

B

B

Final one-third

C

C

Put them together to get the whole
Variations of solutions

- Note-sharing systems
- Record keeping of cognitive processes
  - e.g. CArD
Card Arrangement Displayer
Integration

• Providing frameworks
  – Structured jigsaw
Structure of learning materials

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Same theme, same approach…
Different themes, same approach…

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Same theme, different methodologies…

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Lots of combinations…

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### Project team of members with different backgrounds

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From a student’s personal view...
Evaluate a case of second language leaning using the internet

- Simulation study of LA...
- Theory of mind and LA...
- How does a language evolve?

“Critical period of LA, and its evidence in brain studies”

Brain studies of memory, emotion…
Integration

• Providing frameworks
  – Structured jigsaw

• Sharing processes and results of linking and commenting (of notes, video clips…)
  – ReCoNote
ReCoNote
Conditions for effective collaboration

• Shared goal
• Variations of solutions
• Integration
• Collaborative culture
Collaborative culture

- From jigsaw to constructive interaction
- Peripheral participation support
  - IQ_R
Interactive Query Raiser
• Our classroom goes...
Evaluation

• Performance measures
  – Better, more integrated term papers

• Process data (log analyses)
  – Number of comments, notes, links, visits…
  – Quality of them
  – Progress trace in relation to performance
More integrated term papers

• “How do you introduce Cognitive Science to your friends of different majors?”
  – 1998: Centered around one study
  – 1999: Began to tie two to three studies
  – 2000: Tying together up to 7, 8 studies
1998 vs. 2000 comparison

- On junior (3rd year) level cognitive science courses
- Of ReCoNote use
1998 practice

- “Human problem solving”
  - 57 juniors in 23 groups
  - A semester course
  - Goal “Understand the fundamental characteristics of human problem solving”
1998 design (1/3)

• Literature study (10 weeks)

- Four card problem
- Tower of Hanoi
- Water jar
- 11 tasks
1998 design (2/3)

- Relation making (4 weeks)
  - Listen carefully and make links

![Diagram showing relationships between Four card problem, Tower of Hanoi, and Water jar]
1998 design (3/3)

• Summary writing (4 weeks)
  – Go over all the materials contributed by the entire class.
2000 practice

• “Cognitive science of learning and development”
  – 71 juniors or seniors
  – an intensive course, 3 days
  – Goal: “Propose and Evaluate a new design for a traditional college course based on findings of cognitive science on how people learn”
2000 design

• Literature study (1st day)
• Relation making (2nd day)
• Projects and Summary writing (3rd day + 10 days)

• Project: Design a new course.
2000: The complex jigsaw method

- 4 approaches, 3 materials in each

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<th>Material B</th>
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<tr>
<td>“Situated cognition”</td>
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## Overall

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<tr>
<td>Refer notes (own)</td>
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<td>3504</td>
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<tr>
<td>Refer notes (other)</td>
<td>6786*</td>
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* First 4 weeks not included
Focuses of analyses

1. Did the mutual-linking help the students explore the materials?
2. Did the structure of the materials scaffold collaborative knowledge construction?
3. Did the activities help students learn the materials?
1. Did the mutual-linking help the students explore materials?

• Notes with more links were visited more.
(1998) More links, more visits

No. of links per each note

No. of notes

Average no. of visits
(2000) More links, more visits

No. of links per each note
Use of mutual-links: one’s own vs. others’

![Chart showing comparison of mutual-links usage]

- (2000) Use of mutual-links: one’s own vs. others’
2. Did the structure of the materials scaffold collaborative knowledge construction?

- Notes were actively linked.
- The 2000 students made more relations among others’ notes than the 1998 students.
“Self-centered” to “among other’s”
Link types by study phases

2001.11.13. CREST/JAPAN
3. Did the activities help students learn?

- Moderate to high quality term papers
# Report types

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<tr>
<td>Integrated</td>
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(1998) Note sharing activities by report types
(2000) Note sharing activities by report types
“Super” curriculum?

• 1st year “Orientation to CogSci”
  – Comment on each lecture and tie them together using Jigsaw, IQ_R & CArD
• 2nd year “Introduction to CogSci”
  – Provide your own literature survey and tie the contributions together with Structured jigsaw, & ReCoNote
• 3rd year “leaning sciences”
  – Apply what you learned to evaluate web information
What we are facing now is...

- Renovating and integrating computer supports
- Exploring new types of learning activities
- Preparing better learning materials
- Redefining goals of learning: “what do the students really need to learn?”
- Realizing keener needs for better understanding of how people learn.
Toward the learning sciences...

Thank you.
http://www.crest.sccs.chukyo-u.ac.jp/