Looking at Learning

NSF CCLI Meeting
April 2004

Cynthia J. Atman, University of Washington
Jennifer Turns, University of Washington
Lorraine Fleming, Howard University
Center for the Advancement of Engineering Education

Robert Mathieu, University of Wisconsin
Center for the Integration of Research and Teaching
Looking at Learning
An Interactive Workshop

Goals:
1. describe what we want to know about our learners
2. describe your innovation with respect to the research findings from “How People Learn”
3. develop a list of research questions we would like the answers to about our learners
Workshop Process

Workshop process: Think/Pair/Share

Think – individually think about some topic

Pair – discussion with a colleague
  (someone not in your own discipline, preferably someone you do not know)

Share – group discussion
Thinking about learners

Think: create a list about what you would like to know about the learners in your classrooms (1 min)

Pair: discuss your list with a colleague (2 mins)

Share: generate group list (6 mins)
Thinking about your innovation

Think: create a list about what you know about the learners in your CCLI innovation (1 min)

Think: create a brief description about your CCLI innovation (1 min)

Pair: discuss your list with a colleague (4 mins)
Thinking about your innovation from the “How People Learn” Perspective

Describing our innovations in terms of Key Findings
“*How People Learn*”

Why?

1 – Credibility
2 – Flexibility
3 - Adaptability
“How People Learn”

Three main findings:

- Students have preconceptions
- Knowledge organization matters
- Students benefit from a “metacognitive” approach to instruction

Preconceptions

1. “Students come to the classroom with preconceptions about how the world works.

If their initial understanding is not engaged, they may fail to grasp the new concepts and information that are taught, or they may learn them for purposes of a test, but revert to their preconceptions outside the classrooms.”

Student Preconceptions

Figure 1. Differences in the assumptions between a flawed single loop mental model and the correct double loop model.
Student Preconceptions

Student preconceptions:
Applying to your innovation

Think: in what ways does your innovation take into account student preconceptions? (2 min)

Pair: discuss with a colleague (4 mins)

Share: discuss as a group (6 mins)
Organization of Knowledge

2. “To develop competence in an area of inquiry, students must:
   a) have a deep foundation of factual knowledge,
   b) understand facts and ideas in the context of a conceptual framework, and
   c) organize knowledge in ways that facilitate retrieval and application”

-> Draws on research on expert/novice differences

Expert/Novice differences in physics

**Novices' explanation for their grouping of two problems**

Problem 7 (23)

2 lbs

μ=2 ---- 40°

μ=2 ---- 30°

Problem 7 (35)

**Experts' explanation for their grouping of two problems**

K=200 n/m

15m

6m

equilibrium

Problem 6 (21)

### Senior/Freshmen differences in design processes

**Successful Graduating Student (Quality Score = 0.63)**

<table>
<thead>
<tr>
<th>Time</th>
<th>PD</th>
<th>GATH</th>
<th>GEN</th>
<th>MOD</th>
<th>FEAS</th>
<th>EVAL</th>
<th>DEC</th>
<th>COMM</th>
</tr>
</thead>
<tbody>
<tr>
<td>00:00:00:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>00:16:00:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>00:32:00:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>00:48:00:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>01:04:00:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>01:20:00:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>01:36:00:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>01:52:00:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>02:08:00:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>02:24:00:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Canonical Entering Student (Quality Score = 0.37)**

<table>
<thead>
<tr>
<th>Time</th>
<th>PD</th>
<th>GATH</th>
<th>GEN</th>
<th>MOD</th>
<th>FEAS</th>
<th>EVAL</th>
<th>DEC</th>
<th>COMM</th>
</tr>
</thead>
<tbody>
<tr>
<td>00:00:00:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>00:16:00:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>00:32:00:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>00:48:00:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>01:04:00:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>01:20:00:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>01:36:00:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>01:52:00:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Engineering Student Knowledge Networks

Engineering

- Analysis
- Theory
- Modeling
- Evaluation
- Research

- Design
- Uncertainty
- Implementation
- Teamwork
- Communication
- Economics

- Ethics
- Science
- Experimentation
- Society
- Impact
- Environment
Engineering Student Knowledge Networks
Engineering Student Knowledge Networks

Student One:

Student Two:

Knowledge organization: Applied to your innovation

Think: in what ways does your innovation take into account knowledge organization? (2 min)

Pair: discuss with a colleague (4 mins)

Share: discuss as a group (6 mins)
3. “A ‘metacognitive’ approach to instruction can help students take control of their own learning by defining learning goals and monitoring their progress in achieving them”

Metacognition

Figure 5. Differences in time spent in cognitive activities and processes in iterative activity for Freshmen and Seniors designing a playground.

# Metacognition

## Table 14.2
Planning Cues for Opinion Essays
(From Scardamalia et al., 1984)

<table>
<thead>
<tr>
<th>New Idea</th>
</tr>
</thead>
<tbody>
<tr>
<td>An even better idea is …</td>
</tr>
<tr>
<td>An important point I haven’t considered yet it …</td>
</tr>
<tr>
<td>A better argument would be …</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Improve</th>
</tr>
</thead>
<tbody>
<tr>
<td>I’m not being very clear about what I just said so …</td>
</tr>
<tr>
<td>I could make my main point clearer …</td>
</tr>
<tr>
<td>A criticism I should deal with in my paper is …</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Elaborate</th>
</tr>
</thead>
<tbody>
<tr>
<td>An example of this …</td>
</tr>
<tr>
<td>This is true, but it’s not sufficient so …</td>
</tr>
<tr>
<td>My own feelings about this are …</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Goals</th>
</tr>
</thead>
<tbody>
<tr>
<td>A goal I think I could write to …</td>
</tr>
<tr>
<td>My purpose …</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Putting it Together</th>
</tr>
</thead>
<tbody>
<tr>
<td>If I want to start off with my strongest idea I’ll …</td>
</tr>
<tr>
<td>I can tie this together by …</td>
</tr>
</tbody>
</table>
Metacognition: Applied to your innovation

Think: in what ways does your innovation take into account metacognition? (2 min)

Pair: discuss with a colleague (4 mins)

Share: discuss as a group (6 mins)
How is this useful?

Revisiting:

1 – Credibility
2 – Flexibility
3 - Adaptability
Burning research questions?

Pair: develop two research questions about specific things you would like to know about the learners in your innovation (2 mins)

Share: discuss with group
Looking at Learning

Revisiting the workshop goals:

1. describe what we want to know about our learners
2. describe your innovation with respect to the research findings from “How People Learn”
3. develop a list of research questions we would like the answers to about our learners
Looking at Learning

Dedicated to Mom

My mom is helpful she protecks us and macks shor evrything is all right if thers lova she cols the fire dapartment and she loves everyone aspeshaly her kids and husbind she helps everyone and shes a engineer

*******

helpful
by Tobyn Skye Meyer