A MODEL FOR DYNAMIC TRANSFER OF LEARNING

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Research Theme

Student Thinking of Real-World Contexts

Research Questions

- How do students construct and transfer knowledge when thinking about real-world contexts?
- What factors mediate the these processes?

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Challenges with Real-World Contexts

Most students have ...

- Seldom given prior thought to how real-world devices work, though they may have used them.
- Do not have well formed ideas about the working of these devices.
- Make up their thoughts on the spot, when asked how the devices work.

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Example: Interview on Optic Fibers

(Mateycik, Wagner, *et. al.*, PERC Proc., submitted, 2004)

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Implications for Physics Education Research

- Knowledge in pieces rather than coherent mental model.
- Unstable knowledge -- Difficult to probe student knowledge without affecting it.
- Focus on dynamics of knowledge transfer & construction rather than state of knowledge.

diSessa (1999) Hammer (2001)

What is Transfer?

Ability to use what you have learned in one situation in a different situation.

However, in light of earlier discussion..

Do we need to rethink what transfer actually means?

E.g. McKeough, Lupart & Marini (1995)

'Traditional' Views of Transfer

- Identical elements must exist between contexts.
- Knowledge must be encoded in a coherent schema.
- Researcher pre-decides what must transfer.
- Static one-shot assessment.
- Focus mainly on students' internal knowledge.
- Transfer is rare.

E.g. Gick & Holyoak (1980); Reed & Ernst (1974), Throndike (1906)

'Contemporary' Views of Transfer

- (Re)construct knowledge in new context.
- Knowledge transfers in pieces.
- Researcher examines anything that transfers.
- Dynamic, real-time assessment.
- Focus also on variety of mediating factors.
- Transfer is ubiquitous.

Rebello *et al* (2005); Hammer *et al* (2005); diSessa & Wagner (2005); Bransford *et al* (2005, 1996); Lobato (2003, 1996); Greeno *et al* (1993)

What Affects Transfer?
– The Mediating Factors

- Expectations about new situation.
  - e.g. “Expect to put in lots of effort in this class.”
  - e.g. “Knowledge of mathematics expected in this class.”
- Epistemology: Beliefs about nature of knowledge.
  - “Knowledge is propagated (from authority).”
  - “Knowledge is fabricated (by learner).”
- Motivation to apply knowledge.
- Social interactions.

Redish *et al* (1999) Hammer *et al* (2001)

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Dynamic Transfer

Our Interview Data

(5 different projects & researchers)

+

Other Contemporary Views

Our Model of Dynamic Transfer

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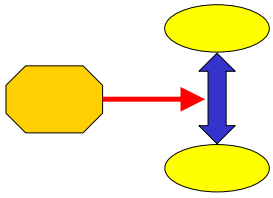
Underpinnings of Model

- ‘Two-level framework’
  - Associations between knowledge elements.
  - Control of these associations.



Redish (2003)

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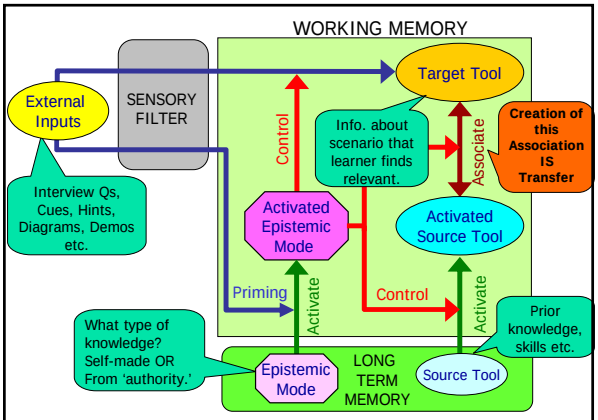

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A More Complex View

Including all possible connections and feedback loops

We get...

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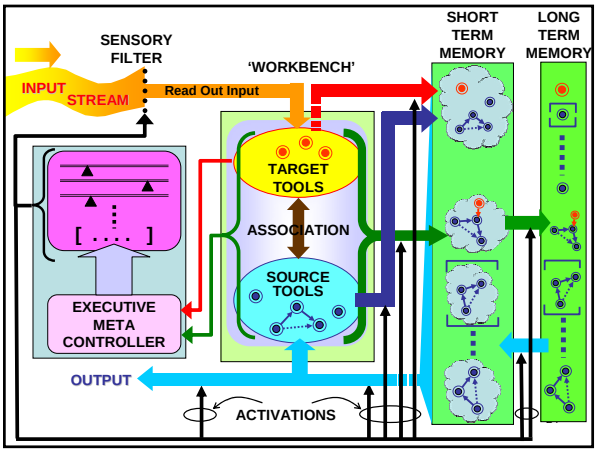

Elements of Model

Slide 1 of 2

- Tools
  - Source Tool: Dormant knowledge activated to make sense of a situation.
  - Target Tool: Attributes of a situation that a learner 'read out' from the external inputs provided.
  - Epistemic Meta-Tool: Epistemic Resources that a learner uses to exercise executive control over process in working memory.

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Elements of Model

Slide 2 of 2

- Processes
  - Read-Out: Recognizing relevant information in from the external input.
  - Activation: Retrieval of source tools or epistemic meta-tools from long term memory.
  - Association: Interconnecting various tools in the working memory e.g. inferential, causal, analogical inductive, deductive.

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Model of Transfer: Summary

- Transfer is the dynamic creation of associations between knowledge elements ('tools').
- Associations are controlled by the learners' epistemic mode.
- Epistemic mode is activated by external inputs.

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Using the Model

Examining interview data based on the model

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Source Tool: What she associates reflections with

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Target Tool: What she notices

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Source Tool: Not glass

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Another Source Tool: Assoc. with computer cables

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Applications to Our Research

Slide 1 of 2

Model provides a lens to frame research questions…

Q#1: How do students construct & transfer knowledge?

- What target tools do they read out?
- What source tools do they activate?
- What assoc. do they construct b/w these?

Q#2: What factors mediate these processes?

- In what epistemic state do they frame the situation?
- What external inputs prime them into this state?

Applications to Our Research

Slide 2 of 2

Model helps design research methodology

- What questions to ask?
  - How to phrase questions to activate desired epistemic mode?
- What knowledge building experiences to provide?
  - What hands on activities, demos to use?
  - How to promote conceptual change?
- How to analyze data?
  - What students actions and interactions to focus on?
  - What coding rubric to use?

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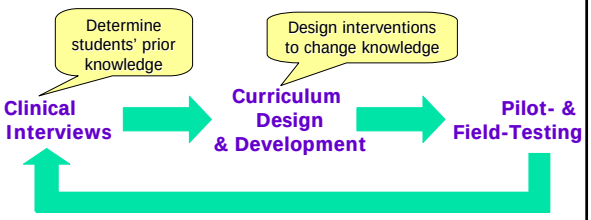
Implications for Curriculum Design

Typical Methodology



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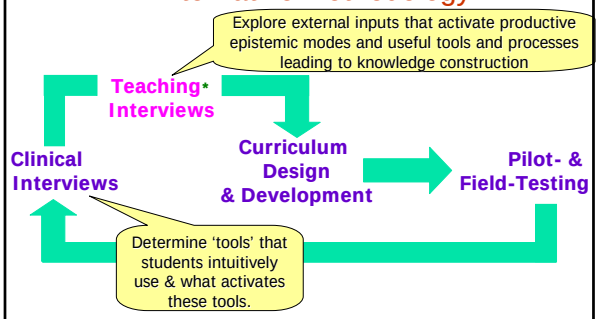
Implications for Curriculum Design

Alternative Methodology



*Steffe (1983); Steffe & Thompson (2000)

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What is a Teaching Interview?

- 'Mock' instruction:
  - Attempts to change student knowledge.
  - Rich setting for students to express themselves.
  - Variety of instructional strategies.
  - Involve groups of up to three students.
- Researcher's Role:
  - Observer.
  - Instructor.

Engelhardt *et al* (2004)

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Benefits of Teaching Interviews

Provide insights about ...

- Dynamics of knowledge construction & transfer.
- Effectiveness of materials & strategies.
- Student interactions with...
  - instructional materials,
  - peers, and
  - instructor.

Teaching Interviews are a useful paradigm for research and curriculum development.

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SUMMARY

- Real-world applications are a useful research context to observe student knowledge dynamics & transfer.
- Our model helps describe dynamic transfer in an interview and provides insights into students' knowledge construction processes.
- Teaching Interviews are a useful research tool to study the dynamics and transfer of student knowledge.

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