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 these processes?

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.
Example: Interview on Optic Fibers

From what I understand, it's a, it's almost a series of reflections. ... I'm pretty sure it's reflected light all the way through. ... I think just by a series of a-, of angled, um, I don't want to say mirrors, but it's got to be mirror-like, a mirror-like substance. ... I guess if, if you did just enclose light in, ... uh, it can't be glass 'cause it's flexible. ... I don't know how you would do it. ...
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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.


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.

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)

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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A More Complex View

Including all possible connections and feedback loops

We get...
Elements of Model

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.

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.

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.

Using the Model
Examining interview data based on the model

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Applications to Our Research

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

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?

Implications for Curriculum Design

Typical Methodology

- Determine students' prior knowledge
- Design interventions to change knowledge

Clinical Interviews → Curriculum Design & Development → Pilot- & Field-Testing

Alternative Methodology

- Determine 'tools' that students intuitively use & what activates these tools.
- Explore external inputs that activate productive epistemic modes and useful tools and processes leading to knowledge construction.

Clinical Interviews → Determine 'tools' that students intuitively use & what activates these tools.

Teaching Interviews → Curriculum Design & Development → Pilot- & Field-Testing

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.

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.

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.