Self–Regulated Learning with Computer–Based Learning Environments

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Overview

- Learning with hypermedia
- Self-regulated learning with hypermedia
- Self-regulated learning frameworks
- Cognition and Technology Lab (CTL)
  - SRL framework
  - Research questions
  - Results
- Principles—design of MetaCognitive tools
Introduction

Research on Learning with Hypermedia
- Learners rarely develop a deep conceptual understanding of complex science topics
- Learners lack cognitive and metacognitive skills
- Focus on product of learning and frequency of tool use

SRL with Hypermedia
- Contemporary cognitive research shows that the potential of hypermedia as a learning tool may be undermined by students’ inability to regulate their learning

Scaffolding SRL with Hypermedia
- Testing the effectiveness of scaffolding conditions to facilitate students’ learning of complex and challenging science topics with hypermedia
Self-Regulated Learning with Hypermedia
Science of Learning

- Science of learning with technology
- Multiple theoretical approaches
- Focus on product and processes of learning
- Focus on cognitive and metacognitive processes
- Multi–method approaches
- Human tutoring and adaptivity
- Scaffolding metaphor
- Multiple internal and external representations
- Designing adaptive technologies

Cognitive Psychology
Cognitive Science
Learning Sciences
Ed. and Dev. \( \Psi \)
AI, CS, Comp. Linguistics
## SRL Frameworks and Models
(Pintrich, 2000; Schunk, 2005; Winne, 2001; Zimmerman, 2000; 2001)

<table>
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<tr>
<th>AREAS</th>
<th>Cognition</th>
<th>Motivation/Affect</th>
<th>Behavior</th>
<th>Context</th>
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| **Forethought, Planning, Activation** | • Goal setting  
• PKA | • Goal orientation  
• Task value  
• Efficacy judgment | • Time and effort planning | • Perception of task  
• Perception of context |
| **Monitoring** | • JOL  
• FOK | | | • Monitoring changing task conditions |
| **Control** | • Learning strategies | • Increase/decrease effort  
• Help-seeking behavior  
• Persistence | | • Change or renegotiate task |
| **Reaction and Reflection** | • Schema adaptations | • Attributions | | • Evaluation of task  
• Evaluation of context |
IPT Model of SRL
(Winne, 2001; Winne & Hadwin, 1998)

**Strengths**
- Theory-driven
- Information processing
- Cognitive and metacognitive processes
- Feedback loops
- Dynamic, cyclical and recursive processes
- Control and monitoring are the hubs of SRL

**Challenges**
- Individual cognition
- Studying vs. learning
- Macro-level specification of SRL processes
- Lacks empirical evidence
Research on Learning with Hypermedia
- Theoretically-driven
- Mediating self-regulatory processes between learner characteristics, system features, and instructional context

Bridging from SRL to ERL Based on Human Tutoring
- Converge process and product data
- Areas of regulation
- Phases of regulation
- Analyze students’ self-regulated learning
- Analyze the role of human tutors as external regulating agents in facilitating SRL
Contextual Model of Self-Regulated Learning with CBLEs

**Learning Context**
- Learning goal(s)
- Instructional resources
- Learning systems (e.g., CBLE)
- External (co-)regulatory agents (embedded artificial or human agents)
- Feedback system (including levels, types, timing, delivery system)

**Task Conditions**
- Instructional resources
- Time allotted for task completion (duration of learning session)

**Cognitive, Affective, Metacognitive and Motivational (CAMM) Processes**
- Prior knowledge
- Knowledge of strategies
- Knowledge of the task
- Knowledge of and skills in using monitoring processes
- Motivational factors and orientations
- Affective states

**Learning System (CBLE)**
- Non-linear structure
- Multiple representations of information
- Content space
- Levels of learner control
- Levels of scaffolding
- Levels of adaptivity
Research Questions

1) Do different scaffolding conditions lead learners to gain significantly more **declarative knowledge** of the circulatory system?

2) Do different scaffolding conditions influence learners' shift to more-sophisticated **mental models** of the circulatory system?

3) **How** do different scaffolding conditions influence learners' **self-regulated learning**?

4) What is the role of **external regulating agents** (human tutors, classroom teachers, and peers) in facilitating learners' self-regulated learning?
Self-Regulated Learning

• Associated with learners gaining significantly more declarative knowledge of complex science topics
• Greater odds of learners NOT “shifting” to more sophisticated mental models
• Associated with learners regulating their learning by deploying non-adaptive self-regulatory processes related to planning, monitoring, and a few less effective learning strategies
Externally-Regulated Learning

- Associated with learners gaining significantly more declarative knowledge of complex science topics
- Greater odds of students “shifting” to more sophisticated mental models
- Associated with students regulating their learning by deploying key self-regulatory processes—planning, monitoring activities, effective strategies, and help-seeking behavior

- **Implications for the design of hypermedia**
  - Design scaffolds that foster SRL by *adapting* in response to students understanding of complex science topics as it emerges during learning
**Key**

**Self-Regulatory Processes**
- Planning
  - Activating Prior Knowledge
  - Creating Sub-Goals
- Monitoring
  - Judgment of Learning
  - Feeling of Knowing
  - Monitoring Use of Strategies
  - Monitoring Progress Towards Goals
  - Time Monitoring
- Learning Strategies
  - Coordinating Informational Sources
  - Drawing
  - Inferencing
  - Knowledge Elaboration
  - Summarization
  - Re-Reading
  - Self-Test
  - Review Notes
- Handling Task Difficulties and Demands
  - Help-Seeking behavior

**Other**

**Self-Regulatory Processes**
- Planning
- Monitoring
- Content Evaluation
- Learning Strategies
  - Free Search
  - Take Notes
  - Memorization
- Handling Task Difficulties and Demands
  - Task Difficulty
Implications for the design of hypermedia

- *What, when, how, and why* to foster and sustain SRL?
- Design scaffolds that foster and sustain SRL by *adapting* to students’ emerging understanding of complex science topics during learning.

Adaptivity (detect, model, and trace SRL)

- Detecting evolving understanding and complex interactions between learner characteristics and system features:
  - Planning and activating prior knowledge
  - Prompting students to use JOL and FOK, and monitor their progress towards goals
  - Prompting the use of several effective learning strategies
  - Allowing students to engage in help-seeking behavior.
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