Designing for metacognition

Applying cognitive tutor principles to the tutoring of help seeking

Group E
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Introduction:

• Develop and evaluate a set of empirically-based design guidelines for metacognitive tutoring in ITS
• Anderson's principles for cognitive tutoring
• Help-seeking in Cognitive Tutors
• Teach metacognitive skills

Method:

• Evaluate Anderson’s principles
• Experiment on Help Tutor: 4 complete studies, 1 on going study
• Formulate the new principles: 10 principles sort into three groups
  ✓ Goals, describe the design of appropriate metacognition learning objective for ITS
  ✓ Instruction, discuss the design of the instructional means, interaction style, pedagogy to be used
  ✓ Assessment, discuss the evaluation of the metacognitive tutoring
<table>
<thead>
<tr>
<th>Study</th>
<th>Goal</th>
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<tbody>
<tr>
<td>1</td>
<td>Design the help-seeking model</td>
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<td>Log-file analysis</td>
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<td>73% of students’ actions were classified as different types of help-seeking errors. These errors were significantly negatively correlated with learning ($p=-0.65$, $p&lt;0.0005$)</td>
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<td>2</td>
<td>Evaluate the model across domains and cohorts</td>
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<td>Log-file analysis</td>
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<td>Students’ errors in two different Cognitive Tutors were highly correlated ($r=0.89$, $p&lt;0.01$)</td>
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<td>3</td>
<td>Implement and pilot the Help Tutor</td>
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<td>Pilot</td>
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<td>Students improved the help-seeking behavior while working with the tutor</td>
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<td>4</td>
<td>Evaluate the Help Tutor</td>
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<td>Randomized experiment with 60 students</td>
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<td>Students improved several aspects of their help-seeking behavior. No improved learning at the domain level was observed</td>
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<td>5</td>
<td>Evaluate the combination of the Help Tutor, preparatory Self-assessment sessions, and help-seeking classroom instruction</td>
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<td>Experiment with 80 students</td>
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<td>Under analysis</td>
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</table>

Help Tutor experiment result
WEAKLY ACCEPT

Decision:

Pros:

- Clear goal: Design of principles
- Justification of work: Lack of guidelines available
- Evaluation strategy: Help Tutor
- Implication:
  - Help Tutor: Help-seeking behavior
  - Guidelines: Applied to other environments
  - Learning at the domain level
- Methodology: Studies using Cognitive Tutor
- Evidence that support the principles: Studies 1 to 5
- Clear how Help Tutor works: Add-on, help-seeking model
- Clear Help Tutor result: Mixed outcomes
- Propose improvements: Both Help Tutor and principles
- Conclusions supported by data: Improvement and evaluation. Can help as a baseline
Decision: WEAKLY ACCEPT

Cons:

• The evaluation of the principles presented is rather scattered
• The new principles are partially supported due to incomplete results of study 5
• Some methodologies used might not be clear to non-experts
• The conclusion of the paper is written as a summary but does not states any result of their work. It rather states that the work is "incomplete".