Designing for Metacognition– Applying Cognitive Tutor Principles to the Tutoring of help Seeking

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Metacognition: “Thinking about thinking”

Can teaching metacognition make students become better learners in general?

Two approaches:

- Theoretical (Expanding the principles on cognitive tutoring)
- Practical (Performed studies using “Help Tutor”)

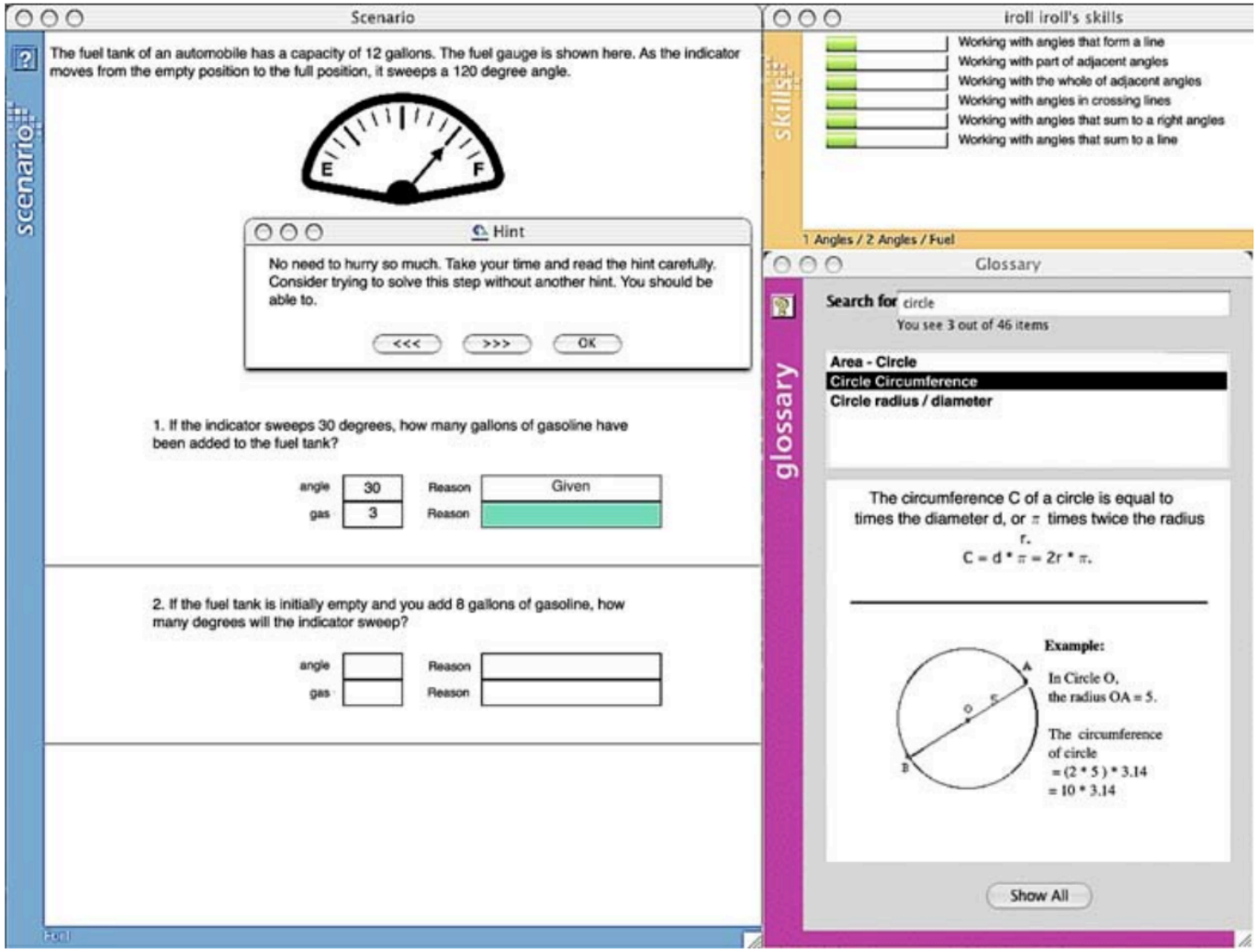
Scenario
scenario
The fuel tank of an automobile has a capacity of 12 gallons. The fuel gauge is shown here. As the indicator moves from the empty position to the full position, it sweeps a 120 degree angle.
E
F
Hint
No need to hurry so much. Take your time and read the hint carefully. Consider trying to solve this step without another hint. You should be able to.
<<<
>>>
OK
1. If the indicator sweeps 30 degrees, how many gallons of gasoline have been added to the fuel tank?
angle
30
Reason
Given
gas
3
Reason
2. If the fuel tank is initially empty and you add 8 gallons of gasoline, how many degrees will the indicator sweep?
angle
Reason
gas
Reason
iroll iroll's skills
skills
Working with angles that form a line
Working with part of adjacent angles
Working with the whole of adjacent angles
Working with angles in crossing lines
Working with angles that sum to a right angles
Working with angles that sum to a line
1 Angles / 2 Angles / Fuel
Glossary
glossary
Search for circle
You see 3 out of 46 items
Area - Circle
Circle Circumference
Circle radius / diameter
The circumference C of a circle is equal to times the diameter d, or π times twice the radius r.
C = d * π = 2r * π.
Example:
In Circle O, the radius OA = 5.
The circumference of circle
= (2 * 5) * 3.14
= 10 * 3.14
A
O
B
Show All

Table 1 Evaluation studies of the Help Tutor

Study	Goal	Methodology	Main findings	Further details
1	Design the help-seeking model	Log-file analysis	73% of students' actions were classified as different types of help-seeking errors. These errors were significantly negatively correlated with learning ($p=-0.65$, $p<0.0005$)	(Aleven et al. 2006)
2	Evaluate the model across domains and cohorts	Log-file analysis	Students' errors in two different Cognitive Tutors were highly correlated ($r=0.89$, $p<0.01$)	(Roll et al. 2005)
3	Implement and pilot the Help Tutor	Pilot	Students improved the help-seeking behavior while working with the tutor	(Aleven et al. 2005)
4	Evaluate the Help Tutor	Randomized experiment with 60 students	Students improved several aspects of their help-seeking behavior. No improved learning at the domain level was observed	(Roll et al. 2006)
5	Evaluate the combination of the Help Tutor, preparatory Self-assessment sessions, and help-seeking classroom instruction	Experiment with 80 students	Under analysis	(Roll et al. 2007)

Design Principles for Metacognition

Existing Problems:

- support productive metacognitive behavior; not teach or improve learning skills
- ITS supports metacognition learning by describing methods for modelling it
- fewer guidelines regarding to pedagogical and interactive aspects for it

Solutions:

- empirically-based design principles for metacognitive tutoring (experience with the Help Tutor and Anderson et al's principles)

Goals: design of learning objectives for ITS (what)

- declarative, procedural and dispositional goals (new)

Instruction: design of instructional means, interaction style and pedagogy (how)

- support metacognition the whole process (new)
- communicate goals (new)
- attach a price tag to metacognition error

Assessment: evaluation of metacognition tutoring

Comments

Positives:

- Format
- Long introduction explaining the key terminology:
  - Cognitive vs. Metacognitive
  - Cognitive Tutors
  - Help Tuttor
- The proposed changes are discussed under each design priciple.

Negatives:

- Some aspects are still very technical (Log-files, Production rules)
- Very specific → Not an introduction to the whole subject
- Work in Progress → Confusing for non-expersts

Student Background → Weak Accept/Neutral

Thank you!