Identifying Relevant User Behavior, Predicting Learning, and Persistence in an ITS-based After-school Program

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Project Summary

- Mathematics is an essential 21st century skill.
- Many countries are failing to reach proficient levels in Mathematics.

Learning Outside of School

- After-school programs are an untapped resource (Gayl, 2004; Kugler, 2001; Miller, 2003).
- Only 11% of students participate in after-school programs.
- Most programs are skill based and do not target academic topics.
- Academic activities improve mathematics performance.
- 6th and 7th grade students that regularly attend after-school programs score about 12 percentile points higher in mathematics than their peers (Vandell, 2007).
- After-school programs encounter several challenges (Vandell et al., 2005).

Our After-school Math Program

- Occurred within the Jackson-Madison County School System (J-MCSS).
- Targeted 6th grade students at 5 middle schools.
- Duration of 21 weeks (two days per week, two hours per day).
- Conducted by 16 certified math teachers.
- Point-based retention program.

Method

- Used the ALEKS (Assessment and Learning in Knowledge Spaces) web-based learning system.
- AI-based Knowledge Space Theory (KST).
- Representation of a large number of possible knowledge states within a topic (e.g., Mathematics).
- Models learners’ current knowledge, including what the student knows, does not know, and is ready to learn.

Help-seeking Behaviors

- Example Knowledge Space

Practice Behaviors

- Example

Help-seeking Behaviors

Practice Behaviors

Learning Behaviors within ALEKS

- Example: read the explanation before attempting a topic.
- Example (Proposition): proportion of explanations being read (the number of explanations/the number of learning behaviors).
- Example after Mistake: read the explanation immediately after making the mistake.
- Example (Latency): delay to seek explanations after making mistakes.
- Example (Tendency): tendency to seek explanations to avoid making mistakes (the number of explanations/the number of mistakes and explanations).

Help-seeking Behaviors

Practice Behaviors

Help-seekingBehaviors:

Practice Behaviors: 

Predicting Student Persistence within ALEKS

- High Persistence
- Correctly classified 96%
- Medium Persistence
- Correctly classified 8.3%
- Non-Persistence
- Correctly classified 1.2%

Help-seeking Behaviors

Practice Behaviors

Help-seekingBehaviors:

Practice Behaviors: 

Predicting Learning within ALEKS

- 204 sixth grade students (Years 2 and 3): included 55,281 learning sequences.
- Typical activities: correct, wrong, examples, mastery, failed, left the attempt.

Help-seeking Behaviors

Practice Behaviors

Help-seekingBehaviors:

Practice Behaviors: 

Predicting Learning within ALEKS

- C1: quick mastery (11%)
- C2: continue practicing after mastery (8%)
- C3: request worked examples after mistake; attain correct answer and mastery (22%)
- C4: request worked examples then quit without practice (13%)
- C5: request worked examples after error, continue to give incorrect response, then quit (17%)
- C6: requested practice but wrong at 2nd & 3rd; request worked examples but only get half of practices correct (6%)
- C7: all practices are wrong; request worked example after two errors; continue errors; quit failure (9%)
- C8: all practices are wrong; reach failure twice (9%)

Conclusions

- Clustered learner strategies and demonstrated context is important.
- Predicted learning based on behavior within ALEKS.
- Successfully predicted student persistence on ALEKS problems.
- Overall, the after-school program with ALEKS was highly successful.
- Improved students math ability (Hu et al., 2011).
- Students continued to perform at the same levels of impact over 4 years.
- Evidence for decreasing achievement gap typically for minority populations (Hu et al., 2016).
- ITS after-school program could be an effective alternative for school systems that have limited trained teachers.
- Still need to better understand the process of learning with this technology.

Project Information


