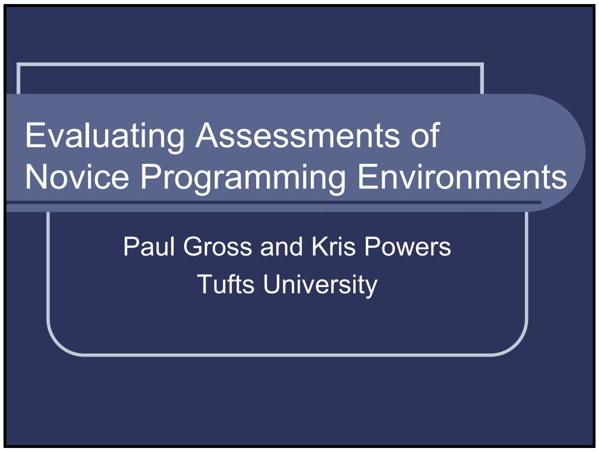
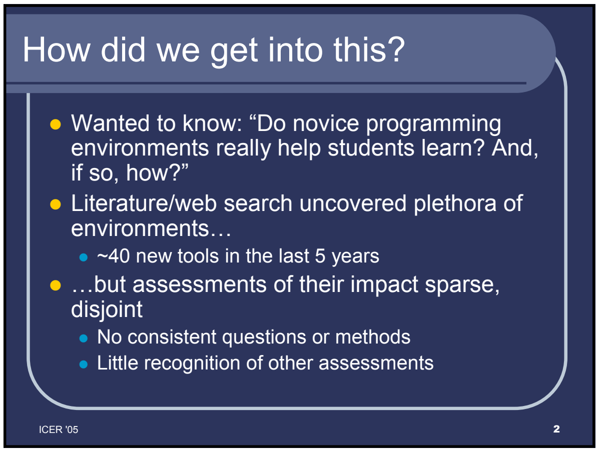


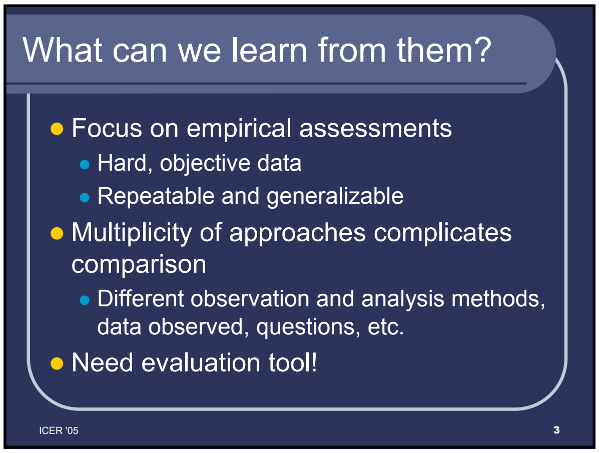
Evaluating Assessments of Novice Programming Environments

Paul Gross and Kris Powers
Tufts University



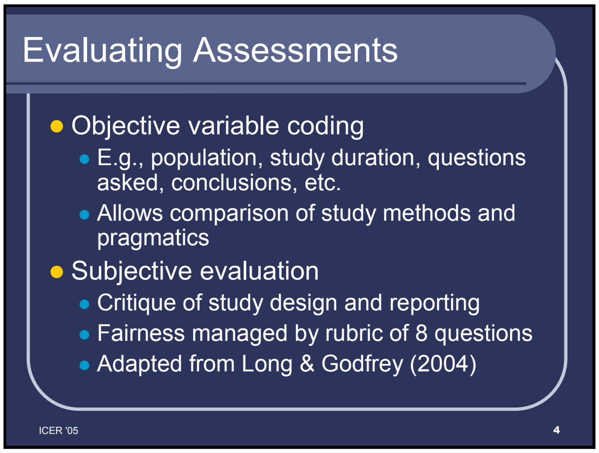
How did we get into this?

- Wanted to know: "Do novice programming environments really help students learn? And, if so, how?"
- Literature/web search uncovered plethora of environments…
  - ~40 new tools in the last 5 years
- …but assessments of their impact sparse, disjoint
  - No consistent questions or methods
  - Little recognition of other assessments



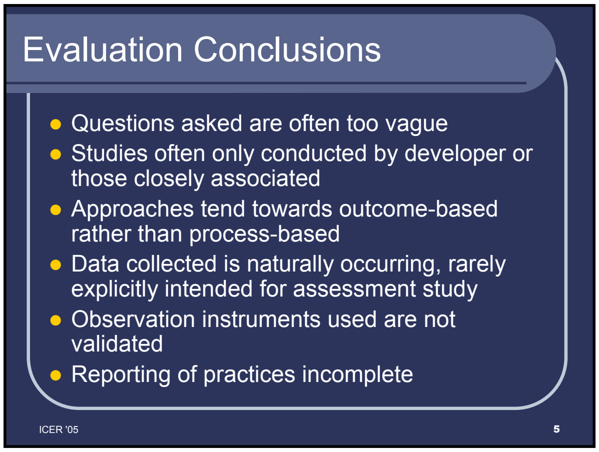
What can we learn from them?

- Focus on empirical assessments
  - Hard, objective data
  - Repeatable and generalizable
- Multiplicity of approaches complicates comparison
  - Different observation and analysis methods, data observed, questions, etc.
- Need evaluation tool!



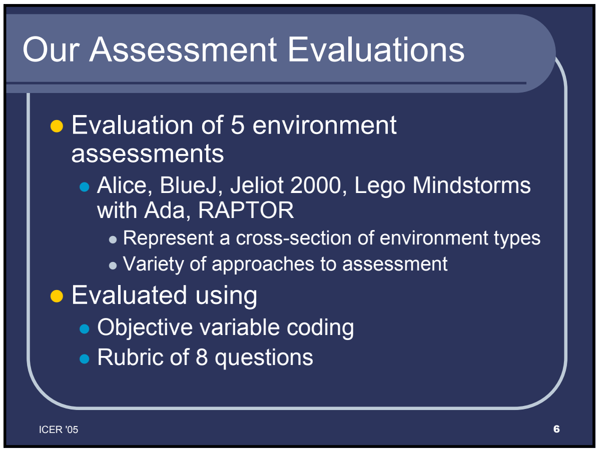
Evaluating Assessments

- Objective variable coding
  - E.g., population, study duration, questions asked, conclusions, etc.
  - Allows comparison of study methods and pragmatics
- Subjective evaluation
  - Critique of study design and reporting
  - Fairness managed by rubric of 8 questions
  - Adapted from Long & Godfrey (2004)



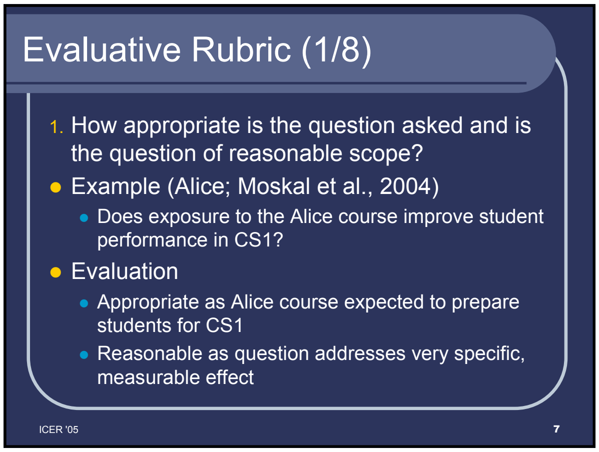
Evaluation Conclusions

- Questions asked are often too vague
- Studies often only conducted by developer or those closely associated
- Approaches tend towards outcome-based rather than process-based
- Data collected is naturally occurring, rarely explicitly intended for assessment study
- Observation instruments used are not validated
- Reporting of practices incomplete



Our Assessment Evaluations

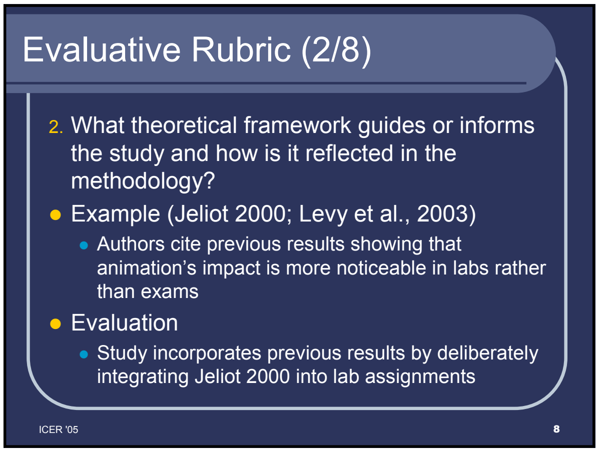
- Evaluation of 5 environment assessments
  - Alice, BlueJ, Jeliot 2000, Lego Mindstorms with Ada, RAPTOR
    - Represent a cross-section of environment types
    - Variety of approaches to assessment
- Evaluated using
  - Objective variable coding
  - Rubric of 8 questions



Evaluative Rubric (1/8)

1. How appropriate is the question asked and is the question of reasonable scope?

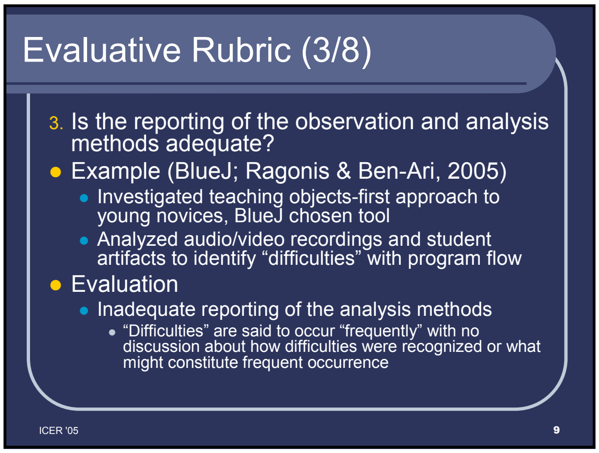
- Example (Alice; Moskal et al., 2004)
  - Does exposure to the Alice course improve student performance in CS1?
- Evaluation
  - Appropriate as Alice course expected to prepare students for CS1
  - Reasonable as question addresses very specific, measurable effect



Evaluative Rubric (2/8)

2. What theoretical framework guides or informs the study and how is it reflected in the methodology?

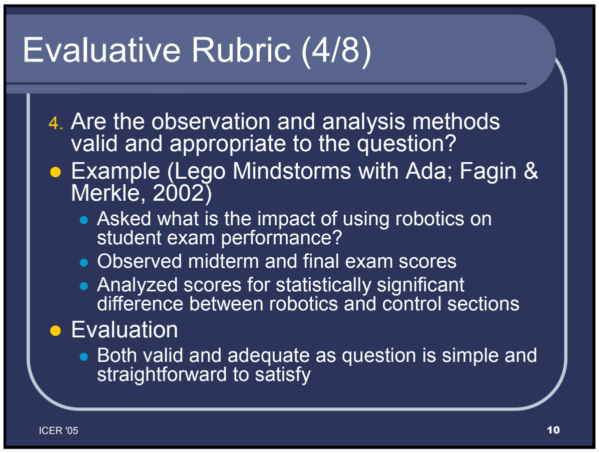
- Example (Jeliot 2000; Levy et al., 2003)
  - Authors cite previous results showing that animation's impact is more noticeable in labs rather than exams
- Evaluation
  - Study incorporates previous results by deliberately integrating Jeliot 2000 into lab assignments



Evaluative Rubric (3/8)

3. Is the reporting of the observation and analysis methods adequate?

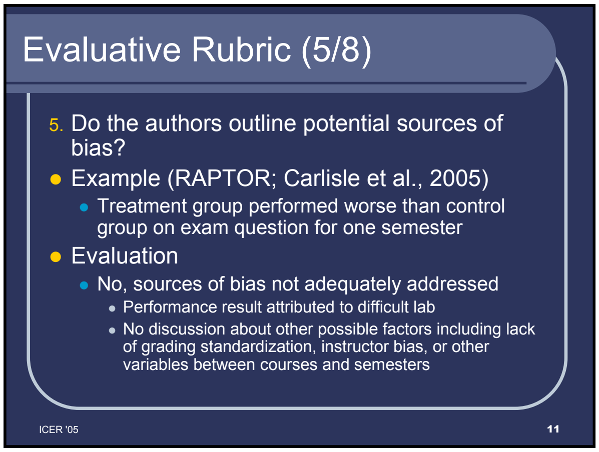
- Example (BlueJ; Ragonis & Ben-Ari, 2005)
  - Investigated teaching objects-first approach to young novices, BlueJ chosen tool
  - Analyzed audio/video recordings and student artifacts to identify "difficulties" with program flow
- Evaluation
  - Inadequate reporting of the analysis methods
    - "Difficulties" are said to occur "frequently" with no discussion about how difficulties were recognized or what might constitute frequent occurrence



Evaluative Rubric (4/8)

4. Are the observation and analysis methods valid and appropriate to the question?

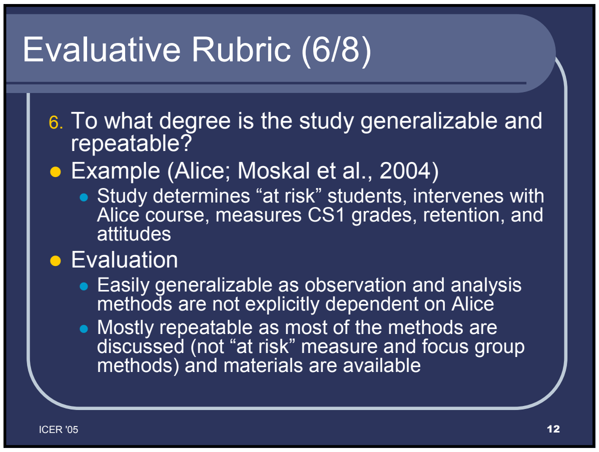
- Example (Lego Mindstorms with Ada; Fagin & Merkle, 2002)
  - Asked what is the impact of using robotics on student exam performance?
  - Observed midterm and final exam scores
  - Analyzed scores for statistically significant difference between robotics and control sections
- Evaluation
  - Both valid and adequate as question is simple and straightforward to satisfy



Evaluative Rubric (5/8)

5. Do the authors outline potential sources of bias?

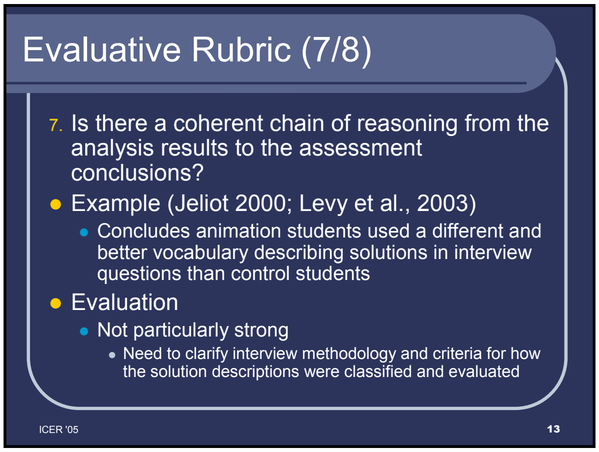
- Example (RAPTOR; Carlisle et al., 2005)
  - Treatment group performed worse than control group on exam question for one semester
- Evaluation
  - No, sources of bias not adequately addressed
    - Performance result attributed to difficult lab
    - No discussion about other possible factors including lack of grading standardization, instructor bias, or other variables between courses and semesters



Evaluative Rubric (6/8)

6. To what degree is the study generalizable and repeatable?

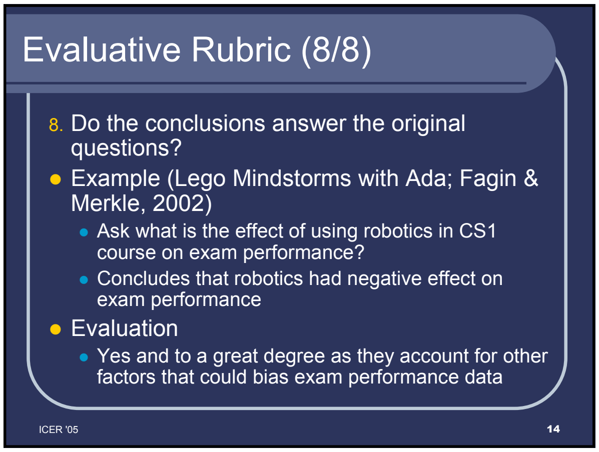
- Example (Alice; Moskal et al., 2004)
  - Study determines "at risk" students, intervenes with Alice course, measures CS1 grades, retention, and attitudes
- Evaluation
  - Easily generalizable as observation and analysis methods are not explicitly dependent on Alice
  - Mostly repeatable as most of the methods are discussed (not "at risk" measure and focus group methods) and materials are available



Evaluative Rubric (7/8)

7. Is there a coherent chain of reasoning from the analysis results to the assessment conclusions?

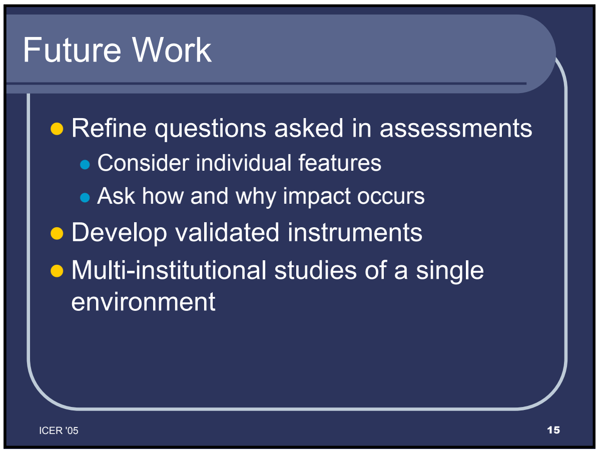
- Example (Jeliot 2000; Levy et al., 2003)
  - Concludes animation students used a different and better vocabulary describing solutions in interview questions than control students
- Evaluation
  - Not particularly strong
    - Need to clarify interview methodology and criteria for how the solution descriptions were classified and evaluated



Evaluative Rubric (8/8)

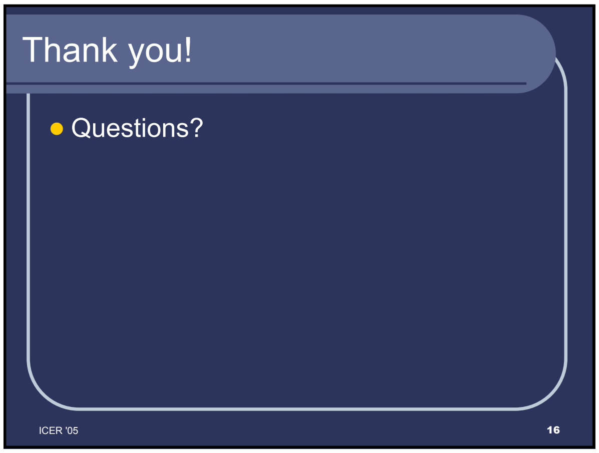
8. Do the conclusions answer the original questions?

- Example (Lego Mindstorms with Ada; Fagin & Merkle, 2002)
  - Ask what is the effect of using robotics in CS1 course on exam performance?
  - Concludes that robotics had negative effect on exam performance
- Evaluation
  - Yes and to a great degree as they account for other factors that could bias exam performance data



Future Work

- Refine questions asked in assessments
  - Consider individual features
  - Ask how and why impact occurs
- Develop validated instruments
- Multi-institutional studies of a single environment



Thank you!

- Questions?