How can we detect a "scientific mind"?

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Talk given at the Second International Symposium on

Building the Scientific Mind

Vancouver, CA

May, 2007

Modeling Across the Curriculum

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http://mac.concord.org

Modeling Across the Curriculum (MAC): Goals and Constraints

- Educational goals of the project
  - Identify longitudinal effects of teaching science through modeling
  - Develop formative performance assessments for content knowledge and inquiry skills

- Requirements of sponsor (NSF)
  - Rigorous ("gold standard") research methodology
 - Potential for very wide scalability

Implementation numbers

- 2 Partner Schools (down from 3)
  - With the project from the beginning
  - Introductory and annual workshops

- 8 Member Schools (down from 12)
  - Recruited at the end of Year 2
  - Annual workshops + compensation/support

- 41 out of 440 Contributing Schools produced usable data
  - Serendipitous: found us on the Web, registered
  - Located in 28 countries

- 127 teachers, approx. 12,000 students, 1.5 gigabytes of data

Curriculum Development

- Developed "Hypermodels" in physical science, biology, chemistry
  - Dynamica: force and motion
  - BioLogica: transmission genetics
  - Connected Chemistry: molecular kinetics and gas laws
- Structure and scaffold students' reasoning with models
- Log data for embedded and performance assessment

Data Flow
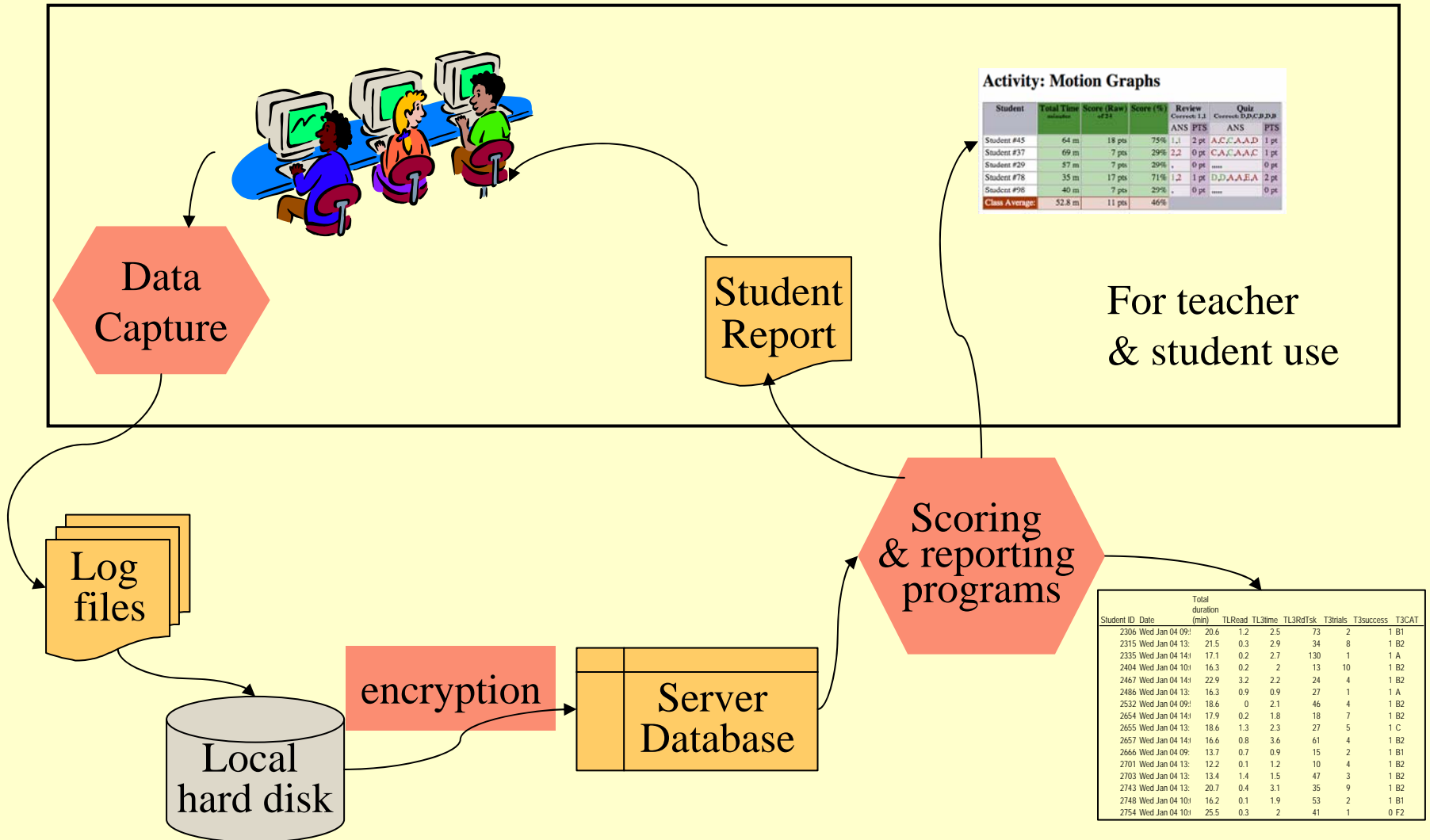
Results

Students who learned modeling in one scientific domain performed better in a different domain in a subsequent year.

Their learning can be ascribed to their use of our modeling activities, even in the absence of a control group.

Their degree of systematicity in the use of models to solve problems correlates with their learning gain as measured by a multiple choice test of science content.

Longitudinal Results

Effect across years

Posttest mean for Dynamica
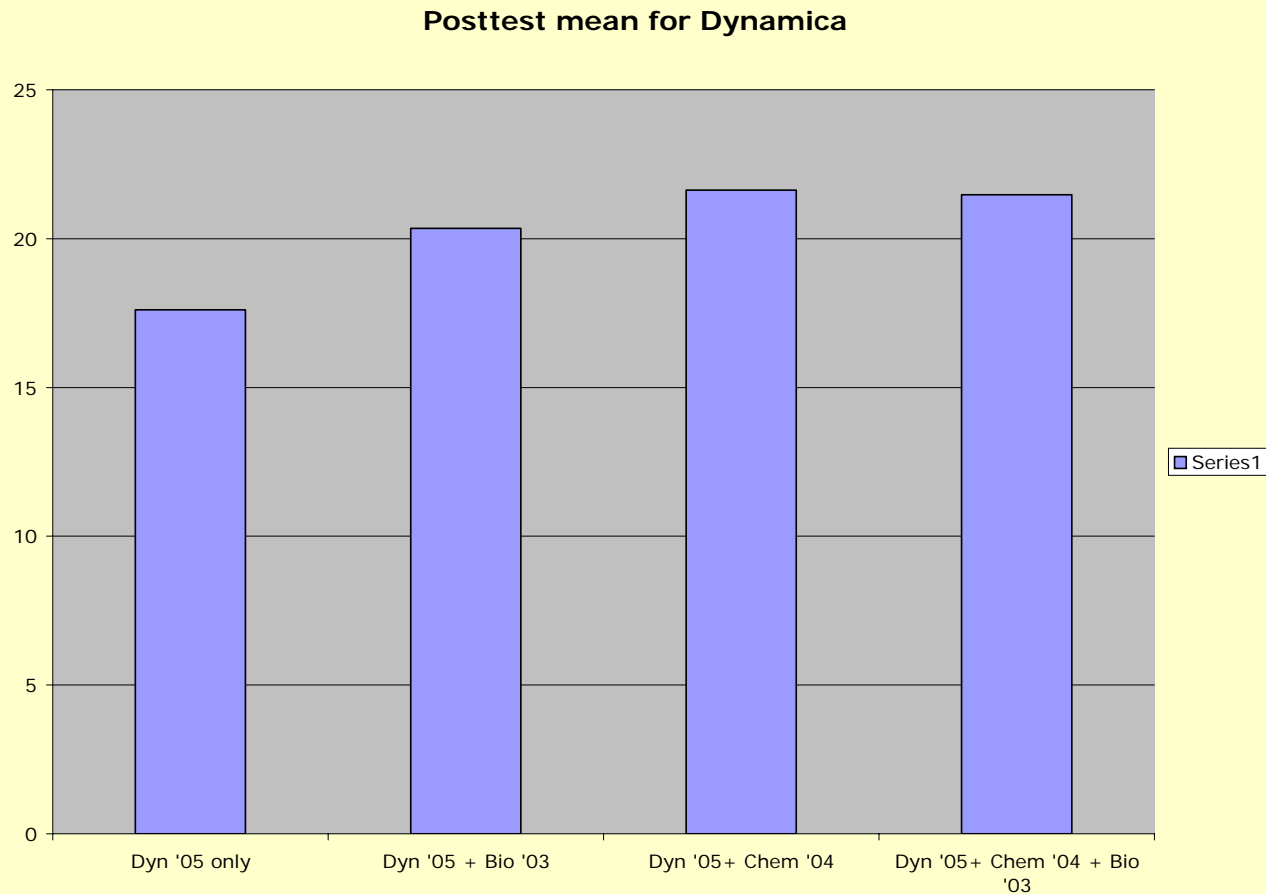
Is learning a result of our "treatment"?

Example: genetics (BioLogica) data:

– Maximum of 12 activities, but many students work with fewer. Length of genetics unit varies from class to class.

– Pre-test score accounts for 34.4% of variance in post-test scores

– Holding pre-test constant, number of BioLogica activities taken accounts for an additional 10.2% of the variance

– Length of intervention (= "time on task") accounts for *no additional variance*.