Assessing-to-Learn (A2L)
Formative Assessment Materials for High School Physics

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MODEL-BASED DESIGN PARADIGM

Cognitive Research Results
ALTERNATIVE EXPERT-NOVICE CONCEPTIONS DIFFERENCES
COGNITIVE OVERLOAD HIERARCHICAL ANALYSIS

3 Premises
1. Proficient problem solving requires structured knowledge.
2. Structuring knowledge requires certain cognitive processes.
3. It is possible to create activities and experiences to stimulate beneficial cognitive processes.

Cognitive Framework

Instructional Approach
CONCEPT-BASED PROBLEM SOLVING

COGNITIVE GOALS
• Explore, define, and hone concepts
• Link and cluster concepts, operations, and procedures
• Develop analysis and reasoning skills
• Organize, prioritize, and structure knowledge
• Develop concept-based problem-solving skills

“BASIC” HABITS OF MIND
• Seek alternative representations
• Compare and contrast
• Extend the context
• Explain, describe, draw, etc.
• Predict & Observe
• Communicate about learning

“ADVANCED” HABITS OF MIND
• Generate multiple solutions
• Categorize and classify
• Reflect, evaluate, etc.
• Discuss, summarize, model, etc.
• Plan, justify, and strategize
• Meta-communicate

Instructional Materials
MOP ASK•IT A2L
Formative Assessment Activities

Formative assessment activities are activities that teachers can use to make decisions about subsequent instruction.

Formative assessment activities should reveal meaningful information about students’ conceptual understanding and reasoning processes.

The information gained from formative assessment activities should be useful to teachers for making decisions about subsequent instruction.

Formative assessment activities should be valuable learning experiences for students.
Project Goals

Φ To develop and evaluate formative assessment materials for high school physics.

Φ Build a comprehensive, searchable database of formative assessment items for use via the web.

Φ Develop accompanying materials for teachers: (1) answers to assessment items 2) discussion of the purpose of each item, (3) suggestions for classroom implementation of each item, (4) discussion of educational research relevant to each item.

Φ Research the impact of formative assessment activities on teacher change.
Curriculum Goals

Φ Create a more active learning environment for students and involve a broader spectrum of students in “meaning making” in the classroom.

Φ Make instruction more responsive to students’ needs.

Φ Make teachers more aware of process (e.g., problem solving, learning, and cognition) and provide teachers with methods for addressing process.

Φ Enhance communication in the classroom.

Φ Encourage students to become self-aware as learners.
Role of Teachers

Φ In the assessing-to-learn model, the role of the teacher is more like that of a coach than like that of a dispenser of information.

Φ Teachers employ cooperative learning groups and let the assessment items serve as the focus of the groups’ discussions.

Φ Teachers use the summary information about students’ answers to assessment items to lead follow-up class-wide discussions. The discussions are managed to be instructive to students and to provide teachers with the information they need to make decisions about subsequent instruction.
Current Teacher Involvement

Φ Seven local teachers used the assessment items with technology during the past school year. These teachers each used approximately 30 items, which were developed by the U Mass group. Some of the teachers also developed their own assessment items.

Φ More than 50 teachers have volunteered to use some of the assessment items during the coming school year. These teachers will download the items from our A2L web site. Most of these teachers will use the assessment items without the support of a Classroom Communication System.
Teacher Reactions & Comments

Φ Teachers enjoyed the approach and expressed the desire to use the approach more frequently.

Φ To use A2L items more frequently teachers feel they would require a much wider array of questions better matched to their curriculum.

Φ All teachers thought that their students enjoyed the experience with A2L. These teachers all used technology and thought that the histogram of student responses increased student interest in the A2L approach.
Role of Classroom Communication Technology

Implementation of continuous assessment faces a number of challenges: (a) the loss of class time devoted to assessment, (b) information gleaned from assessment is not timely enough to impact instruction, and finally, (c) the clerical nightmare that useful record keeping presents to teachers.

Classroom communication technologies, of which Classtalk and PRS are examples, can remove these obstacles by providing an integrated package that permits: (1) presenting questions for the class to work on; (2) collecting and store individual student answers; (3) displaying a histogram of the class’ responses; (4) producing a record of each student’s progress.

Used merely as an efficient way of grading students, technology diminishes, rather than enhances, the learning environment.
Comparison of CCSs

**Personal Response System (PRS) wireless infrared transmitters**

Limitations
- Only multiple choice responses - albeit with confidence
- Can not present question (easily)
- Primitive interface

Virtues
- Simple to use
- Relatively inexpensive
- PC based
- No installation

**Classtalk - wired network of TI calculators**

Limitations
- Powerful but complex to use
- Relatively expensive
- MAC based
- Needs “installation”

Virtues
- Flexible response forms - sets of questions
- Presents question and stores with responses
- Sophisticated and powerful interface
- Two way communication
Feedback available
Role of WEB Technology

Φ Gives teachers easy access to A2L items even during the development phase of the project.

Φ Enables the developers of A2L items to get feedback from a large group of potential users in time to have an impact on development.

Φ Allows the developers to collect wide array of student performance data for each A2L item.

Φ Provides new opportunities for collecting research data.
Research Questions

1) What types of questions are most useful for monitoring learning?

2) Can properly designed formative assessments, coupled with an efficient system for administering them during instruction, drive teachers to adopt a more interactive, student-centered style of instruction?

3) Can teachers use the information gained from formative assessment to make decisions about subsequent instruction?

4) Are teachers able to address students' difficulties on the fly?

5) Do students "learn more" with this approach?

6) How are teacher and student views of, and attitudes toward, assessment changed after using an integrated formative assessment approach?
For additional information, visit our web site:

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Or if you want more specific information about the Assessing to Learn Project, visit:

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