Classroom Trials of *MathLab* Software

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Abstract

MathLab, designed by staff at SRI International's Center for Technology in Learning, is a set of computer-based problem-solving activities for middle-grades students. A dozen teachers participated in a semester-long trial of the MathLab software. Data were collected both from teachers and from students.

MathLab met the goals for which it was designed. Teachers found the MathLab problems to be well matched to important topics in the curriculum, of appropriate difficulty, and highly engaging to students. As intended, MathLab is well suited for collaborative student work; students reported that they preferred working in pairs to working alone. After working on the MathLab problems for an average of 10 to 12 class periods, students demonstrated improvement in their understanding of the use of formulas in spreadsheets and in their ability to solve a novel, complex paper-and-pencil mathematics problem. The students, like the teachers, reported that MathLab was a valuable addition to their mathematics classes.

Background

During the spring of 2001, 12 teachers were asked to complete three or four MathLab problems with a class of their choosing. Each class used a series of MathLab problems designed to take from one to three class periods. The teachers came from three different school districts—one in California and two in Maryland. Nine of the classes consisted of 7^{th} and 8^{th} graders, two were 6^{th} grade classes, and one was a 5^{th} grade class. In all, about 250 students participated in the trials. After finishing work on the problems, students and teachers were asked to complete questionnaires about their experiences with MathLab. Students were also presented with two mathematics tasks prior to their introduction to the MathLab software, and then presented with similar tasks at the end of the year.

The teachers completed an average of slightly more than three activities with each class. For each problem that was completed, SRI's researchers received samples of students' work as well as feedback from the teacher in the form a questionnaire.

Although the research design included a control or comparison group of classrooms, analyses of data about the teachers and students showed that the differences between the experimental and control groups were too large to allow for valid comparisons. In particular, the students in the control group were from higher-poverty classrooms. As a result, no data were used from the comparison classrooms.

What were teachers' and students' overall reactions to MathLab?

The 12 teachers that participated in the pilot found MathLab to be educationally valuable. When asked to compare MathLab to other educational software products available for mathematics instruction, 83% of the teachers considered MathLab to be more valuable.

Most teachers indicated that MathLab contributed to positive changes in students' academic achievement. High percentages of teachers indicated that MathLab increased students':

- opportunity to work on challenging problems (100%),
- engagement in activities (83%),
- problem-solving skills (75%), and
- depth of understanding of the mathematics topics covered (75%).

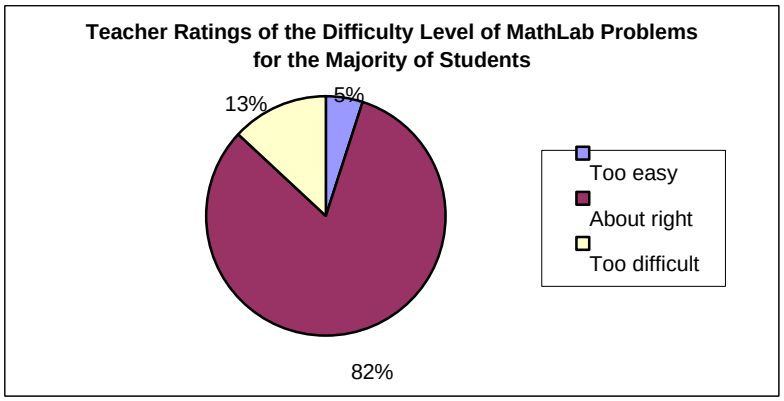
Nearly all teachers indicated that they would like to use MathLab with their future mathematics classes. For the two that indicated, "It depends," their reasons did not have to do with the quality of the software, but focused instead on whether or not the school had the appropriate technology resources.

The majority of students (72%) indicated that MathLab was a valuable addition their mathematics classes.

One teacher commented that, "[MathLab] was very interesting and my class enjoyed it. Some students wanted to know if they could have their own copies because they enjoyed it so much!" Another teacher said, "I really loved this software. I will continue to use it with my classes next year."

What did teachers think of the MathLab problems?

Teachers found the activities to present an appropriate level of difficulty for the majority of their students, as figure below illustrates.



Teachers found that the problems did an excellent job of addressing the mathematics concepts they were intended to address.

- Teachers were asked to rate the activities on their fit with the underlying mathematics concepts each was designed to address. On a scale of 1 to 5 (with 1 indicating a poor fit, and 5 indicating an excellent fit between the activity and the concept), the average rating across all problems was 4.7. No problem received a ranking below a 3, and 71 percent of the activities were rated a 5.

Teachers found the problems to fit well with their curricular goals.

- On the same 1-5 scale, (1 indicating poor and 5 indicating excellent) the average rating of the fit between the activities and the goals of the teacher's mathematics curriculum was 4.55. Nearly all (97%) of the activities were rated a 4 or 5.

Another teacher wrote, "I love the structure of the problems, the great support in the written guide, and the writing task given for each problem." And another said, "The teacher resource materials are *fantastic!*"

How long did it take to conduct MathLab activities?

- On average, teachers spent 45 minutes familiarizing themselves with the problems before introducing them to students.
- Most teachers spent approximately one 45-minute class period preparing students before actually sending them to computers to work on a MathLab activity.
- The average amount of time students spent doing a MathLab problem was two 45-minute class periods.
- After two-thirds of the activities, teachers chose to spend a 45-minute class period or less on a follow-up activity such as handing back graded work, and/or having a whole-class discussion about possible solutions to the problem presented.

One teacher told us, "the biggest constraint is *time*—or, more importantly, lack of time to devote to such an activity."

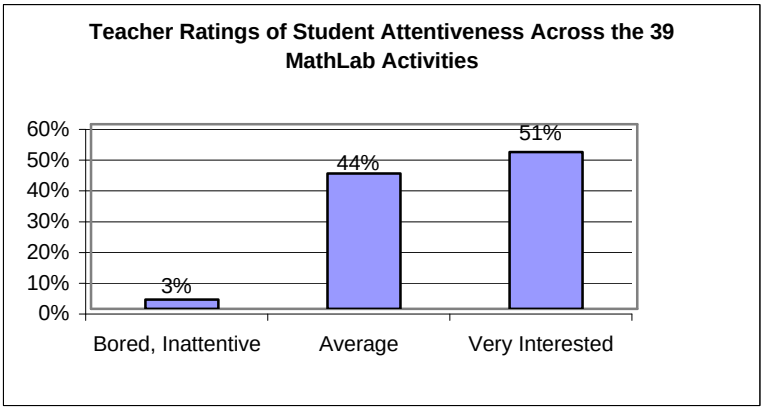
What was the classroom arrangement when students completed the activities?

- In 85% of the cases, students worked in pairs at computers while engaged in the MathLab problems. In about half of those cases, pairs of students cycled through the activity at different times; in the other half, all pairs of students in the class completed the activity at the same time.

- When students were asked their opinions about the arrangements when using MathLab, the great majority of students (85%) indicated that they preferred working with a partner to working individually.

How did students respond to the MathLab activities?

- According to teachers, students' attention level during MathLab activities was in nearly all cases average (44%) or above average (51%). The figure below describes the teachers' ratings.



What did students learn?

Students were asked to complete two mathematics tasks and demonstrated significant improvement on both tasks.

- The first task was designed to measure students' knowledge of formula use in spreadsheets. Students were required to choose the appropriate formula for a given calculation. The fraction of students choosing the correct formula on the pre-test was 30%, and on the post-test, that increased to 48%. The gain was statistically significant at the .01 level (t (208)=-4.017, p<.01).

- The other task was a more complex, constructed-response problem solving activity. This problem required them to use mathematical operations and come up with an appropriate answer. A random sample of the students' written solutions were scored, and a significant increase in their ability to solve the problem correctly was observed (t (48) =2.619, p<.02). (Of course, factors other than MathLab use may have contributed to these gains.)

Suggestions from the Teachers

At the request of the researchers, teachers provided suggestions for the MathLab development team. A number of useful suggestions were incorporated into subsequent versions of MathLab. For example, several new problems were created to help students practice using a specific tool (such as a data table), and a sample scoring rubric for grading students' work was added to the Teacher's Guide.