A Logo-based Elementary School Geometry Curriculum

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In 1986 the National Science Foundation awarded $5 million to six projects that would create prototypical instructional materials for K-6 mathematics under the assumption that students have unlimited access to computers and calculators. As one of these projects, our particular aim has been to address deficiencies in current elementary school geometry instruction by developing a reconceptualized curriculum that takes advantage of the graphics-based computer programming language Logo.

Rationale

There has been a recognized "failure of students to learn basic geometric concepts" especially geometric problem solving. This poor performance is due, in part, to the current elementary and middle school geometry curriculum. The major focus of most current curricula is on recognizing and naming geometric shapes and learning to write the proper symbolism for simple geometric concepts. There is little opportunity for geometric problem solving. There is little chance to develop students' spatial thinking, a commodity that has primary importance in the geometry curriculum. There is little opportunity for students to form proper mental representation for geometric concepts. It is no wonder that, after experiencing such impoverished geometry curricula in elementary school, many high school students do not have the necessary geometric intuition and background for a formal deductive geometry course.

The prior use of the Logo computer language, which includes explicit elaboration of the mathematical ideas in Logo, has the potential to transform both the method and context of the elementary geometry curriculum. In particular, our Logo-based geometry curriculum is being designed to help students progress through the initial levels of geometric thinking as described by van Hiele. (Figure 1, page 4.) For instance, imagine students constructing a rectangle procedure. They must analyze the visual aspects of the rectangle and reflect on how its component parts are put together, an activity that encourages them to move from the visual to the descriptive-analytic level. If then asked to design a "generalized" rectangle procedure that takes the length and width as inputs, students must construct a form of definition for rectangles, one that the computer understands. Participating in this activity and in accompanying teacher - led discussion orients students to the next higher level of thinking. (See activity on page 8.)

Project Organization

Our project is being conducted in three phases, each one year in duration. In the first phase, extant curricula and research in the teaching and learning of elementary school geometry were reviewed; a new elementary school geometry curriculum was developed; Logo activities designed to promote the objectives of that curriculum were constructed and the new, Logo-enhanced curriculum was pilot-tested. In the second phase, the curriculum was field-tested by 14 teachers in their classrooms. We observed and met with these teachers frequently, and during the summer, after the teachers gave us an extensive critique of the materials and suggestions for improvements, the materials will be revised again and written in final form.

Curriculum Goals

The curriculum is designed to help students progress to higher levels of geometric thinking. This is accomplished by facilitating students development of:

- major geometric concepts and skills, including but not limited to those encountered in standard curricula;
- geometric problem solving abilities including such general problem solving heuristics as making tables, looking for patterns, and generating and testing hypotheses; and

*See **Curriculum**...page 12*