Exploring Students’ Responses to Visual Problems at the High School Calculus Level

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Research Apprenticeship Report Abstract

The Curriculum and Evaluation Standards for School Mathematics (National Council of Teachers of Mathematics, 1989) emphasizes the fact that understanding in mathematics is making connections among ideas, facts and procedures, where the definition of ideas includes external representations of a concept. Further, it advocates the use of multiple representations while teaching. Visualization is one such form of representation that is particularly useful since it can provide a concrete aspect of very abstract ideas.

The research questions I formulated for this study were guided in principle by the advice given by Bogdan and Biklen (1992) who suggest that qualitative researchers bring only general research questions to a study. This allows the researcher to be guided by the events in the field. I brought the following questions to the study: (a) How do students who have been taught largely in a traditional manner with an algebraic approach to the concept of derivatives respond to problems that have strong visual content? (b) What are students’ views and perceptions of such problems? (c) What is their mathematical response to such problems? (d) Are there aspects of the graphics calculator which may be useful in teaching with an emphasis on visualization? If so, what are they? (e) What are students’ viewpoints on the usefulness of graphics calculators? (f) What role do multiple representations play in the learning of complex concepts? How important are the linkages among graphical and symbolic representations in understanding functions and the concepts that are encountered in calculus? (g) Are students able to develop such linkages by themselves?

The respondents for this study were eight students from two sections of a calculus class in a suburban high school in the northeastern region of the United States. The data were gathered through participant observations and in-depth interviews.

In general, the respondents displayed very positive attitudes toward visualization and its role in helping them to grasp a particular concept, understand a problem or guide them towards its
solution. Students exhibited a strong preference for particular features of the graphics calculator—primarily, to sketch graphs of various functions and use them for analysis. I observed that the students used, in general, only disjoint strategies for approaching the problems, however, a few students used a holistic blend of various strategies (algebraic methods, visual methods) in solving some problems.