Implementing the Dynamic Geometry Approach

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Short presentation

This is a four-year research project funded by the National Science Foundation. The project compares effects of an approach to high school geometry that utilizes Dynamic Geometry (DG) software with standard instruction that does not make use of DG exploration tools. The basic hypothesis of the study is that use of DG software to engage students in constructing mathematical ideas through experimentation, observation, data recording, conjecturing, conjecture testing, and proof results in better geometry learning for most students.

The theoretical foundation of the DG approach and the theoretical framework of this project consist of the constructivist perspective and the van Hiele model. Building upon previous studies, this study will seek to answer the following research questions: 1) How do students in the experimental condition perform in comparison with students in the control condition on measures of geometry standardized tests and a geometry conjecturing-proving test? 2) How does the DG intervention affect student beliefs about the nature of geometry and about the nature of mathematics in general? 3) How does the DG intervention contribute to narrowing the achievement gap between students receiving free or reduced price lunch and other students? The research study follows a mixed methods, multi-site randomized cluster design. The population from which the participants of this efficacy trial are sampled are the 10th grade geometry teachers and their students at all high schools in Central Texas at which 50% or more of the students are eligible for free or reduced lunch. For determining the sample size, a power analysis has been conducted. Taking an attrition rate (20%) into consideration, 76 teachers are randomly selected from that population for the study.

The 76 teachers are then randomly assigned to two groups. Each teacher is represented in the study with measurements from only one classroom of students, and the classroom and teacher unit of analysis will overlap, yielding the design where the students are nested within teachers/classrooms, which are nested within schools. Teachers in both treatment and control groups receive relevant professional development. Fidelity of implementation for the experimental treatment is monitored carefully.

The study tests the basic hypothesis by assessing student learning using the tests indicated in the research questions. Data for answering the research questions are analyzed by appropriate HLM and qualitative methods. Results will provide strong evidence that can inform school decisions about innovation in that core high school mathematics course.

The implementation plan for the project is: Year 1: Preparation (All research instruments, DG instructional materials, recruitment and training of participants, etc.); Year 2: The first implementation of DG treatment, and related data collection and initial data analysis; Year 3: The second implementation of the DG treatment, and related data collection and continued data analysis; Year 4: Careful and detailed data analysis and reporting.

Keywords

dynamic geometry, experimentation, observation, conjecturing, proving, random assignment, fidelity of implementation