

Effect of Professional Development and Teacher's Content Authoring  
on Student Achievement in Geometry: Year 1 Fall Semester Interim  
Report

Case Study 16

# Effect of Professional Development and Teacher's Content Authoring on Student Achievement in Geometry: Year 1 Fall Semester Interim Report

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|---------------------------|---|
| <b>Teacher/Researcher</b> | Dr. Irina Lyublinskaya, College of Staten Island      |
| <b>Location</b>           | MacArthur High School, Levittown, NY                  |
| <b>Course</b>             | Geometry  |
| <b>Grade</b>              | 10-11   |
| <b>Student Profile</b>    | 195 students in 13 Sections of on grade-level classes |
| <b>Technology</b>         | TI-Nspire handheld vs. TI-84 graphing calculator      |

*The TI-Nspire group demonstrated significant increase in performance, which demonstrates that students crossed performance levels (for example from lower to higher achievers).*

**Setting.** Levittown Public Schools is a small district located in a suburban community of 53,000 people on Long Island, New York. The district is comprised primarily of White students, most from middle-income families. Relative to other districts in the state, mathematics scores in Levittown are above average.

### Characteristics of Students in the Participating School

| <b>MacArthur High School</b>          |                            |
|---------------------------------------|----------------------------|
| <b>Ethnicity</b>                      | <b>Percent of Students</b> |
| African American                      | 1%                         |
| Hispanic                              | 5%                         |
| White                                 | 90%                        |
| Asian/Pacific Islander                | 4%                         |
| Native American                       | 0.1%                       |
| Free or Reduced Price Lunch           | 7%                         |
| English Language Learners             | 3%                         |
| Percent of Students with Disabilities | 15%                        |

**Study:** In this quasi-experimental design, teachers who were already familiar with TI-Nspire (experimental) were compared to teachers experienced with the TI-84 graphing calculator (control). Teachers in the experimental group received special training and development for use of TI-Nspire's unique capabilities. Composition of the groups is:

- Experimental group (TI-nspire): 6 teachers with 1 – 6 years of teaching experience, 7 sections of geometry in the fall. 117 students.
- Control group (TI-84): 5 teachers with comparable teaching experience, 6 sections of geometry in the fall. 114 students.

**Treatment.** The teachers in the experimental group were initially involved in 3-hour professional development on the features of new release of teacher edition of TI-Nspire handheld and technology provided by Brittany Zweibel (Mathematics teacher and T<sup>3</sup> instructor) as part of the T<sup>3</sup> professional development program of Texas Instruments.

One 4-week instructional unit in the Fall semester was identified by the teachers. During that unit the participating treatment teachers met after school for three-hour weekly professional development workshops with a focus on reasoning, using graphs, and concepts. During these meetings, the teachers presented for peer review, comments and suggestions their designed curriculum materials that integrate TI-Nspire technology. Following these meetings, teachers revised these materials working collaboratively, used them in teaching, and then shared their experiences with their peers at the consequent meetings.

Thus, suggested professional development model cycled three times through six stages in the content development of TI-Nspire materials:

1. Development of TI-Nspire curriculum materials for the lesson, individually or in small groups prior to the 1<sup>st</sup> meeting.
  2. Presentation of the developed materials to the group at the 1<sup>st</sup> curriculum workshops for peer discussion and suggestions.
  3. Revision of the developed materials based on peer review and suggestions from the group.
  4. Classroom teaching using developed curriculum materials.
  5. Reflection and discussion of teaching and learning experience with the peers during 2<sup>nd</sup> curriculum meeting.
  6. Finalizing the curriculum materials based on teaching experience and discussion with colleagues.
- All treatment teachers developed lesson materials for the same topic. As a result of these meeting teachers developed three TI-Nspire lessons.

The control classes used TI-84 and the traditional NY State curriculum. This group did not use Cabri Jr.

**Results.** To measure achievement gains in the trial unit, a special pre and post unit test was constructed based on released questions from the New York Regents exam, the National Assessment of Educational Progress (NAEP), the California standards test (CAL) and the CILS:

- Pretest: 10 questions drawn from 8th grade NAEP and TIMSS.
- Posttest 10 questions from NY Regents test, CAL, NAEP which were on grade level, relevant to the unit taught.

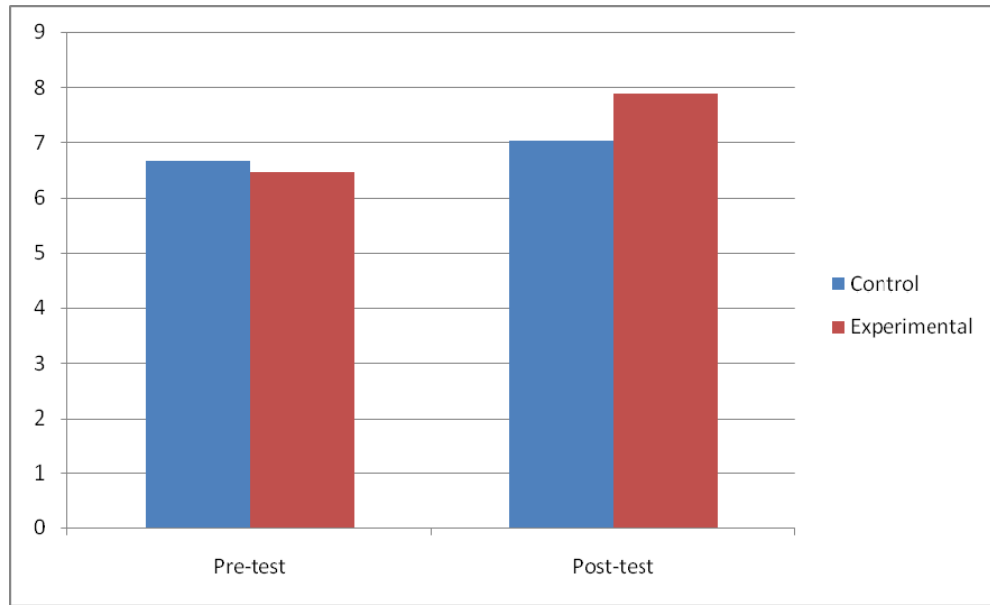
*Pretest group equivalence.* The following table represents statistics on students' performance on pre-test and shows no significant difference in students' performance:

|              | N   | Mean | Std. deviation | Std. error mean | P (T)                 |
|--------------|-----|------|----------------|-----------------|-----------------------|
| Control      | 114 | 6.65 | 1.964          | .184            | $p=0.488$<br>$t=.695$ |
| Experimental | 175 | 6.48 | 2.109          | .159            |                       |

*Post-test Comparison.* The post-test results showed a significant difference in favor of the experimental (TI-Nspire) group (note that not all students in both groups have completed proofs units that the study focuses on, that is why the number of tested students in the post-test is smaller):

|              | N   | Mean | Std. deviation | Std. error mean | P (T)                   |
|--------------|-----|------|----------------|-----------------|-------------------------|
| Control      | 81  | 7.04 | 1.920          | .213            | $p=0.002$<br>$t=-3.092$ |
| Experimental | 114 | 7.87 | 1.747          | .164            |                         |

The graph below shows these comparisons:



Item analysis identified that the significantly higher scores on post-test for the experimental group came from questions 9 and 10. These questions (from the NAEP) addressed visual and conceptual skills at a higher level of processing information:



9. In the five quadrilaterals shown above, the midpoints of the sides have been joined by broken line segments. Which best describes the five dotted figures formed?

- A) All are parallelograms.
- B) All are rectangles.
- C) All are squares.
- D) All are rhombuses.
- E) No generalization can be made.

10. In the space below, use your ruler to draw a parallelogram that has perpendicular diagonals. Show the diagonals in your sketch.

Further analysis was performed on achievement gains in both groups. Even though the pre and post-tests covered different material, the pre-test focused on geometry readiness, while post-test focused on testing students understanding upon learning. Thus post-test was a higher level test.

The control group scores did not increase significantly ( $p = .170$ ), which demonstrates the fact that students learned material and were consistent in their performance across different levels. The experimental group demonstrated significant increase in performance ( $p=.000$ ), which demonstrates that students crossed performance levels (for example from lower to higher achievers).

**February, 2009. This interim report is based on preliminary analysis of the Fall, 2008 data. The study is continuing in the Spring of 2009.**