Supporting Teachers in Implementing Innovative, NGSS-based Curriculum:
Integrating Technology with Science and Engineering Practices

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Study Overview

Our 6-week curriculum integrates science, social studies, ELA, and mathematic concepts in a 6-week curriculum for 5th grade classrooms. Most student action takes place in GIS (Geographic Information Systems), which is used to solve spatial problems by using digital map layers. Targeted outcomes include:

1. Develop instructional modules that are focused on promoting children's spatial thinking using GIS,
2. Measure the impact of these modules on children's thinking and problem-solving.

Materials Overview

Student Materials
- QGIS Software (free)
- Data files for GIS-based activities
- Student workbook

Teacher Materials
- Answer booklets
- Basic lesson plans
- Video tutorials

Training and Support Overview

(A) Summer Workshops
- 26 hours of training over the summer
  - Review of entire curriculum
  - GIS and computer training
  - Instructional Strategies
  - Experience teaching small groups of students using GIS

(B) Ongoing Training
- Periodic meetings with participating teachers and ongoing technical support
  - Advise teachers on issues and questions
  - Meeting with teachers at their request

(C) Daily Presence
- Daily presence in the classroom during data collection
  - Teacher reassurance from daily presence during implementation was an unintended yet notable impact of our data collection model

Baker, T. R., Palmer, A. M., & Kerski, J. J. (2009). A national survey to examine teacher professional development and implementation of desktop GIS. *Journal of Geography*, *108*(4-5), 174-185.

McClurg, P. A., & Buss, A. (2007). Professional development: Teachers use of GIS to enhance student learning. *Journal of Geography*, *106*(2), 79-87.

Prescriptive Supports for Elementary Teachers Implementing NGSS

Primary Question:
How can upper elementary teachers be optimally supported to implement innovative, NGSS-based instruction?

Two Models for Supporting Teachers

Framework First
By introducing teachers to the NRC Framework first, the goals of the NGSS Standards become a salient foundation for the design and/or utilization of innovative, standards-focused curriculum.

Ideal for master teachers who develop their own curriculum materials.

Curriculum First
By introducing teachers to a NGSS-aligned curriculum first, the curriculum itself helps shape the teacher's understanding of the NRC Framework while providing a reference for daily instruction.

Ideal for teachers who are not as confident with science instruction and preparation.

Both models must invest in teachers' understanding of the *NRC Framework for K-12 Science Education*. Effective implementation of NGSS requires a broad understanding of the philosophy outlined by the framework.

Resources for Three Stages of Teacher Growth

Learning
Teachers need effective resources to learn new concepts, technologies, and instructional strategies before preparing a lesson. **Goals:**
- *Expand teachers' tool sets*
- *Add depth to teacher understanding*

Prep
Teachers need effective resources for lesson prep. These may include video tutorials, pre-made lesson plans, or advice from other teachers. **Goals:**
- *Instill teacher confidence*
- *Reduce time needed for prep*
- *Improve outcomes*

Prime Time
Teachers need access to effectively designed assessments, student materials, manipulatables, etc. during class instruction . **Goals:**
- *Increase teacher comfort*
- *Reduce wasted instruct. time*
- *Reduce prep time needed to find and make class materials*

Methods and Platforms for Teacher Support

(A) Workshops
Best for: introducing new tools and strategies, reviewing successes and struggles

(B) Videos
Best for: understanding new and complex concepts or tools, modelling lessons or instruction

(C) Print Materials
Best for: Pre-made student materials and quick reference materials for planning and instruction

(D) Web
Best for: Consolidating materials in one place and facilitating communication with teachers

Obstacles to Implementation

- **Time** constraints for science instruction/preparation
- Inadequate **Professional Development** and **Administrative Support**
- **Outdated curriculum** materials
- **Intimidation** Factor

Guiding Principals: Tech-based Instruction

Our research centered on the use of GIS, an innovative technology more typically applied in high school and college classrooms. We developed all of the curriculum materials and training materials from scratch. Based on research by Baker, Palmer, and Kerski (2009),and McClurg and Buss (2007), we concluded that:

- Prebuilt curricula are essential for a wide application of innovative, technology-based instruction
- Resources should be developed for technical support
- Training should develop technology skills through a prebuilt curriculum, not focus on technology independent of the curriculum
- Training should focus on how instructional and assessment strategies will need to adapt
- Training should be well paced and continue through implementation

Final Note on NGSS

The Next Generation Science Standards outline Disciplinary Core Ideas, Crosscutting Concepts, and Science and Engineering Practices. The print-design of the standards are likely to lead to the prioritization of the Disciplinary Core Ideas, which tend to be limited in scope. We disagree with this prioritization, and think it is essential for teachers to have a more holistic view as presented in the Framework. Communicating about and agreeing on the broader aims of science instruction are a substantial part of implementing superior science instruction.

We also believe that the practices and crosscutting concepts can be applied through the integration of scientific thinking with social studies and ELA content and standards. We must perpetually look for ways to break down arbitrary walls between subjects, and apply scientific thinking and practices outside of the confines of science content.