

EFFECTIVENESS OF A GEOSPATIAL SCIENCE-TECHNOLOGICAL PEDAGOGICAL CONTENT KNOWLEDGE PROFESSIONAL DEVELOPMENT MODEL

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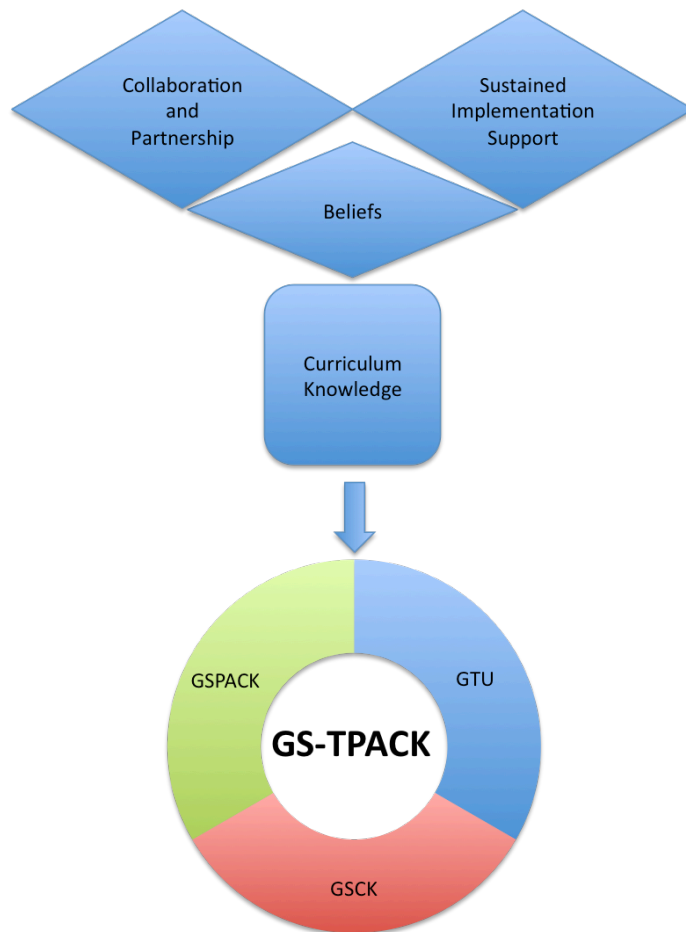
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Why is there a need to create another Professional Development model?

- Science and Environmental Education (EE) is complex and interdisciplinary
- Few educators have had pre-service experiences that promote **EE** and **technology** integrated learning methodologies
- Even fewer have had any formal experience in using or teaching with Geospatial Technologies (GT)

GS-TPACK PD Model Components



- **Geospatial Technology Use (GTU)** - Teacher's knowledge about and proficiency with GT such as Google Earth or GIS applications.
- **Geospatial Science Content Knowledge (GSCK)** – Teacher's understanding to how GT can be used to better understand science.
- **Geospatial Science Pedagogical Content Knowledge (GSPCK)** – Teacher's perceived knowledge of how GT interacts with their PCK in ways that produce effective teaching and student learning opportunities.

GS-TPACK PD Design



- Aligned to the Environmental Literacy and Inquiry (ELI) Curriculum
- Emphasis on geospatial learning activities
- Geospatial thinking and reasoning skills
- Analysis and synthesis of spatial patterns with data
- Teaching *with* GT within science curriculum contexts.
- Investigations with inquiry-based laboratories
- Embedded educative curriculum materials

Research Question



- How does the GS-TPACK PD Model improve teacher's GS-TPACK across all three components (GTU, GSCK, GSPCK) as applied to the *Environmental Literacy and Inquiry* curriculum?

Participants and Implementation

| Face-to-face PD | Curriculum (AY) | Geospatial/ Laboratory/ Other Content (min.) | New Teachers | Returning Teachers |
|--|-----------------------------|--|-----------------|-----------------------|
| Summer 2009 3 - 4hr sessions | Energy (pilot) 2009-10 | 275/210/155 | 2 | 1 |
| Fall 2009 2 - 6hr sessions | Energy (pilot) 2009-10 | 285/210/145 | 2 | 0 |
| Spring 2010 1 - 6hr session | Land Use (field) 2009-10 | 200/(N/A)/100 | 9 | 5 |
| Fall 2010 4 - 3hr-25min sessions 1 - 5hr-30min session | Energy (field) 2010-11 | 485/275/385 | 4 | 10 |

GS-TPACK Instrument

- Likert-type instrument - 23 items
 - Overall Reliability (2010-11)
 - Total Cronbach's $\alpha = 0.961$
 - GTU Subscale results – 9 items
 - Scale Reliability: Cronbach's $\alpha = 0.871$
 - GSCK Subscale results – 7 items
 - Scale Reliability: Cronbach's $\alpha = 0.936$
 - GSPCK Subscale results - 7 items
 - Scale Reliability: Cronbach's $\alpha = 0.948$
 - Reliability has been consistent over for past three years of implementation

Additional Data Sources



- Periodic Feedback Survey (PFS)
 - Likert and open-ended items.
 - Teachers complete approximately every 10 days of curriculum implementation
- Summative Response and Reflection Survey (SRRS)
 - Likert and open-ended items.
 - Administered at the end of the curriculum implementation
- Observations during PD sessions
- Follow-up teacher interviews

GS-TPACK Results 2009-2010

- Summer 2009 Energy (n=3) and Fall 2009 Energy (n=2)
 - Pre-Post GTU Score : $t(4) = 10.590, p < .000$
 - Pre-Post GSCK Score : $t(4) = 4.5099, p = .015$
 - Pre-Post GSPCK Score : $t(4) = 2.039, p = .111$
 - Pre-Post GS-TPACK Total Score : $t(18) = 4.111, p = .015$
- Spring 2010 (n=14)
 - Pre-Post GTU Score : $t(13) = 3.818, p = .002$
 - Pre-Post GSCK Score : $t(13) = 4.588, p = .001$
 - Pre-Post GSPCK Score : $t(13) = 4.050, p = .001$
 - Pre-Post GS-TPACK Total Score : $t(13) = 5.387, p < .001$

2010-2011 Implementation Results

- New teachers (n=4) demonstrated significant increases in GS-TPACK scores.
 - GSPTACK Total = $t(3)=10.510, p = .002$
 - GTU: $t(3) = 10.139, p = .002$
 - GSCK: $t(3) = 8.981, p = .003$
 - GSPCK: $t(3) = 4.520, p = .020$
- Returning teachers demonstrated no significant difference (alpha = .05) between in GSPTACK Total and subscale scores.
- For the entire group (n=14) several individual GS-TPACK items exhibited significant increases in score (alpha = .05).
 - GTU: 9 of 9 items
 - GSCK: 6 of 7 items
 - GSPCK: 5 of 7 items

Discussion



- Overall, data supports the effectiveness of the GS-TPACK PD model for preparing educators to teach science with GT.
- Factors to consider:
 - Ceiling effect
 - All participants in 4th implementation, including 4 new teachers, had prior experience with using GT for personal use (Google Earth or a Web GIS).
 - Overestimation of self-efficacy in self-report data
 - Sensitization to the instruments over time

For More Information



Paper available at:

<http://www.ei.lehigh.edu/eli/research/pubs.html>

ELI Curriculum:

<http://www.ei.lehigh.edu/eli>

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