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

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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

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