Geospatial Science Technological Pedagogical Content Knowledge Professional Development Model: First Year implementation findings

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Background

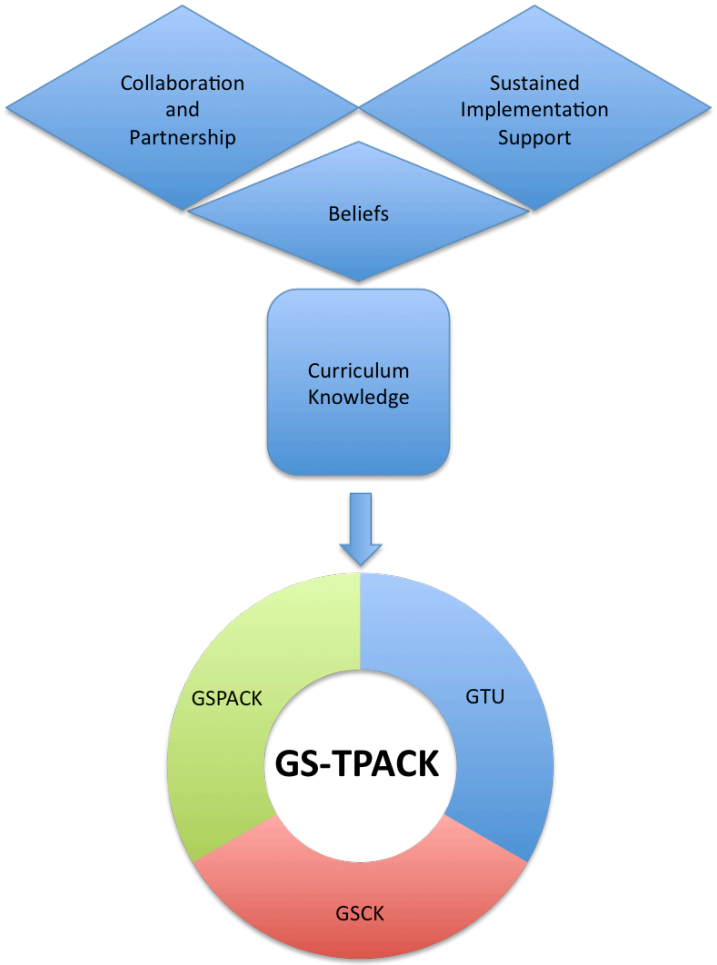
- Science and Environmental Education (EE) is complex and interdisciplinary
- Few educators have had pre-service experiences that promote EE and Technology integrated learning methodologies
- Even fewer have had any formal experience in using or teaching with Geospatial Information Technologies (GIT)

GS-TPACK

Geospatial Science Technological Pedagogical Content Knowledge:

a way of thinking about how teachers integrate their knowledge of geospatial technology and teaching across science disciplines.

GS-TPACK Model Overview

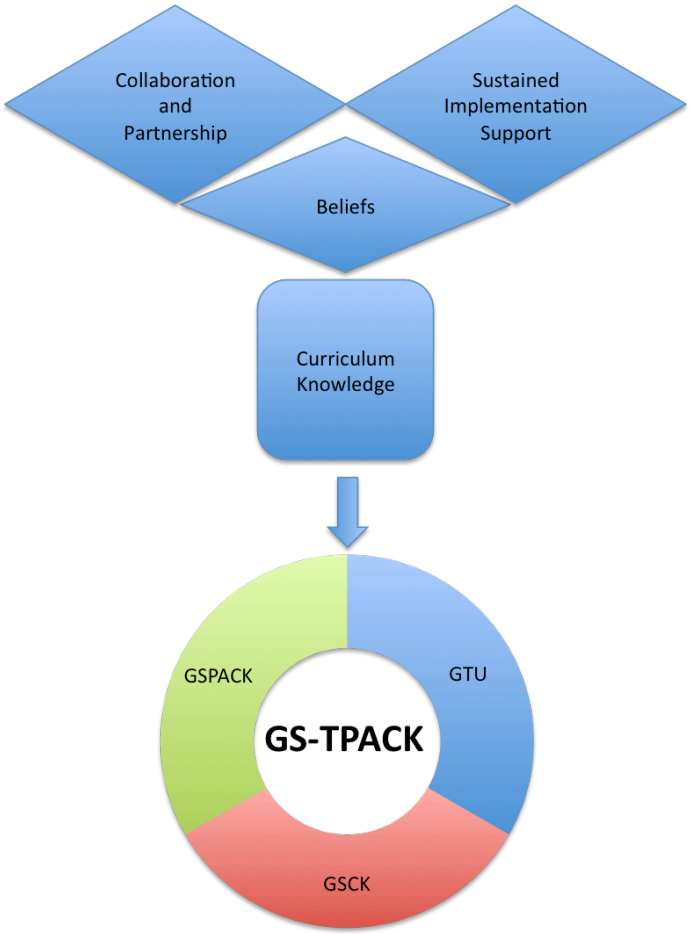


- Blends interdisciplinary pedagogical approaches of environmental education with GIT integration

- Designed to enhance the pedagogical content knowledge of inservice science teachers

- Provides opportunity to build requisite spatial thinking skills needed to effectively teach complex environmental issues

GS-TPACK Model Components



- ***Geospatial Technology Use* (GTU) -** Teacher's knowledge about and proficiency with GIT tools such as Google Earth or GIS applications.
- ***Geospatial Science Content Knowledge* (GSCK) –** Teachers understanding to how GIT can be used in science education.
- ***Geospatial Science Pedagogical Content Knowledge* (GSPACK) –** Ability to adapt teaching strategies, pair GIT to content, and design and implement science curriculum materials that enhance and assess student learning.

GS-TPACK PD Design

- Aligned to the Environmental Literacy and Inquiry (ELI) Curriculum
- Emphasis on geospatial learning activities
  - Spatial thinking skills
  - Analysis and synthesis of spatial patterns data
  - Instructional scaffolding for learning GIT tools within curriculum contexts.
- Investigations with inquiry-based laboratories
- Embedded educative curriculum materials

Participants and PD Implementation

- 8th grade teachers from 2 urban school districts teaching a wide range of ability levels
- First time using GIS in curriculum for all but one teacher
- Energy: 12-hours of face-to-face PD sessions (n=5)
  - 3 - 4hr sessions in summer
    OR
  - 2 - 6hr sessions in Fall
- Land Use Change: 6-hours of face-to-face PD sessions (n=14)
  - 1- full day in April

Assessment Tools and Data Sources

- GS-TPACK Instrument
  - Administered before first session and at end of day-long session
  - (*Energy*: n=5; *LUC*: n=14)
- Periodic Feedback Survey (PFS)
  - Teachers completed multiple times during *Energy* implementation.

    (23 responses from 5 teachers)
- Summative Response and Reflection Survey (SRRS)
  - Administered at end of *Energy* curriculum implementation
  - (n=5)

GS-TPACK Results

- Significant increases in GS-TPACK total scores after PD sessions
  - Pre-Post Administration: $t(18)=4.527$. $p<.001$
- Reliability (n=19):
  - Pre-GS-TPACK Total *Cronbach's* $\alpha = 0.956$
  - Post-GS-TPACK Total *Cronbach's* $\alpha = 0.904$

Geospatial Technology Use

- Subscale results (n=19)
  - *Significant increase: GTU* $t(18) = 6.68$, $p<.001$
  - Scale Reliability:
    - Pre - GTU *Cronbach's* $\alpha = 0.893$
    - Post - GTU *Cronbach's* $\alpha = 0.883$
- SRRS results after *Energy* implementation (n=5):

Item	Strongly Disagree % (n)	Disagree % (n)	No Opinion % (n)	Agree % (n)	Strongly Agree % (n)	Mean
My **knowledge of geospatial technologies** increased as a result of my participation in the ELI professional development sessions.	0.0% (0)	0.0% (0)	0% (0)	40.0% (2)	60.0% (3)	4.60
My **geospatial technology skills** increased as a result of my participation in the ELI professional development sessions.	0.0% (0)	0.0% (0)	0% (0)	20.0% (1)	80.0% (3)	4.80

Geopsatial Science Content Knowledge (GSCK)

- GSCK Subscale results (n=19)
  - *Significant increase: GSCK* $t(18) = 5.68, p<.001$
  - Scale Reliability:
    - Pre-GTU *Cronbach's* $\alpha = 0.873$
  - Post -GTU *Cronbach's* $\alpha = 0.775$

Item	Strongly Disagree % (n)	Disagree % (n)	No Opinion % (n)	Agree % (n)	Strongly Agree % (n)	Mean
PFS: The curriculum and support materials provides me with **appropriate content knowledge**.	0.0% (0)	0.0% (0)	4.3% (1)	65.2% (15)	30.4% (7)	4.26
SRRS: My **content knowledge** about the topics presented in the ELI unit I just completed increased as a result of my participation in the professional development sesions.	0.0% (0)	0.0% (0)	0.0% (0)	40.0% (2)	60.0% (3)	4.60

Geospatial Science Pedagogical Content Knowledge (GSPACK)

- Subscale results (n=19)
  - *Significant increase: GSPACK* $t(18) = 5.87$, $p<.001$
  - Scale Reliability:
    - Pre-GTU *Cronbach's* $\alpha = 0.893$
    - Post -GTU *Cronbach's* $\alpha = 0.864$

	Strongly Disagree % (n)	Disagree % (n)	No Opinion % (n)	Agree % (n)	Strongly Agree % (n)	N/A	Mean
PFS: I was able to **manage my classroom** sufficiently when using geospatial technologies.	0.0% (0)	13.0% (3)	17.4% (4)	21.7% (5)	26.1% (6)	21.7% (5)	3.78

	Strongly Disagree % (n)	Disagree % (n)	No Opinion % (n)	Agree % (n)	Strongly Agree % (n)	Mean
PFS: The curriculum and support materials provided appropriate teaching ideas to help me use the instructional materials.	0.0% (0)	0.0% (0)	21.7% (5)	65.2% (15)	13.0% (3)	3.91

Geospatial Science Pedagogical Content Knowledge (GSPACK)

	Strongly Disagree % (n)	Disagree % (n)	No Opinion % (n)	Agree % (n)	Strongly Agree % (n)	Mean
PFS: The curriculum and support materials provided appropriate teaching ideas to help me use the instructional materials.	0.0% (0)	0.0% (0)	21.7% (5)	65.2% (15)	13.0% (3)	3.91

Item	Strongly Disagree % (n)	Disagree % (n)	No Opinion % (n)	Agree % (n)	Strongly Agree % (n)	Mean
SRRS: My understandings to why certain technologies were used in the curriculum to promote science learning increased as a result of my participation in the professional development sessions.	0.0% (0)	0.0% (0)	20.0% (1)	40.0% (2)	40.0% (2)	4.20
SRRS: My understandings of how and when to **adapt my instruction while using geospatial learning tools** (Google Earth or GIS) increased as a result of my participation in the professional development sessions.	0.0% (0)	0.0% (0)	40.0% (2)	0.0% (0)	60.0% (3)	4.20

Conclusion

- Data supports the effectiveness of the GS-TPACK PD model
- GS-TPACK instrument had good reliability for the entire instrument and for each subscale
- Teachers geospatial science technological pedagogical content knowledge improved significantly after PD sessions

For More Information

Paper available at:

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

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ELI Curriculum:

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