

Design-based approaches to identify causation in GIS education research

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What we know about GIS&T education

- NCGIA core curriculum 1990 >>>>
- Yet, after 25 years “Knowledge around geospatial technologies and learning remains sparse, inconsistent, and overly anecdotal” (Baker et al. 2015)
- Review 2007-2017, 45 papers addressing questions on teaching and learning with GIS
 - Journal of Geography (Vol. 106-116)
 - Journal of Geography in Higher Education (vol. 31-41)
 - International Research in Geographical & Environmental Education (Vol. 16-24)
- Corroborated previous reviews research lacks significant questions and links to relevant theory.





What seems to be the problem?

- Thus far we asked *if* or *what* students are learning
 - “Yes, teaching produces significant learning, but it is unclear exactly what causes this, and why or how this happens. Further research is needed.”

Description and correlation → causation and identification of process & mechanisms

- Need to ask *how* and *why* are they learning
 - “How do students learn [topic/skill]?”
 - “How does the learning environment impact learning?”
 - “Why is [activity/task/environment] helping/hindering learning?”



Discovering Design Based research

Our journey from traditional experimental science tradition, pre-post or A-B intervention-control study to...

“... get closer to the learner, incrementally refine your technology based on what you learn about how it is used, and seek to answer more general questions about the roles that this type of technology can play in learning”

(J. Kolodner pers. comm.)

What is Design Based Research?

- Research *intervenes* in the teaching and learning process in a naturalistic classroom setting. Design and development of learning theory is intertwined.
- *Iterates* through continuous cycles of design, enactment, analysis, and re-design.
- Methods and assessments are able to connect the *processes* of enactment and learning with targeted outcomes.
- Designs and research based on *theoretical* propositions that generalize to other settings. No ‘grand theories’, but suggesting design-principles and context that allow others to translate into their own setting.

Why DBR + GIS?

- DBR *intervenes*. Use your regular classroom or course settings, implement new teaching approaches as part of ongoing modification of the curriculum.
- DBR *iterates*. Conduct iterations over several semesters that form sequences of intervention, testing and revision.
- DBR connect learning *processes* with outcomes. Have students reflect on what they are thinking, why or how a lab/activity helps or hinders their learning.
- DBR connects to *theory* propositions. What learning theory is your design founded on? How is the intervention situated in the curriculum? Characteristics of the students? Instructional (lab) environment?



Conclusion

- GIS&T education particularly well-positioned to lead the way in high-quality geography education research, and building an empirically and theoretically grounded understanding of teaching and learning GIS.
- Lessons, labs, tutorials are highly mediated by technology
- They are by definition designs, often iteratively improved upon
- Technology embeds ample opportunities to “get close to the learner”