

Effect of Professional Development on Teachers' Understanding of Interdisciplinary Earth Science Concepts

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Project Background

- Dryland Critical Zone is a member of the Critical Zone Network, focusing on western deserts
- The critical zone, or CZ, is the layer of Earth where water, soil, air, rock, and life interact.
- Insights Science Discovery collaborates with grants to provide outreach K12 and community activities as well as professional development
- Teachers may want to incorporate CZ topics but lack the background knowledge and experience with techniques

How does a professional development impacts teachers' knowledge and confidence?

Research Questions & Instrument Matrix

Focus Question
How do teachers' mental models of the CZ change after PD with scientific researchers?

- Drawing of CZ and Written Narrative
- **Related Disciplines List**
- Reflection on Changes

Sub-Question 1
How are teachers' knowledge of and confidence towards teaching CZ concepts affected by the PD?

- **Related Disciplines List**
- Reflection on Changes
- **Pre and Post Test**
- **Pre and Post Survey**

Sub-Question 2
How do researchers' motivations and goals for participating in PD compare to teachers' reasons?

- Pre and Post Survey
- Researcher Survey

Bolded Instruments indicate that the instrument was a source of quantitative data.

Methodology

- The 3-day professional development included:
- Research presentations by CZ scientists
 - Hands-on lesson & activity demonstrations
 - Field Trip to a local farm and research site

Teachers

- Average 11.2 years of experience
- 13 HS Teachers & 17 MS Teachers
- HS Teachers: Physics, Chemistry, Biology, Environmental Science

Districts

- All of the districts represented had:
- >80% Hispanic students
 - >80% economically-disadvantaged students
 - >70% Hispanic teachers

Teachers were given time to complete the instruments before and after the PD. Researchers were emailed a survey the Monday after the PD.

Data Analysis

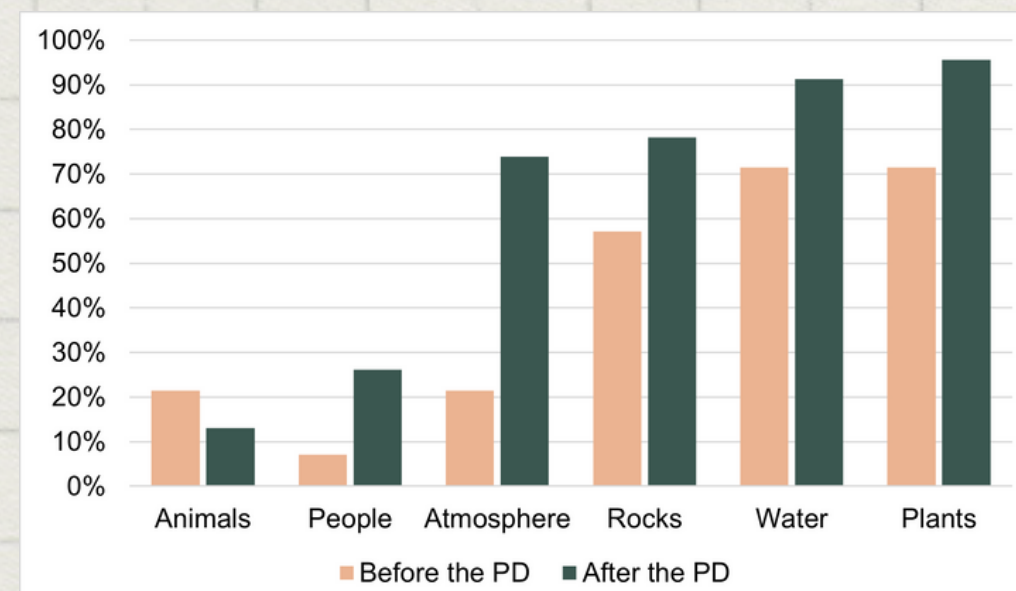


Figure 1. Percent of Drawings that included each component of the Critical Zone, made by teachers before the PD (n=14) and after the PD (n=23).

Drawings also included more interactions among spheres, from being included in 50% of drawings before the PD to 87%.

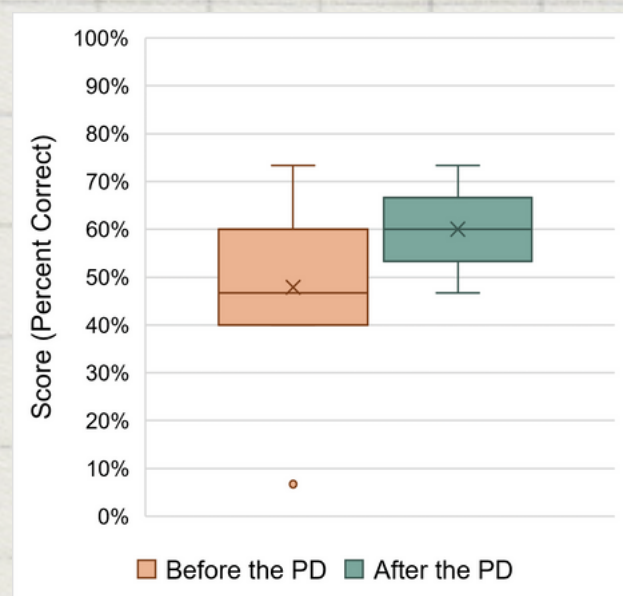


Figure 2. The range of knowledge assessment scores from before the PD (n=11) to after the PD (n=12). After the PD, the average increased from 48% to 60% and the range of scores was smaller.

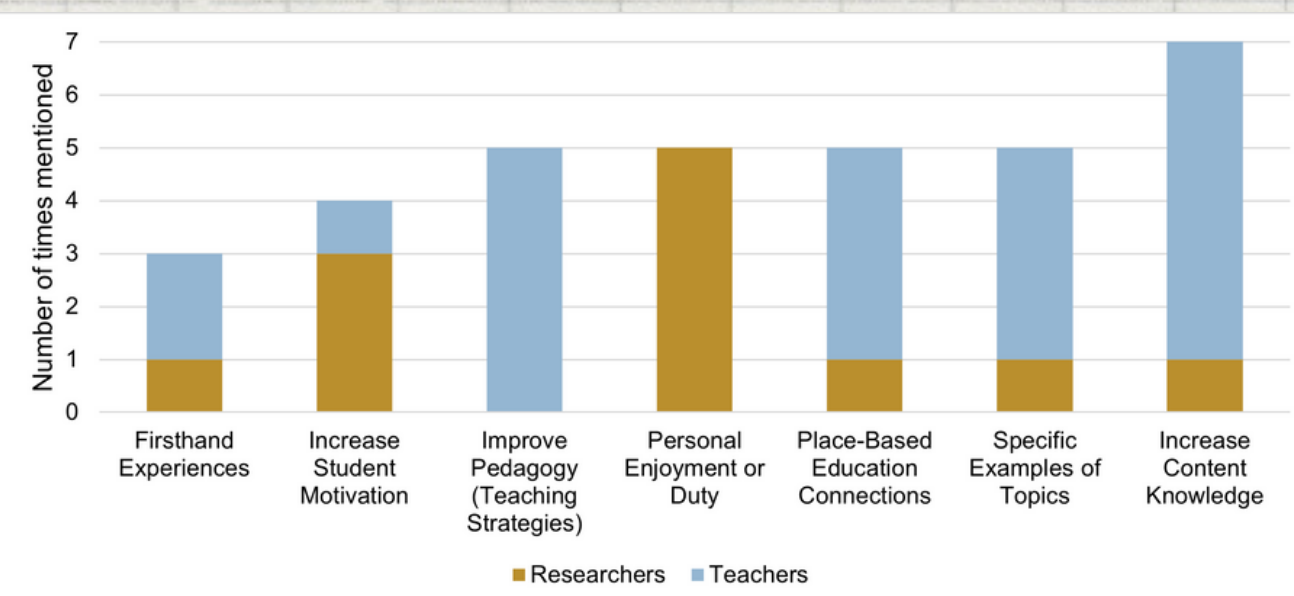


Figure 3. Motivations for participating in professional development as reported by Teachers (n=11) and Researchers (N=6). There was overlap in five reasons and the two distinct ones could be due to discipline-specific responsibilities.

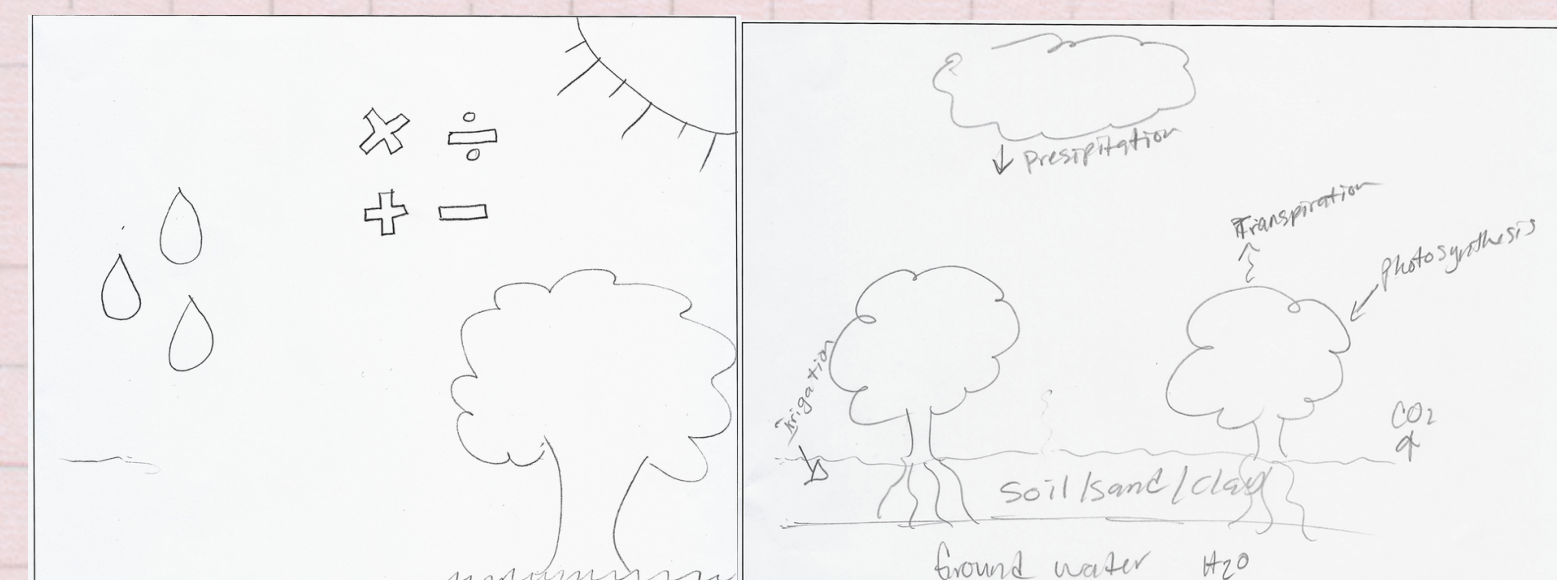


Figure 4. Before and after drawing. Note the interactions that are labeled in addition to the components of the CZ.

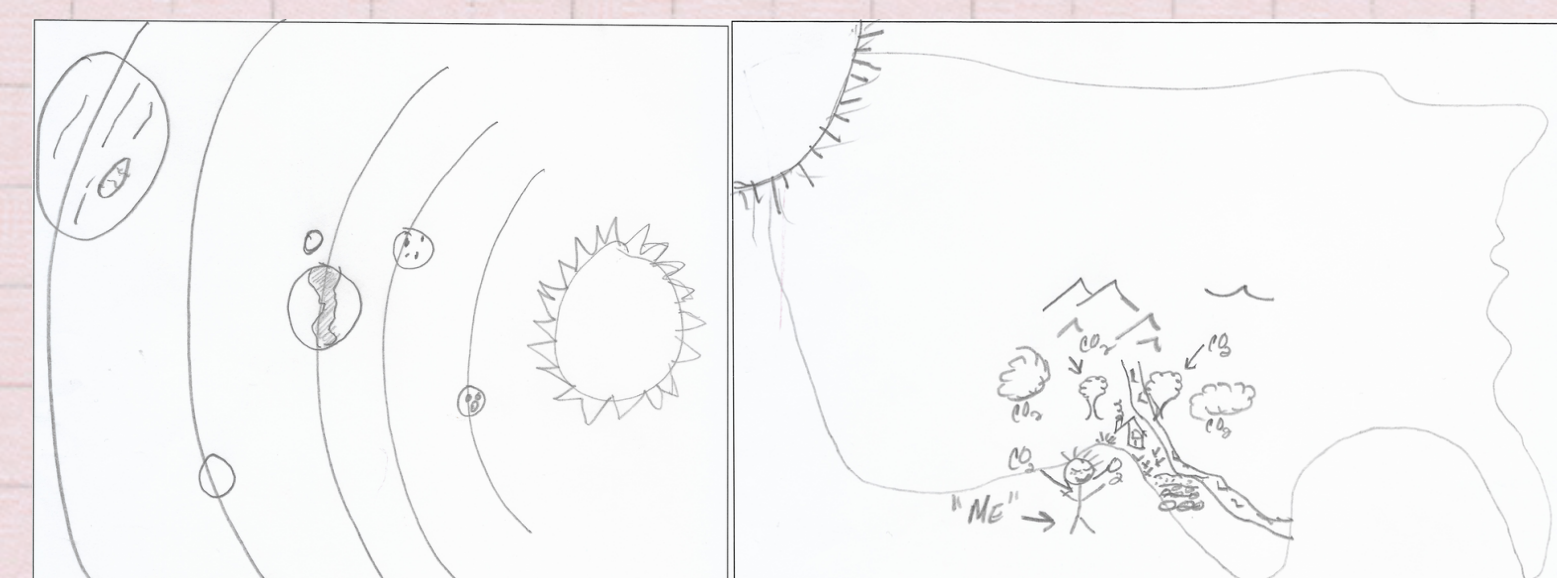


Figure 5. Before and after drawing. Note the change from a similar concept (Goldilocks Zone) to a map-like drawing that includes many parts of the CZ.

Conclusions & Impact

- Teachers' models of the CZ increased in accuracy (including all 4 major components) and in detail.
 - *I have better understanding... Where now I understand its a variety of connections to our land and how it connects to many aspects of life."*
- Teachers understood some topics better (and some topics worse) but overall gained confidence with incorporating CZ concepts into their classes.
 - *"...more comfortable now than I was before coming to this training. I do not have any major concerns"*
- Scientists involved in education are motivated, but may need support in developing effective and engaging learning experiences, whether for teachers or their own students.