# Why Does Teacher Learning Vary in Professional Development? Accounting for Organizational Conditions

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## The Need for Research

- Much of the past research on science professional development (PD) focuses on teacher characteristics, such as self-efficacy (Schipper et al., 2020).
- Yet teacher characteristics do not fully explain variability in teacher instructional change (Sandholtz, et al., 2019).
- **Need to understand how organizational conditions influence instructional change during PD** (Opfer & Pedder, 2011).
- Research in this area is growing (special issue of *Science Education*, 2025), but conceptual frameworks and mixed methods studies are nascent (Hayes & Allen, 2025)

Understanding salient organizational conditions and how they shape teacher equity self-efficacy and instructional change can help PD providers better support teacher learning of equitable science instruction.

## Framework

In order to organize the organizational conditions that may influence professional learning, self-efficacy, and instructional practice in science education, we use the instructional capacity framework (Hayes et al., 2020).

| **Construct** (Cronbach's) | **Definition** |
|---|---|
| **PD predictor** | |
| PD Hours | Hours of participation in SLP PD up to the point of the survey |
| **Main Outcome** | |
| Instructional Practices Alignment (α =.863) | Alignment between equitable reform-based pedagogical philosophies and teacher's instruction (Hayes et al., 2019) |
| **Mediating variable** | |
| Equity self-efficacy (α =.843) | Teachers' belief in their ability to meet the science learning needs of marginalized children, leading to particular outcomes for students (outcome expectancy) (Ritter et al., 2001) |
| **Instructional capacity framework (predictors)** (Settlage et al., 2015; Short & Johnson, 1992) | |
| ***Cultural dimension*** | |
| Impact on other teachers (α =.729) | The degree of influence teachers believe they have on other teachers at their site in terms of science education |
| Principal Support (α =.938) | The degree to which the teacher perceives the principal supports science education |
| Autonomy in instruction (α =.924) | Degree of choice in both pedagogy and curriculum, including selecting teaching techniques and addressing student needs |
| Autonomy time (α =.872) | Degree of choice in determining the designation of class time |
| Shared leadership (α =.717) | The degree to which teachers have input on organizational structures such as science curriculum |
| ***Social dimension*** | |
| Collaboration focus (α =.869) | Time spent collaborating with other teachers with the focus on science teaching and learning |
| Collaborative culture (α =.863) | A culture in which sharing ideas and feedback from colleagues supports improvements in teaching |
| Trust (α =.854) | A climate of trust and support amongst teachers at the site |
| ***Structural Dimension*** | |
| Science teaching resources (α =.779) | The degree to which supportive structural and material resources were present and high quality |
| ***Policy Dimension*** | |
| Policy: equitable science initiatives (α =.632) | Teachers' perception of the degree to which district and state initiatives support them in implementing equitable science instruction. |
| Policy: equitable class time (α =.494) | Teachers' perception of the degree to which class time policies support equitable science instruction. |
| Policy Alignment (α =.891) | The degree to which PD activities were consistent with policies at the site, district, and state level (Garet et al., 1999) |

## Methods

**Research Questions**

1. **Quantitative**:
   - Does equity self-efficacy mediate the relationship between PD participation and reform-based science instructional practices?
   - To what degree do organizational conditions predict teacher equity self-efficacy and instructional practices in the context of PD?
2. **Qualitative**: How do teachers' perspectives contextualize and explain the relationships identified in the quantitative models?

**Context: Science Learning Partnership (SLP)**
- Four-year, NSF funded elementary science PD program; grades 3-5
- 8 districts, 100 teachers
- Weeklong summer institute and three Saturday workshops each year; Lesson study

**Instructional outcome: Equitable Sensemaking Discourse** (Odden & Russ, 2018; Basu et al., 2009)

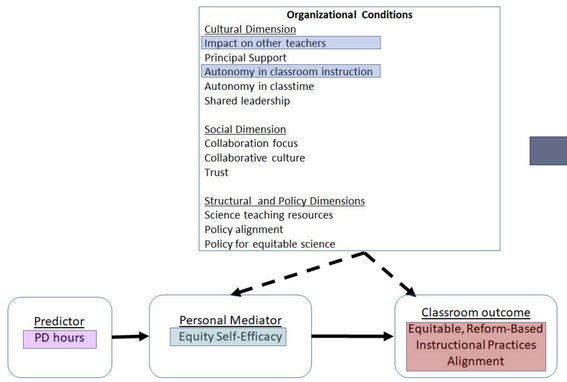
**Design:** Explanatory sequential mixed methods

**Sample and Data sources:**
- Instructional capacity survey: N =54
- Interviews: N = 19

**Analysis**:
- Quantitative: mediation models
  - Path analysis using maximum likelihood estimation
  - Stepwise modeling of pathways
- Qualitative: a priori application of salient quantitative variables
  - Thematic examination of relationships between constructs
  - Memoing of relationship between quantitative and qualitative results

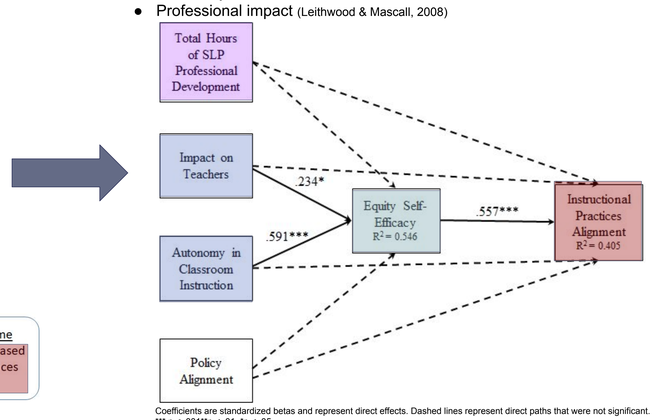
## Results

**Hypothetical model:** We tested the significant relationships and mediation roles of these variables




**Quantitative Results**

**Final Quantitative Model:** Organizational conditions that mattered in instructional practice (mediated by equity self-efficacy):
- Autonomy in instruction (Schipper et al., 2020)
- Professional impact (Leithwood & Mascall, 2008)




Coefficients are standardized betas and represent direct effects. Dashed lines represent direct paths that were not significant.
*** p < .001**p < .01, *p < .05.

**Qualitative Results**

13 of the 19 interviewed teachers spoke about the focal variables in **ways that confirmed the relationships within the quantitative model.** These teachers talked highly of the PD and experienced high autonomy and impact, high equity self-efficacy, and correspondingly high alignment in instructional practices, or the reverse.

> "So with our science kit committee and through SLP we are making progress in getting the district to get on board with this idea of hands-on materials, students having conversations."

Six of the 19 interviewed teachers spoke about the focal variables in **ways that explained the error within the quantitative model**.

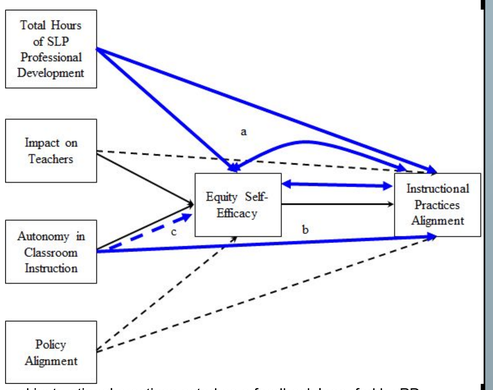
Two experienced low autonomy, yet resisted and taught science, drawing on existing equity self-efficacy and what they learned in the PD.

> "They have come down and said, 'We only want you teaching reading, writing, listening, speaking, and math,' I still teach science and social studies, because I've been teaching long enough to know that we want to teach the whole child. The PD…[is] a lifeline."

Four had high autonomy, but were unable to make use of this freedom to teach aligned science instruction due to issues with equity self-efficacy and misaligned pedagogical beliefs.

> "[The students are] young and they're not used to this kind of inquiry, so I find that I want to explain everything to them… So that has been challenging for me. "

**Mixed Model**




a) Self-efficacy and instructional practices acted as a feedback loop, fed by PD (non-linearity)
b) Autonomy allowed for reform-based instructional practices, increasing self-efficacy (reverse causality)
c) Self-efficacy can support resistance in the face of low autonomy

## Discussion

There has been little systematic research on which organizational conditions influence the translation of PD to practice, making it difficult to address organizational barriers to professional learning (Opfer & Pedder, 2011; one exception is Schipper et al., 2020). This paper, along with the rest of the Special Issue in *Science Education,* contributes to this nascent literature.

**Quantitative results:**
- **Professional impact** and **autonomy in instruction** were the only significant predictors, **explaining substantive variance** in equity self-efficacy (40% and 54% respectively)
- Results are consistent with literature on teacher empowerment, that notes the importance of teacher leadership, shared decision making, and autonomy (Pearson & Moomaw, 2006)
- Results indicate salience of the cultural dimension and downplay materials and structures

**Mixed findings provide context:**
- **Teacher change is neither linear nor unidirectional:** PD provides resources, community, and opportunities to practice, begetting a recursive interaction between self-efficacy and instructional practice
- **Autonomy may be "necessary but not sufficient:"** Some organizational autonomy may be necessary for teachers to feel a sense of ownership (Szelei et al., 2020). However, autonomy only supports equitable reform-based instruction if combined with PD and a collaborative learning community (Rivera Maulucci et al., 2015).
- **Teachers without autonomy can still resist:** Equity self efficacy and PD may help teacher resist organizational constraints (Carlone et al., 2010; Gutierrez, 2016)

## Implications

- Organizations that provide space for teacher autonomy and impact, in combination with PD and targeted support for equity self-efficacy, may create the best conditions for teacher growth. In other words, teachers need to be able to engage in their profession with agency while simultaneously learning about and trying out equitable practices with colleagues.
- **Engaged autonomy** (Fullan et al., 2022; Lamb et al., 2011) may provide leaders a way to balance this tension.
- **In the current policy landscape engaged autonomy,** in combination with equity-focused science PD, **may be essential** for equity-focused elementary science instruction.
- PD can support in several ways, including
  - **Helping teachers resist low autonomy** by providing time to make sense of the organizational environment (Heredia, 2020)
  - **Providing opportunities for teacher leadership** (e.g., professional impact) (Heredia, 2023)

Additional research:
- How do key organizational conditions differ across times and contexts?
- What is the role of teacher acts of 'creative insubordination' for science in the elementary context today? How does teacher autonomy play a role in a changing policy context?

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Link to paper

Link to special issue introduction

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