Measuring Science Teachers' Change through a Two-year Professional Development Program for District Science Coordinators

Julie A. Luft[1], Brooke Whitworth[2] Yuxi Huang[1], Joe DeLuca[1], and Jennifer Bateman[2]

1 Department of Mathematics, Science, and Social Studies Education, University of Georgia, Athens, GA
2 Department of Teaching and Learning, Clemson University, Clemson, SC

This study was made possible in part by the National Science Foundation grant 1908431, and the University of Georgia Athletic Association Professorship. The findings, conclusions, and opinions herein represent the views of the authors and do not necessarily represent the view of personnel affiliated with the National Science Foundation or the University of Georgia Athletic Association.

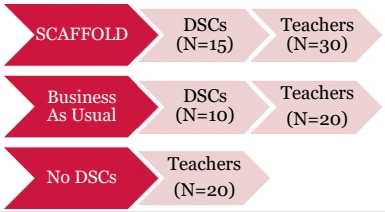
SCAFFOLD Overview

The SCAFFOLD project has two main goals. The first is to develop a high-quality professional learning program (PLP) for District Science Coordinators (DSCs) because they are in leadership roles but may not have appropriate leadership knowledge or skills (Whitworth & Chiu, 2015). DSCs often have classroom experience, but that does not necessarily translate into leadership knowledge and skills. The second goal is to track the knowledge and teaching practices, which are important areas of study (Luft & Hewson, 2014), of the DSCs and their teachers over the course of two years. This data can reveal if the DSCs' PLP had an impact on either the DSCs or their teachers.

There are three groups of participants in this project. One group consists of DSCs participating in the SCAFFOLD program, which is an online PLP composed of asynchronous assignments and monthly synchronous meetings. Another group consists of DSCs who are not participating in a PLP- this is the *business as usual* group. The third group consists of teachers who do have not DSCs in their districts - this is a *no DSC* group. Figure 1 shows the design of the project. The question pertaining to the teachers is:

- How, if at all, do DSCs (in the SCAFFOLD program and the business as usual program) impact the practice of science teachers (e.g., their use of 3D instruction, equitable instruction)?

Figure 1. Comparison Groups in the Project



SCAFFOLD Program:
- Online modules: Curriculum, Equitable Science Teaching, Professional Learning
- Monthly program
- Support materials: Teaching Channel & NSTA

Data Collection

Data from the teachers were collected over a two-year period. The process of data collection followed the format used by Luft et al. (2011; 2023). There were interviews with the teachers at the beginning and end of the year regarding their experiences with PLP. During each year, the teachers were interviewed three times about their instructional practices over a week. Teachers provided an overview of their practices and supplied supporting documents. These interviews were conducted during specific two-week windows of time. The teachers also completed surveys about their NGSS use and their orientation towards equitable teaching.

Figure 2. Project Timeline

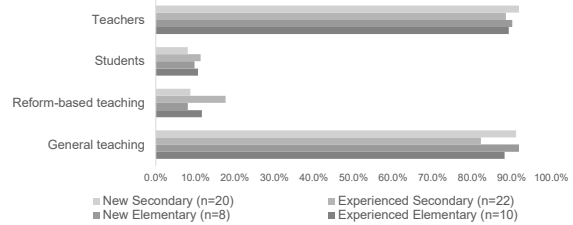
Year 1 Aug-May	May-Aug	Year 2 Aug - May
• Pre-interview and surveys • Interviews about one week of classroom instruction (November, February, April)	• Mid-point interview and surveys • Focus Groups	• Post-interview and surveys • Interviews about one week of classroom instruction (November, February, April)

Data Analysis

Two different preliminary analyses regarding the teachers have occurred to date. The first analysis focuses on the knowledge of the science teachers. Short videos of science classroom instruction were used to elicit the knowledge of teachers (see Huang et al, in progress; Luft et al., in review). One video instrument consisted of a 10-minute video that highlighted different science and engineering practices. There were different videos for elementary and secondary teachers, which were identified from open-source materials. Teachers watched the videos three times over the course of two years. While watching the videos, they were asked to discuss important instructional events related to the teaching of science. The interview was audio-recorded and transcribed.

These data were analyzed by research assistants, who worked collaboratively to code the data (Creswell & Creswell, 2017). Figure 3 is a preliminary analysis of this data. In general, the teachers were focused on the actions of the teachers in the videos, and they consistently noticed general instructional practices instead of reform-based instruction consisting of the SEPs.

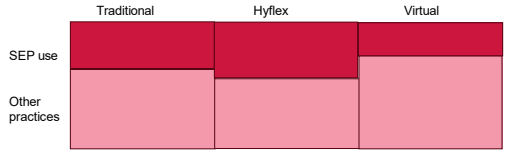
Figure 3. Noticing Difference Between Teachers



The second analysis focused on the actions of the teachers in their classrooms (He et al., in review). The instructional reports provided by the teachers comprised this source of data. These reports were analyzed with a coding scheme focused on three different types of practices: (1) investigating (e.g., asking questions and defining problems, planning and carrying out investigations), (2) developing explanations and solutions (e.g., developing and using models, constructing explanations and designing solutions), and (3) evaluating (e.g., analysing and interpreting data, using mathematical and computational thinking, engaging in argument from evidence).

Similar to the coding process used in the video data, research assistants analyzed the data and used a process that involved comparing and reaching agreement in their codes (Creswell & Creswell, 2017). Figure 4 reports these findings, which revealed that the teachers used a higher proportion of SEPs in a HyFlex or traditional (face-to-face) setting than they did in a virtual setting. The analysis also revealed few investigative and more explanatory SEPs among the teachers, and secondary teachers with more evaluating SEPs than their elementary counterparts.

Figure 4. Plot of the Instructional Settings and the Implementation of the SEPs



Discussion

This study explores the connection between DSCs and the teachers with whom they work. In this preliminary analysis the connection between the DSCs and the teachers is not yet apparent. Data pertaining to the teachers was not attributable, at this point, to the DSCs. The more comprehensive analysis may provide insights into the influence the DSCs have on the science teachers.

This data, however, does offer a few insights that are worth noting. In terms of our teachers, there is still more work to be done in order for teachers to notice and use reform-based practices (see *NGSS*, 2013; *NSES*, 1996). Our findings point out that teachers can notice and use general practices (e.g., interacting with students), but are limited in their noticing and use of specific topics associated with reform-based science education (e.g., modeling).

In terms of noticing, the limited number of noticed reform-based practices was surprising given Chan et al.'s (2021) conclusion that content-specific videos often result in more insights into the complexity of science instruction. But without opportunities to build a sophisticated knowledge of science instruction, teachers will focus on general instructional actions (Zummo et al., 2021).

In terms of the practices used by teachers, it is important to point out that our data is consistent with other researchers who have documented the limited use of SEPs by science teachers (e.g., Banilower et al., 2018; Trygstad et al., 2016). Among the teachers in this study, they used about three SEPs every two weeks. When they used the SEPs during instruction, the SEPS were more likely to emphasise evaluation and developing explanations. There was little use of the investigating SEPS among the teachers.

Implications

The vision of the *NGSS* (NGSS Lead States, 2013) involves the regular use of the SEPs in order for students to understand how they are both a knowledge and a skill (Pruitt, 2014). Clearly, there is more to be done to ensure teachers are implementing all SEPs. One important area involves providing teachers with well-developed, personalized, and focused learning opportunities so they can build their understanding of reform-based instruction (Luft & Hewson, 2014).

Selected References

Banilower, E. R., Smith, P. S., Malzahn, K. A., Plumley, C. L., Gordon, E. M., & Hayes, M. L. (2018). Report of the 2018 NSSME+. *Horizon Research, Inc.*

Chan, K. K. H., Xu, L., Cooper, R., Berry, A., & van Driel, J. H. (2021). Teacher noticing in science education: do you see what I see?. *Studies in Science Education*, *57*(1), 1-44.

He et al. (in review). Science teachers' implementation of science and engineering practices in different instructional settings.

Luft, J.A., et al. (in review). Exploring the noticing of science teachers: What teachers notice and using video to capture teacher knowledge.

Luft, J.A., et al. (2011). Beginning secondary science teacher induction: A two-year mixed methods study. *Journal of Research in Science Teaching*, *48*(10), 1199-1224.

National Research Council [NRC]. (2012). *A framework for K-12 science education: Practices, crosscutting concepts, and core ideas*. National Academies Press.

NGSS Lead States. (2013). Next generation science standards: For states, by states.

Zummo, L., Hauser, M., & Carlson, J. (2022). Science Teacher Noticing via Video Annotation: Links between Complexity and Knowledge-Based Reasoning. *Journal of Science Teacher Education*, *33*(7), 744-763.