Elementary Teachers' Mindsets: Does Situated Professional Development Promote Growth Mindedness?

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Abstract

The purpose of this sequential explanatory mixed-methods investigation is to (1) examine the extent a professional development (PD) experience for elementary science teachers changes teachers' mindsets and (2) explore contextual factors that may cultivate teachers' growth- or fixed-mindednesss. Participants were 46 elementary science teachers recruited from a cohort currently participating in a state-wide PD program for which alignment with key features of effective PD was previously established. Data included validated pre- and post-PD Mindset Surveys, observations of the PD, and semi-structured follow-up interviews. Survey responses were analyzed via t-tests to identify teachers' mindsets prior to and following the PD. Interview responses and PD observations were analyzed using analytic induction to explore the PD and school culture elements that influenced teachers' mindsets. Results have the potential to help PD developers better understand how to design and implement PD that is effective in facilitating long-term teacher change and may broaden the lenses used to design and evaluate PD by applying a psychological perspective already used to examine variation in K-12 student achievement. Future research will examine what relationship, if any, exists between mindset, implicit goals, and teachers' classroom practice prior to and following reforms-based PD.

Subject/Problem

The *Framework for K-12 Science Education* identifies the principal goal of science education as preparing students to use scientific knowledge to draw evidence-based conclusions about science-related issues and engage in science-related matters (National Research Council [NRC], 2011). Professional development (PD) is the primary way science teachers learn about new evidence-based teaching practices that ultimately have the potential to improve students' science achievement (Johnson, Kahle, & Fargo, 2007). Although PD implementers are optimistic science teachers will integrate newly learned reform-based instructional strategies into their instruction, research indicates this is often not the case (e.g. Supovitz & Turner, 2000), and long-term instructional change is often not observed (Freeman, Marx, & Cimellaro, 2004). This is problematic for many reasons. First, from a financial perspective, money spent on PD that does not evoke long-term changes in teachers' practices is effectively wasted. Second, when teachers do not embrace evidence-based strategies, student learning and achievement are limited. Therefore, novel research is needed to help explain and remedy less than desirable teacher change following PD.

Current research efforts in science education to support lasting instructional change and student achievement have focused on key professional design and implementation features such as authentic context, coherence, modeling, active learning, collective participation and opportunities for practice (e.g. Garet, Porter, Desimone, Birman & Yoon, 2001; Loucks-Horsley, Stiles, Mundry, Love & Hewson, 2010). In addition to examining the features of PD that are likely to promote changes in teachers' practices, there is a growing awareness that teachers' beliefs about students, the nature of science, and effective teaching strategies must also be identified and addressed during PD (Anderson, 2002; Ertmer, 2005). Attention to these variables in PD design and implementation improves outcomes; however, instructional change is not guaranteed (Pennell & Ewing-Taylor, 2012). Further, theories explaining why certain PD components are critical to effecting change are under-developed (Borko, 2004). In particular, theoretical frameworks applied in PD research consider social and cognitive aspects of learning. These frameworks include situated learning theory (Lave & Wenger, 1991), situated cognition (Brown, Collins & Duguid, 1989), and constructivism (NRC, 2000). What is absent from PD research is a psychological perspective that could be applied to explain unexpected results.

Mindset and Professional Development

Educational psychologists have repeatedly documented two psychological profiles that predict academic achievement and learning (Dweck, 2000; Elliot & Dweck, 1988). These psychological profiles are implicit theories, or mindsets, that shape beliefs about personal effort, coping strategy use, affect, and motivation (Dweck, 2000; Yaeger & Dweck 2012). Students of any age can be characterized as being goal- or learning-oriented (Dweck, 1988). A student who is goal-oriented is characterized by a fixed mindset. A student with a fixed mindset approaches tasks with the intent to prove their success, avoid negative judgment, and believes personal traits including intelligence and talent are innate (Dweck, 2006; Dweck, 2000). Students with a fixed mindset are less likely to take risks or attempt something new if they perceive a high likelihood of failure (Elliot & Dweck, 1988). Ultimately, fixed-minded people limit themselves to what they can learn and accomplish as a result of their fear of failure, unwillingness to take risk, and low learning motivation (Dweck, 1988). Conversely, a student who is learning-oriented has a growth mindset. A student with a growth mindset does not find value in a task unless they have learned something new or improved a certain skill. Students with a growth mindset are not preoccupied with the possibility of failure like their fixed-minded counterparts. In fact, growth-

minded individuals perceive confusion, difficulty, and even temporary failure as indicators they are learning and succeeding (Dweck, 2006). These implicit beliefs about the fixed nature of personal traits and the meaning of "failures" have profound implications for learning and success inside and outside traditional school settings (Dweck, 2006; Vedder-Weiss & Fortis, 2013)

Research results indicate mindsets can be used to predict a wide range of outcomes and behaviors including students' math achievement, success at smoking cessation, aggression toward peers, engagement in science, and willingness to attempt new challenges (Elliot & Dweck, 1988; Vedder-Weiss & Fortus, 2013; Yaeger & Dweck, 2012). It is likely the divergent beliefs of growth- and fixed-minded individuals may be useful in understanding why some teachers readily embrace professional growth and adopt novel evidence-based instructional practices while others prefer to continue down the road they are familiar with despite evidence-based PD design and implementation. For example, a classroom full of students can be a daunting environment for a teacher attempting something for the first time; a "clumsy" lesson could lead to student frustration, confusion, and the need to reteach. Whether the teacher views such a situation as a positive opportunity to grow as a teacher or as a negative experience that reflects poor teaching skills likely influences the teacher's decision to actually attempt the new instructional strategy (Grant & Dweck, 2003). However, mindsets have not been examined within the context of science teacher PD and teacher change. The extent to which elementary science teachers' vary in their mindsets and whether their mindsets predict instructional change following PD needs to be examined to further develop an explanatory lens for PD outcomes. Furthermore, since mindset is a flexible psychological characteristic (Dweck, 2006; Dweck, 1988), PD programs may be able to leverage this to explicitly address and include growth mindset elements to foster instructional change. It is possible, effective PD characteristics attend to psychological as well as social and cognitive aspects of learning (e.g., Loucks-Horsley & Matsumoto, 1999). For example, PD programs that include opportunities to practice new instructional strategies may facilitate risk-taking the participant would not have engaged in. The possibility that PD implemented with situated learning elements attends to psychological mindsets has not been explored.

Purpose

The purpose of this investigation is two-fold. First, we examine elementary teachers mindset prior to and following a PD experience for elementary science teachers. Second, we explore the contextual factors that may cultivate growth- or fixed-mindednesss among teachers. The following research questions guide the investigation: (1) What are elementary teachers' mindsets prior to and following a PD experience that incorporates key characteristics of effective PD? (2) In what ways does PD and school context cultivate growth- or fixed-minded teachers?

Design/Procedure

An explanatory sequential mixed methods approach was used to answer the research questions (Creswell & Clark, 2007; Hesse-Biber, 2010; Schram, 2014). The qualitative data (teachers' interview responses and observations of the PD) was triangulated with the quantitative data (teachers' pre- and post-PD mindset survey responses) to help explain the quantitative results. Teachers' mindsets changed pre-and-post PD was assessed through surveys. School context was explored through interviews with a subset of participants.

Participants/Context

Participants were 43 elementary science teachers who participated in a year-long state-wide PD. The summer portion of the PD lasted 4 weeks and focused on reform-based student-centered science practices including problem-based learning (PBL), inquiry, nature of science

(NOS) instruction, and effective integration of educational technology. Participants received follow-up coaching during the academic year. Previous research has documented that the PD incorporates many of the key features of effective PD for science teachers described above including authentic context, coherence, collaborative participation, modeling, opportunities for practice, active participation, and coaching (e.g. Author, 2014).

Data Collection/Analysis

The validated Mindset Survey instrument (modified from Dweck, 2006 and Midgley et al., 2000) consists of 43 items designed to elicit whether a person has a fixed or growth mindset and the extent to which school culture influences mindset. Nine different constructs were evaluated on the survey: mindset, mastery goal orientation, academic efficacy, personal teaching efficacy, performance avoidance goals, performance approach goals, avoiding novelty, mastery goals for students, PD incentives. All survey statements were answered using a Likert response ranging from strongly agree to strongly disagree. The survey was administered online prior to (pre) and following (post) the PD and took participants approximately 20 minutes to complete. Composite variables for each construct were calculated. Pre-and post-patterns in teachers' mindsets and underlying constructs were analyzed quantitatively using paired t-tests.

Qualitative data included participant interviews and PD observations. A purposeful sample of 10 (20%) of participants were interviewed following the PD. These validated semi-structured interviews contained 6 questions designed to elicit the contextual factors of the PD that participants perceived as influencing their mindset. For example, one question asked participants to consider the perception of how or why the PD will help them successfully implement inquiry instruction. Participants for this interview were selected based on the following combinations: fixed to growth (3), growth to fixed (3), fixed - no change (2), growth - no change (2). Each interview lasted approximately 30 minutes. Participants' semi-structured interview responses provided qualitative data about PD and school culture elements that influenced teachers' mindsets. Fieldnotes and writeups of PD observations documented evidence of teacher's mindsets and goals and PD elements that may have cultivated or hindered growth mindedness. These data sources were analyzed using an analytic induction approach (Bogdan & Biklen, 1992).

Results

Preliminary results suggest that participants' entered the professional development with a growth mindset (M=15.0, scale was 3 to 18, 18 associated with growth mindset) and their mindset did not change significantly following the professional development (M=14.5), p=.288. Participants' responses indicated the majority strongly agreed with statements aligned with a mastery goal orientation and a positive academic efficacy and continued to agree with these statement following the PD. Participants were neutral toward statements aligned with the following constructs: performance approach goals, performance avoidance goals, avoiding novelty, and personal teaching efficacy. Participants were also neutral toward the majority of statements related to mastery goals for students both prior to and following the PD. Finally, participants perceived the financial incentives to be a positive factor that influenced their participation in the PD. Interview and observation data will provide a lens through which to interpret these quantitative data.

Contribution/Interest to NARST Members

This investigation makes two primary contributions to the field of science education. First, the study has practical significance. The findings may help developers of PD better understand how to design and implement PD that is effective in facilitating long-term science

teacher change. Second, application of implicit self- theories to PD is novel and integrates educational psychology research to a new domain (teacher PD). PD and contextual variables that influence teachers' mindsets need to be identified to help develop communities of adult learners that in turn cultivate student growth mindsets, school engagement, academic achievement, and personal success (Dweck, 2000; Grant & Dweck, 2003; Vedder-Weiss & Fortus, 2013). Further, this line of research has the potential to be extended beyond elementary science teachers to examine if the same mindset patterns exist for secondary teachers who are typically experts in a single content area. Finally, exploring preservice science teachers' mindsets prior to and following general and content-specific methods courses, after student teaching, and into their first year of teaching has the potential to inform teacher preparation programs and beginning teacher mentoring programs.

Selected References

Anderson, R. (2002). Reforming science teaching: What research says about inquiry. *Journal of Science Teacher Education, 13*, 1-12.

Author, 2014

Bell, R. L., Blair, L. M., Crawford, B.A., & Lederman, N.G. (2003). Just do it? Impact of a science apprenticeship program on high school students' understandings of the nature of science and scientific inquiry. *Journal of Research in Science Teaching, 40*, 487-509. doi:10.1002/tea.10086

Birman, B. S., Desimone, L., Porter, A. C., & Garet, M. S. (2000). Designing professional development that works. *Educational Leadership, 57*(8), 28-33.

Borko, H. (2004). Professional development and teacher learning: Mapping the terrain. *Educational Researcher,33*(8), 3-15.

Brown, J. S., Collins, A., & Duguid, P. (1989). Situated Cognition and the Culture of Learning. *Educational Researcher, 18*(1), 32-42.

Crawford, B. A. (2007). Learning to teach science as inquiry in the rough and tumble of practice. *Journal of Research in Science Teaching, 44*, 613-642.

Dweck, C. S. (2000). *Self-theories: Their role in motivation, personality, and development*. New York, NY: Psychology Press.

Dweck, C. (2006). *Mindset: The new psychology of success*. New York: Random House, Inc.

Elliot, E. S. & Dweck, C. S. (1988). Goals: An approach to motivation and achievement. *Journal of Personality and Social Psychology, 54*(1), 5-12.

Ertmer, P. A. (2005). Teacher pedagogical beliefs: the final frontier in our quest for technology integration? *Educational Technology Research and Development, 53*(4), 25-39.

Freeman, J. G., Marx R. W., & Cimellaro, L. (2004). Emerging considerations for professional development institutes for science teachers. *Journal of Science Teacher Education, 15*(2), 11-131.

Garet, M. S., Porter, A. C., Desimone, L., Birman, B. F., & Yoon, K. S. (2001). What makes professional development effective? Results from a national sample of teachers. *American Educational Research Journal, 38*, 915-945.

Gerard, L. F., Bowyer, J. B., & Linn, M. C. (2008). Principal leadership for technology-enhanced learning in science. *Journal of Science Education and Technology, 17*, 1-18.

Grant, H. & Dweck, C. S. (2003). Clarifying achievement goals and their impact. *Journal of Personality and Social Psychology, 85*, 541-553.

Hazen, R.M. & Trefil, J. (1992). *Science matters: achieving scientific literacy*. New York: Random House.

Hesse-Biber, S. N. (2010). *Mixed methods research: Merging theory with practice.* New York: The Guilford Press.

Johnson, C. C., Kahle, J. B., & Fargo, J. D. (2007). A study of the effect of sustained, whole-school professional development on student achievement in science. *Journal of Research in Science Teaching, 44*, 775-786.

Ketelhut, D. J. & Schifter, C. C. (2011). Teachers and game-based learning: Improving understanding of how to increase efficacy of adoption. *Computers & Education, 56*, 529-546.

Kolstoe, S. D. (2000). Consensus projects: Teaching science for citizenship. *International Journal of Science Education, 22*, 645–664.

Lederman, N. G. (2007). Nature of science: Past, present, and future. In S.K. Abell & N.G. Lederman (Eds.), *Handbook of research on science education* (pp. 831–880). Mahwah, NJ: Lawrence Erlbaum Associates.

Loucks-Horsley, S., & Matsumoto, C. (1999). Research on professional development for teachers of mathematics and science: The state of the scene. *School science and mathematics, 99*, 258-271.

Milner, A. R., Sendergeld, T. A., Demir, A., Johnson, C. C., & Czerniak, C. M. (2012). Elementary teachers' beliefs about teaching science and classroom practice: An examination of pre/post NCLB testing in science. *Journal of Science Teacher Education, 23*, 11-132.

Pennell, S. & Ewing-Taylor, J. (2012). 21st Century Learning and Teaching through Integrating Technology into Inquiry-Based Professional Development. *In Society for Information Technology & Teacher Education International Conference, 2012, (1),* 2055-2060.

Roberts, D.A. (2007). Scientific literacy/science literacy. In S.K. Abell, & N.G. Lederman (Eds.), *Handbook of research on science education* (pp. 729–780). Mahwah, NJ: Lawrence Erlbaum Associates.

Roehrig, G. H. & Luft, J. A. (2006). Does on size fit all? The induction experience of beginning science teachers from different teacher preparation programs. *Journal of Research in Science Teaching, 43*, 963-985.

Schneider, R. M., & Plasman, K. (2011). Science teacher learning progressions: A review of science teachers' pedagogical content knowledge development. *Review of Educational Research, 81*, 530-565.

Schram, A. B. (2014). A mixed methods content analysis of the research literature in science education. *International Journal of Science Education.* (ahead of print). doi: 10.1080/09500693.2014.908328

Supovitz, J. A. & Turner, H. M. (2000). The effects of professional development on science teaching practices and classroom culture. *Journal of Research in Science Teaching, 37*, 963-980.

Vedder-Weiss, D. & Fortus, D. (2013). School, teacher, peers, and parents' goals emphases and adolescents' motivation to learn science in and out of school. *Journal of Research and Science Teaching, 50*, 952-988.

Yaeger, D. S. & Dweck, C. S. (2012). Mindsets that promote resilience: When students believe that personal characteristics can be developed. *Educational Psychologist, 47*, 302-314.

Yerrick, R., Parke, H., & Nugent, J. (1997). Struggling to promote deeply rooted change: the "filtering effect" of teachers' beliefs on understanding transformational views of teaching science. *Science Education, 81*, 137-159.