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Creating partnerships between teachers & undergraduates interested in secondary math & science education☆

Lauren H. Swanson*, Lorelei R. Coddington

Whittier College, Whittier, CA, USA

HIGHLIGHTS

- Undergraduates and teachers formed partnerships during yearlong program.
- Participation in these partnerships was sustained but flexible over time.
- Participants shared and were viewed as resources within the partnerships.
- Engagement in partnerships was transformative for undergraduates and teachers.
- Participants viewed their involvement in partnerships as beneficial.

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ABSTRACT

During a yearlong program experience, high school teachers and college undergraduates formed three content area partnerships in which they co-planned and implemented lessons aligned to newly adopted math and science content standards. Participants' within-program experiences and the mentorship that occurred in their developing content area partnerships were explored. Findings suggested that both the high school teachers and undergraduates engaged in mentoring relationships that prompted two-way reflection and colearning. The content area partnerships formed were sustained yet flexible, represented accountability through shared goals, exhibited mutual and equitable sharing, and were transformative as evidenced by practice and identity.

1. Introduction

This study explores mentoring relationships within a program designed to connect undergraduates interested in math and science education with practicing high school teachers; together they engaged in content area research and discussed curriculum. In California, where this study took place, math and science teachers are in the midst of curricular change brought forth by the state's adoption of the Common Core State Standards Mathematics (National Governors Association Center for Best Practices, Council of Chief State School Officers, 2010) and the Next Generation Science Standards ([NGSS], NGSS Lead States, 2013). Associated frameworks advocate for the use of mentoring to help teachers understand the shifts in practice called for by these new standards (California Department of Education, 2015; National Research Council, 2012).

The program we investigated was designed to: (1) give all participants experience planning, implementing, and reflecting on curricular materials aligned with the newly adopted state standards; (2) provide high school teachers with classroom support as they enacted new lessons; and (3) provide undergraduates an authentic context in which to learn about the teaching profession prior to enrolling in a teacher education program. Participants attended 102 h of program activities consisting of a two-week summer institute and three full-day follow-up sessions during the academic year. The undergraduates also completed 60 h of fieldwork in the teachers' classrooms during the academic year. With respect to the undergraduate program experience, similar courses and programs have been conducted to stimulate recruitment and teaching interest among math and science

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* Corresponding author. Department of Education and Child Development, Whittier College, 90608, USA.
E-mail address: lswanson@whittier.edu (L.H. Swanson).

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undergraduates (Luft, Fletcher, & Fortney, 2005; Otero, Finkelstein, McCray, & Pollock, 2006) and graduates (Abell et al., 2006).

Guided by the view that learning occurs within communities of practice (Wenger, 1998), we asked: What is the nature of content area partnerships formed between undergraduates and high school teachers participating in a program focused on math and science education? Through this work, we attempt to demonstrate how mentoring through the content area partnerships shaped teachers' and undergraduates' views on mathematics and science education.

2. Mentoring relationships among teachers

Trust and collaboration are essential elements in mentoring (Awaya et al., 2003; van Velzen, Volman, Brekelmans, & White, 2012) along with relational characteristics that foster dialogue and reflective practice (Fairbanks, Freedman, & Kahn, 2000; Hawkey, 1998). In the mentoring relationship, teachers' sense of agency matters in their sharing of knowledge and contributes to the identity development of student teachers (Fairbanks et al., 2000; Hawkey, 1998). Hawkey (1998) recognized teacher knowledge as an important mentoring characteristic and contended that teachers bring their own perspectives to bear on mentoring relationships.

Mentoring partnerships can benefit both teachers and those they mentor. For example, mentoring causes teachers to examine, uncover, and explain their own teaching (Fairbanks et al., 2000; Feiman-Nemser, 2001). According to Koballa, Bradbury, and Deaton (2008), colearning relationships produce "a beginning teacher who feels empowered and a beginning teacher and mentor who grow in their understanding of their teaching practices" (p. 407). Similarly, Woodgate-Jones (2012) noted that two-way learning occurs between teachers and student teachers when student teachers are recognized for their expertise and are contributing members of the partnership. Margolis (2008) found that when effective mentoring partnerships are developed, not only does colearning occur but also teacher mentor revitalization. Through close examination of their practice and sharing their love of teaching, teacher mentors became newly energized.

The elements described in these studies allude to the power of mentoring and its potential to develop knowledge and learning that can be transformative for both mentor and mentee. Yet, while providing insight into the characteristics and benefits of mentorship, much of this work was done with pre-service or practicing teachers, not individuals who have yet to enter a teacher education program. Hawkey (1998) contended that mentoring between teachers and student teachers is complex, highly situated in practice, and dependent on the individuals. Hobson, Ashby, Malderez, and Tomlinson (2009) argued that few studies successfully tease apart benefits from mentoring of pre-service teachers from other aspects of a teacher preparation program. Further, the authors noted mentoring programs are not without cost nor are they free from potential disadvantages for either mentor or mentee. As such, the benefits of mentoring should not be assumed for all individuals entering into such partnerships. Our study seeks to add to this body of literature on mentoring by investigating partnerships between high school teachers and undergraduates pursuing math and science majors/minors, who express an interest in learning about a career in teaching but have not yet committed to a teacher education program.

3. Learning in communities of practice

We view learning as situated in social contexts and believe that a community of practice (CoP) is necessary for teachers to engage in to learn and contribute to the joint enterprise of instructional practice (Lave & Wenger, 1991; Wenger, 1998). Wenger described a CoP along three dimensions: *mutual engagement* whereby members learn through their interactions and relationships with others; *joint enterprise* through which members develop a sense of accountability to one another; and *shared repertoire* which are resources, such as tools, values, ideas, and discourses that assist members in negotiating meaning. Researchers have used this framework to explore the impact of teacher learning in math and science professional development (PD) contexts. Hardré et al. (2013) and Akerson, Cullen, and Hanson (2009) highlighted the positive impact of teachers participating in a CoP including collaboration, increased knowledge and skills, reflection on practice, and the development of a supportive environment. Akerson et al. explored how elementary teachers' views regarding the nature of science shifted as a result of a CoP that developed among participants during a yearlong professional development program. Similarly to Akerson et al., we documented participants' experiences through the use of surveys, interviews, observations, reflections, and artifacts in order to describe the developing content area partnerships.

Within a CoP framework, learning involves engagement in practice and construction of relationships. Like Woodgate-Jones (2012) and Fairbanks et al. (2000), we found Lave and Wenger's (1991) description of new members' involvement in a CoP as legitimate peripheral participation useful when analyzing our participants' within-program experiences. Lave and Wenger used this term to explain the relationships that form within a community. Membership does not equate to assimilation; "[r]ather than a teacher/learner dyad, [participation in a community of practice] points to a richly diverse field of essential actors and, with it, other forms of relationships of participation" (p. 56). All members' contributions are valued and their knowledge and individuality are considered a resource. Both Woodgate-Jones (2012) and Fairbanks et al. (2000) explored Lave and Wenger's (1991) concept of legitimate peripheral participation when describing how student teachers were supported as they began the practice of teaching. In particular, Woodgate-Jones (2012) found the benefits resulting from the legitimate peripheral participants' relationships are mutual, "which implies that the arrangement is not only of benefit to the apprentice, but the master/community can benefit too" (p. 151). Framing the mentoring that occurred between a student teacher and teacher as a CoP allowed the authors to capture the coinquiry and colearning that resulted. We too used a CoP framework to inform our investigation of mentorship within the content area partnerships that formed between teachers and undergraduates.

4. Research context

Currently, there are various teacher preparation routes in the United States. According to Bowe, Braam, Lawrenz, and Kirchhoff (2011), the two most common are "traditional" and "alternative" programs (p. 29). Traditional programs, also known as university-based programs, require four to five years of teaching preparation and include coursework to meet state standards certification (Darling-Hammond, Chung, & Frelow, 2002; Zeichner & Schulte, 2001). Students in traditional programs may also be in a combined program that includes both undergraduate and graduate studies, or a graduate program. On the other hand, alternative programs offer post-baccalaureate students abbreviated preparation over a few weeks or a summer allowing students to enter with full responsibility for teaching with minimal preparation. In most cases, 1- or 2-year post-baccalaureate alternative programs require "ongoing support integrated coursework, close mentoring, and supervision" (Darling-Hammond et al., 2002, p. 287).

The program within which this study was situated provided