Building Community in Triads Involved in Science Teacher Education: An Innovative Professional Development Model

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Abstract

This article describes a pre-service and in-service science teacher joint professional development pilot project. It is intended to strengthen the community and facilitate professional growth for triad members involved in the professional development of pre-service science teachers. Through a summer workshop and follow-up monthly meetings, this project connected the clinical experiences of the pre-service teachers with the joint professional development of both the pre- and in-service teachers. A mixed-methods research design was used to investigate the impact of this project. Results indicated that this model was successful in aligning with characteristics of effective professional development derived from national standards documents and professional development literature. Additionally, through engaging pre- and in-service teachers in the co-creation of modules, which were subsequently enacted in classrooms, collaborative positioning occurred whereby the pre- and in-service teachers were found more equally sharing and co-negotiating responsibilities in the classroom. This article describes the need for this project and provides an in-depth description of each component of the project enacted, as well as additional findings supportive of its effectiveness.

Keywords: professional development, pre-service science teachers, in-service science teachers, triads

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Introduction

The National Research Council (NRC), the American Association for the Advancement of Science (AAAS), and the National Science Teachers Association (NSTA) all recognize and promote student inquiry in the science classroom as a central strategy for instruction at all grade levels (NRC, 1996; AAAS, 1993; NSTA, 2004). Inquiry, as described in the National Science Education Standards allows students to “describe objects and events, ask questions, construct explanations, test those explanations against current scientific knowledge, and communicate their ideas to others” (NRC, 1996, p. 2). And, the alignment of inquiry as an instructional strategy is seen as compatible with constructivist principles grounded in more current educational learning theory. But, while major national organizational influences promote student inquiry in the classrooms, O’Sullivan and Weiss (1999) found that sixty-nine percent of U.S. high school seniors reported “never or hardly ever designing and carrying out their own experiments” in science classrooms (p. 262). Additionally, similar shortcomings are reported in current science experiences such as in *America’s Lab Report: Investigations in High School Science* (NRC 2005) and in Campbell’s and Bohn’s (2008) article as articulated in the same western state where this professional development pilot project took place. While the focus of this project is on inquiry in science education, the investigative results of this research and the targets (i.e. science teacher professional development) in this pilot project may apply to other fields (e.g. Social Studies education, English education), in their constructivist-based pedagogies. So, while science education is discussed in detail throughout this paper, it is believed that broader application considerations are also appropriate.

As pre-service science teachers enter classrooms for practicum experiences, they too experience first-hand the differences between constructivist-based reforms in science education outlined in national standards documents (NRC, 1996) and current teaching practices in schools. As an example, Fazio and Volante (2011) found that pre-service science teachers perceived some constructivist-learning environment factors present in practicum classrooms, however, for the most part, the co-operating teachers in the study, were not applying or supporting a critical constructivist perspective along with aligned innovative practice. For pre-service teachers, these experiences coupled with the powerful influence of a mentor’s/cooperating teacher’s beliefs and teaching approaches, potentially out-of-step with reform efforts, are cause for concern (Hewson, Tabachnick, Zeichner, & Lemberger, 1998; Erickson, Mayer-Smith, Rodriguez, Chin, & Mitchell, 1994).

Additional complications and considerations often arise in practicum experiences as members of triad (university supervisor, mentor/cooperating teachers, and pre-service teachers) work to position themselves within the triads (Bullough & Drapper, 2004; Campbell & Lott, 2010). Recognizing the seriousness of these problems, Hewson et al. (1998) suggest making certain that mentors/cooperating teachers are continually offered opportunities to learn and grow, while van Zee, Lay, and Roberts (2003) suggest increasing the opportunities for collegial exchange between members of triads.

Through engaging in practicum and student teacher supervision, many experience the dynamics of triads that are established to facilitate clinical experiences. As part of professional development for pre-service teachers, education researchers recognize the

important influence of the mentor/cooperating teacher and understand the benefits that can emerge if collaborative climates are fostered within triads (Campbell & Lott, 2010). This article describes a professional development project that was initiated to build community in triads and foster the professional growth of both pre- and in-service teachers, while also providing findings from research into the effectiveness of the project model.

Background

The Need for a Joint Pre- and In-service Professional Development Model

Assertions that inquiry instruction, although supported as an instructional strategy by research (Chang & Mao, 1999; Ertepinar & Geban, 1996; Hakkarainen, 2003; Khishfe & Abd-El-Khalick, 2003; Schwartz, Lederman, & Crawford, 2004) and leading national organizations (AAAS, 1993; NRC, 1996; NRC, 2005; NSTA, 2007), is not being employed in science classrooms (Campbell & Bohn, 2008; NRC, 2005; O'Sullivan & Weiss, 1999; Windschitl, 2003). In this section, a connection will be made between the need for an increased focus on inquiry instruction with the utility of a model of professional development that partners in-service and pre-service teachers.

Current Approaches to Professional Development Experienced by In- and Pre-service Teachers.

Professional development programs encountered by in-service teachers in schools have often received criticism because they are typically brief in nature, and lack continuity and adequate follow-up (Fullan & Steigelbauer, 1991; Lewis, Parsad, Carey, Bartfai, Farris, & Smerdon, 1999; Mullins, Leighton, Laguarda, & O'Brien, 1996). When the National Center for Educational Statistics (NCES, 2001) surveyed over 5,000 teachers from 50 states and the District of Columbia in 2000, their findings revealed that few teachers reported,

[T]hat their professional development was linked to other program improvement activities at their school to a great extent . . . [and] of the few teachers reporting that their professional development was followed by related school-based activities, even fewer of these were connected to activities where teachers helped others to put new ideas to use (2001, p. 6).

Additionally, when current approaches to professional development experienced by pre-service science teachers are examined, the following problems have been identified:

- As pre-service science teachers enter classrooms for practicum experiences, they witness firsthand the differences between current reforms in science education and current teaching practices in schools (Hewson, Tabachnick, Zeichner, & Lemberger, 1998).

- The hierarchical model of interaction between university educators and in-service is historical, perpetuated through models of professional development while neglecting the teacher's role (Carlone & Webb, 2006). It discourages opportunities for the pre-service teacher to engage in "coteaching/cogenerative dialoguing" or collaborative teaching and discussion as outlined by Roth, Tobin, Zimmermann, Bryant, and Davis (2002).
- Pre-service teachers receive little, if any, mentoring as they enter in-service science teachers' classrooms (Hudson & Skamp, 2002). Hudson and Skamp (2002) found that mentoring can be central to improving science education, yet they were hard pressed to find such actions occurring in science classroom where pre-service teachers had been placed.

In Canada, more recently, researchers such as Ciuffetelli-Parker, Fazio, Volante, and Cherubini (2008) explore possible school-university partnerships aimed at developing more cohesive teacher preparation programs that address many of these in- and pre-service professional development concerns. Similar to the work of these researchers, this current research also addresses relationship development, maintenance, and relational intricacies in establishing and maintaining school-university partnerships while supporting professional growth programs involving pre-service and in-service teachers.

Disparity Between Current Approaches to Professional Development and Professional Development Research.

As the historical approaches to professional development are examined, one problem identified for in-service teachers is the lack of cohesion between what is learned in workshops and what is expected and typically done in classrooms. This problem is worsened when professional development experiences are not linked to, or supported through classroom experiences integrating new materials, methodologies, and practices into the everyday experiences of teachers (Costenson & Lawson, 1986). Current research in professional development supports the seamless integration of professional development experiences with classroom experiences designed to allow participants to examine the basis of what is being learned or created in the context that it will be employed (Lemke, 2001; Birman, Desimore, Porter, & Garet, 2000; Carlone and Webb, 2006; Stein, Smith, & Silver, 1999; NRC, 1999; NRC, 2001). Carlone and Webb (2006) argue that, "[i]nnovative approaches to professional development take seriously teachers' knowledge goals, context, voice, and experience" (p. 546). This is best accomplished by viewing the professional development of teachers through a transformative lens as a process whereby teachers develop teaching practices that are shaped by standards and knowledge that is garnered from practice (Wenger, 1998).

Innovative approaches to professional development focus on the construction of knowledge through the circuitous routes taking place within the context of the professional development participants' experiences. This acknowledges that "learning to teach involves cognitive engagement" (Neubert and Stover, 1994, p. 12) as opposed to a deficit model of professional development that views in-service teachers as in need of external help so that they can learn teaching practices better than those they currently use.

These approaches do not yield complete authority to the experienced teacher, nor do they blindly accept the authority of the remedies and prescriptions of the outside expert (McIntyre & Hagger, 1992). Innovative approaches to professional development allow teachers to examine “basic questions about what it means to be a teacher” (NRC, 2001, p. 80) through connecting the professional development experience with the classroom. The NCES (2001) survey referenced earlier points out the problems currently found in linkages between professional development and other activities fostering the teacher’s ability to implement new practices in the classroom. These results illuminate disparity between what is currently happening and research on professional development.

Literature in professional development also acknowledges the benefits that can emerge from “teacher assistance embedded in or directly related to the practice of teaching” (Stein, Smith, & Silver, 1999, p. 239) or activities such as coteaching, coplanning, mentoring, and reflection on lessons and practice with colleagues (Roth, et al., 2002). This is closely aligned with research previously mentioned in calls for innovative professional development focused on the local context of teachers (Carlone & Webb, 2006; Shroyer & Enochs, 1987). Research completed regarding the effectiveness of coteaching has demonstrated learning gains for coteachers, whether these were new teachers, veteran teachers, or in-service teachers (Roth, Masciotra, & Boyd, 1999; Tobin, 1999), but according to NCES (2001) data, few teachers reported opportunities to help other teachers put new ideas to use.

The *National Science Education Standards (NSES)* (NRC, 1996), as well as other research (Birman *et al.*, 2000; Carlone & Webb, 2006), stresses the importance of movement away from a one-shot approach to professional development and toward long-term views that focuses on “[i]nquiry into teaching and learning” (p. 72). Current conditions reported by NCES (2001) and Porter, Garet, Desimone, Yoon, & Birman (2000) indicate that to a large extent this is not happening. Additionally, a survey of principals, staff, and teachers indicated that “primary responsibility for deciding the content of professional development activities, designing and planning activities, and conducting activities rests most commonly with district staff or principals” (Choy, Chen, & Bugarin, 2006, p. iv). These findings also contradict the position taken in the *NSES* (NRC, 1996) whereby emphasis is placed on “teachers as source and facilitator of change . . . teacher as leader . . . teacher as producer of knowledge about teaching” (p. 72). If teachers are to become leaders, the source of change, producers of knowledge about teaching and given responsibility for deciding content, planning, and conducting activities, then they need to be included as collaborators with principals, staff, teacher educators, and others involved in professional development (NRC, 1996).

While much of the research pertaining to the professional development of in-service teachers is applicable to pre-service teachers, the problems currently experienced by pre-service teachers only serve to exacerbate an already difficult period for pre-service science teachers as they struggle to learn to teach and form their professional identities. Examples of some of the most influential problems experienced by pre-service teachers are the disconnect between what is taught in their teacher education program and what is experienced in schools, positioning within triads, and a traditional hierarchal model predicated on unequal power distributions inhibiting collaboration between members of triads.

Given the current state of science education outlined specifically, and education more broadly and the need for professional development for both pre- and in-service teachers, a joint pre-service and in-service teacher professional development project was seen as a fitting mechanism for addressing these teachers' needs.

A Professional Development Project for Pre- and In-Service Teachers

The *Chautauqua Model Professional Development (CMPD)* program was originally developed with National Science Foundation (NSF) funds in 1983 (Kimble Yager, & Yager, 2006). The pre- and in-service professional development model described in this article emerged from the *CMPD* model. More about the history and effectiveness of the *CMPD* are described next before specifics about the pre- and in-service model is described in detail.

Although the *CMPD* was developed prior to the release of the *National Science Education Standards (NSES)* (NRC, 1996), it incorporates those shifts in professional development called for in the *NSES* professional development standards and has the essential components of professional development including the incorporation of practice, implementation, feedback, and follow-up (Gusky, 1995; Joyce & Showers, 1980; Sparks 1983; Wood & Thompson, 1980). A few examples of the shifts in professional development practices present in the *CMPD* include:

- integration of theory and practice in the school setting through the implementation of a fall and spring, teacher created modules,
- collegial and collaborative learning through co-planning instructional modules and sharing the results of the implementation,
- staff developers acting as facilitators, consultants, and co-planners as they interact to help build collegial communities of teachers, and
- teachers seen as intellectual reflective practitioners with the freedom, responsibility, and support for designing modules as well as assessment programs.

Several studies have been completed to assess the effectiveness of the *CMPD*. Among these, specific studies investigated changes in teacher perceptions and practices as a result of their involvement in the *CMPD* (Blunck, 1993; Dass, 1997; Liu, 1992). Among other things, this research revealed that *CMPD* teachers' better developed the capacity to:

- ask more questions
- dispense less information
- use more student questions to drive discussions
- spend more time using student questions to drive discussion

- spend less time at the front of the classroom “before” the students
- spend more time interacting with individual students (Lui, 1992).

Additionally, teachers participating in CMPD models were found to develop increased capacities for working with other teachers, administrators, parents, community members, and outside experts. These are only a few of the findings that support the effectiveness of the CMPD and the important potential benefits this model provides to support triad collaborations that were the focus of the professional development presented here. Because of the established success and important research supported benefits of the *Chautauqua Model of Professional Development (CMPD)*, it was selected to inform the development of the model of professional development that was initiated and described here.

The Pre- and In-Service Professional Development Model

Like the *Chautauqua Model for Professional Development (CMPD)*, the pilot pre- and in-service professional development model started with a summer workshop and extended through the fall semester of the pre-service teachers clinical experiences. The project consisted of 24 contact hours during a summer workshop and 6 contact hours spread out over four monthly meetings, for a total of 30 contact hours. In comparison to the CMPD model, this number of contact hours were reduced because of (a) the pilot nature of the project and (b) pre- and in-service teacher availability. In addition to the summer workshop and monthly meetings, e-mail correspondence, weblog postings, and three classroom visits throughout the project were also used to support additional interactions between and across triads.

During the summer workshop participants met one day a week for three weeks in June and July. Monthly meetings followed this, along with regular classroom visits. The monthly meetings were facilitated with webconferencing technologies that allowed the pre- and in-service teachers to participate from the in-service teachers' classrooms. Activities central to this project were (a) pre-service and in-service mentoring teacher groups revising and implementing curriculum in the mentoring teachers' classroom during the clinical experience and (b) pre-service and in-service mentoring teacher groups completion of a collaborative inquiry project investigating one aspect of science teaching and learning. All activities in the summer workshop, monthly meetings, and classroom visits were designed to support participants in their implementation of revised curriculum and completion of collaborative inquiries.

Summer workshop. Prior to the summer workshop, the mentoring/cooperating teachers were contacted and asked to identify one module that was currently part of their curriculum that they were not satisfied with, either because of poor student response or concern over student learning. The identified modules provided the focal point for module revisions between paired pre- and in-service teachers. During the summer workshop, the paired groups revised the modules, peer taught portions of these modules

to other project participants, further revised and finalized these modules in preparation for implementation during the Fall in the in-service teachers classrooms.

Collaborative inquiries were also included in the summer workshop because they were perceived as a mechanism that could facilitate participants seeing themselves as producers of knowledge about teaching and learning (NRC, 1996). Emily van Zee was the guest speaker who helped introduce and organize these whereby “[t]he prospective teachers [clinical students] work in small groups to design . . . small educational research projects to conduct in collaboration with practicing teacher researchers” (van Zee, Lay, & Roberts, 2003, p. 591). van Zee, Lay and Roberts (2003) explain that “[t]his complex process makes possible a rich collaboration among prospective, beginning, and experienced teachers who are researching their own science teaching practices” (p. 519).

Monthly meetings and classroom visits. The monthly meetings were held once each month for 1 ½ hours in the evenings after school. Webconferencing was used to facilitate these meetings, so that the mentoring teacher and pre-service teacher from each triad could gather in the mentoring teacher’s classroom after school to meet with the other project participants. Classroom visits were completed three times during the fall semester.

Through the planned implementation of the revised modules in the classrooms, teachers were not only afforded the opportunity to implement new ideas and practices (Bell & Gilbert, 1996; Costenson & Lawson, 1986), but the monthly meetings also allowed for continued teacher assistance embedded in practice for participants beyond the summer workshop (Stein, Smith, & Silver, 1999).

As with any professional development project, idiosyncratic problems and concerns were expected and did arise (Akerson & Hanuscin, 2007; Loucks-Horsley, Hewson, & Love, 2003). These are identified and discussed in the findings from research completed to investigate the effectiveness of this model.

Methods

Design

A mixed-methods design was used to investigate the effectiveness of the professional development model. The mixed methods design relies on multiple approaches, rather than restricting, or constraining, researchers’ choices to the exclusive benefits of quantitative or qualitative designs alone. Johnson and Onwuegbuzie (2004) argue that the methodological pluralism of mixed methods research frequently results in superior research when compared to quantitative or qualitative methods alone. In this research, deductive quantitative methods combine with the inductive qualitative method to reveal the level of effectiveness of the professional development model and underlying emergent explanations for this level of effectiveness respectively.

Data Sources

Two data sources were used to assess the effectiveness of the pre- and in-service professional development model piloted as an initial group of two triads engaged in the

model: 1) post workshop participant surveys administered at the conclusion of the piloted project and 2) a secondary case study (Campbell & Lott, 2010). The post-workshop participant surveys served as the basis of the quantitative investigation whereby descriptive statistics were used to determine the effectiveness of the professional development model. The emergent findings from a qualitative secondary case study (Campbell & Lott, 2010), a complementary research study completed prior to this current study, was used to further explicate the underlying factors influencing the effectiveness of the professional development model.

Research Instrumentation and Strategies

A post workshop survey was used as primary data sources for the quantitative component of the mixed methods design. The post workshop survey was a three-part survey. Part one of the survey was developed as a rubric derived from the *National Science Education Standards* (NRC, 1996), and *Evaluating Professional Development* (Guskey, 2002). This provided a means for assessing the extent to which the professional development program used the characteristics of quality professional development to assist science teachers. Part two of the survey was developed to assess the materials, learning environment, meaningfulness of the experience, and implementation expectations. Part three, the final part of the survey, contained open-ended questions to solicit the most valued aspects of the professional development and opportunities for improvements to the professional development. Because the university supervisor in both triads also served as the professional development provider and researcher, no post workshop surveys were collected for this member of the triads, but this member was a central informant in the secondary case study findings presented from Campbell and Lott (2010).

The secondary case study (Campbell & Lott, 2010) was a phenomenological qualitative study completed to investigate positioning occurring in triads. The emergent findings reported in the earlier study were coordinated with the quantitative findings in this study to provide depth of explanation regarding the effectiveness of the professional development. More about the methods used in the secondary case study can be found in Campbell and Lott (2010).

Findings and Discussion

Post Workshop Participants Surveys

Part one of the post workshop survey contained eleven indicators that were rated on a three-point scale (i.e. Least Effective-1, Somewhat Effective-2, Most Effective-3). The descriptive statistics for part one are found in Table 1.

Table 1.

Post Workshop Survey Part One

Indicator	Avg. (N=4)
Professional Development Quality Indicator	2.5
Professional developer presents clear goals relative to the knowledge and skills to be gained by participants (Guskey, 2002)	3
Duration/spacing of professional development (NRC, 1996)	3
Delivery mode includes theory, practice, coaching, and feedback (Guskey, 2002)	2.75
Integration of science and teaching (NRC, 1996)	3
The learning environment (NRC, 1996)	3
Source of expertise (NRC, 1996)	3
Role of professional developer (NRC, 1996)	3
Role of teacher (NRC, 1996)	3
Source of knowledge about teaching (NRC, 1996)	3
Teachers role outside the classroom (NRC, 1996)	3
Teachers role in change (NRC, 1996)	3

As evidenced by the average score of 2.5-3.0 for each indicator in comparison to the total possible score of 3.0 on each indicator, the workshop participants reported that the piloted model was very much aligned to the characteristics of quality professional development outlined by the National Research Council (1996) and Gusky (2002).

Part two of the post workshop survey was rated on a scale from -2 to +2 (i.e. Strongly Disagree [-2], Disagree [-1], Neutral [0], Agree [1], Strongly Agree [2]). The descriptive statistics for the six indicators in part two are found in Table 2.

Table 2.

Post Workshop Survey Part Two

Indicator	Avg. (N=4)
The materials used enhanced the learning process.	1.5
The environment was conducive to my learning.	1.5
I was engaged in meaningful learning.	1.75
I found the content to be relevant to my work.	1.75
I believe I will incorporate my new knowledge and skills into practice.	1.75
I believe the implementation of the skills and knowledge presented will positively impact school improvement.	1

Because of the maximum possible score aligning with strongly agree for each indicator and the emergent averages for each of the indicators ranging from 1.00-1.75, this part of the survey revealed an overall positive response from the participants with respect to the materials, learning environment, meaningfulness of the experience, and implementation expectations included and supported by the model.

The following are a few common ideas shared by participants from part three of the survey in their own words regarding the facets of the professional development model most valuable:

[The University Supervisor's/Professional Development Provider's] very strong belief in inquiry based science teaching. Also important was the idea that teachers can do valid and meaningful educational research right in their own classrooms;

Implementation of the module was most valuable;

Collaboration with other educators.

In addition, responses from part three of the survey revealed the following with respect to important additional topics that they felt could be targeted for improvement in future iterations.

A little more on ways to share research with other teachers would be helpful.

More discussion and emphasis on standards [National Science Education Standards] and their role in the curriculum and their relation to the state curriculum.

Based on the post workshop surveys reported here, the professional development model was effective because it included components of effective professional development previously identified in the literature (e.g. teachers as producers of knowledge (NRC, 1996), implementing new ideas and practices (Bell & Gilbert, 1996; Costensons & Lawson, 1986)). Additionally, as suggested in the literature, idiosyncratic problems and concerns were expected and did arise (Akerson & Hanuscin, 2007; Loucks-Horsley, Hewson, & Love, 2003) (e.g. more connection between standards and state curriculum).

The second source used to assess the effectiveness of the pre- and in-service professional development in the mixed methods design (Campbell & Lott, 2010) revealed the following with respect to the positions and influences found shaping positions occurring in triads:

- Mentoring teachers and clinical students in both triads assumed positions as collaborators.
- Collaborative positions were found connected to the projects in the professional development that promoted participants' synthesis of products (curriculum revision/implementation and collaborative inquiries).
- Social forces such as classroom possession, relationships, and trust were all found important in the positions assumed and connected to the storyline of participants on a journey to learn more about teaching and learning in science.
- Fluidity of positioning was found as mentors oscillated between mentoring and collaborative positions (p. 349).

In addition to the findings reported by Campbell and Lott (2010), the following recommendations were put forth from the case study to inform future iterations of the pre- and in-service professional development model:

- Include projects in joint professional development that promotes participant synthesis of products as they enlist what they are learning,
- Ensure that adequate time is allotted for the professional development to facilitate the establishment of trust and relationships, and
- Ensure that professional development expectations are clear so that visions align among participants. (p.349)

Finally, this model of professional development benefitted the professional growth of the university supervisor. This occurred through increased opportunities to (a) identify and develop more effective mechanisms for working collaboratively with pre- and in-service teachers, (b) co-develop curriculum modules, and (c) facilitate the professional growth of all members of the triad (Campbell & Lott, 2010).

Conclusion

There are many avenues of support than can occur to assist pre-service teachers as they move from roles as students in teacher education programs to early career teachers. In Canada, programs such as The New Teacher Induction Program (Ministry of Education Ontario, 2010) see the importance of supporting pre-service teachers beyond their teacher education programs. The professional development model described and investigated here is positioned to extend models already being established in Canada (e.g. school-university partnerships, Ciuffetelli-Parker, Fazio, Volante, and Cherubini (2008)) and to provide even better support leading into the first year induction program (Ministry of Education Ontario, 2010). By working to move beyond only peripherally including the in-service cooperating teachers that are so influential, this approach seeks to extend the professional development experienced in the teacher education classrooms to the clinical classrooms. This increases the effectiveness of the professional development of pre-service teachers, while also creating professional development opportunities for the in-service teachers. Even though exploration of the joint professional development model is in its infancy, and much can and should be considered in moving forward, the following assertion offered by one of the pre-service teacher participants in the pilot project provides a snapshot of what can be accomplished and is one among several reasons for moving forward:

The Professional Development Seminar . . . helped me visualize myself as a real teacher . . . I was able to feel like a part of something that could affect change and make a difference in the lives of students. My opinion and ideas were considered on the merits of being an intelligent, thoughtful person with significant contributions to share, not simply a student. (Campbell & Lott, 2010, p. 349)

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