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Preparing Pre-Service School Librarians for Science-Focused Collaboration with Pre-Service Elementary Teachers: The Design and Impact of a Cross-Class Assignment

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Abstract

Numerous authors in the library and information science (LIS) field have called for more authentic collaborative experiences for students in school librarian education programs, particularly experiences that partner school library students with pre-service teachers to collaboratively design instruction. The first-iteration, design-based study described below examines the impact of such a project, a collaborative science-focused lesson plan assignment given to pre-service elementary school teachers (PSTs) and pre-service school librarians (PSLs) at a public university in the southeastern United States. Specifically, this paper explores the impact of the project on school library students' understanding of collaboration between teachers and school librarians, particularly science-focused collaboration, and examines the features of the assignment that either facilitated or hindered their progress toward improved understanding. Based on the results of this project, we provide recommendations for school librarian educators interested in designing and implementing similar projects.

Introduction

Both the K–12 education community and the school library community emphasize the critical role that collaboration among educators can play in student learning. In the education field, teacher collaboration is a key component of President Obama's framework for teacher professionalization (U.S. Dept. of Ed. 2013), is one of the core propositions for what teachers should know and be able to do according to the National Board for Professional Teaching Standards (1989), and is at the heart of a wide variety of school-reform efforts including

Professional Learning Communities (PLCs), team teaching, and the small-schools movement (Supovitz and Christman 2005; Vescio, Ross, and Adams 2008). In the school library field, teacher-librarian collaboration (TLC) across subject areas and across all roles of the school librarian is heavily emphasized in the most recent set of national professional standards (AASL 2009), which mentions collaboration roughly fifty times.

However, despite this emphasis on collaboration in both fields, empirical research in the school library field has found that, for a variety of reasons, TLC is still infrequent in many, if not most, schools (Lindsay 2005; Montiel-Overall and Jones 2011; Montiel-Overall 2005b; Todd 2008). Further, evidence suggests that what collaboration does occur between teachers and school librarians is unevenly distributed across academic subject areas, with science-focused TLC being particularly rare (Hoffman and Mardis 2008; Schultz-Jones and Ledbetter 2009).

Along with school-based factors such as lack of time and lack of teacher awareness of school librarians' collaborative roles, the role that pre-service programs for teachers and school librarians might play in developing future educators' collaborative competencies and motivation to collaborate has also been explored for its relationship to the frequency and quality of collaboration between teachers and school librarians (e.g., Asselin and Lee 2002; Dow, Davis, and Vietti-Okane 2013; Moreillon 2008, 2013). A number of LIS (library and information science) articles have suggested that one possibility for improving the quality and authenticity of pre-service education related to TLC might be the design and implementation of interdisciplinary projects that reach outside of LIS programs to partner pre-service school librarians with pre-service classroom teachers (Latham, Gross, and Witte 2013; Neuman 2001; Tilley and Callison 2001). Yet if such projects have been attempted, their design and impacts have not yet been described in published literature. The design-based study described below addresses this gap by investigating the impact of a collaborative science-focused lesson plan assignment given to pre-service elementary school teachers (PSTs) and pre-service school librarians (PSLs) at a public university in the southeastern United States. While the full study investigated the effect of this assignment on both pre-service school librarian and pre-service teacher participants, this paper will focus only on the project's impact on students studying to become school librarians ("school library students"). We hypothesized that this assignment would lead to a greater understanding of teacher-librarian collaboration, particularly science-focused TLC, among these school library students. By "understanding," we mean participants' personal definitions of TLC as well as their awareness of the process of collaboration, including issues or barriers that might arise during the collaborative process. Specifically, this paper addresses study results related to two research questions:

- Research Question 1: How does the collaborative lesson plan design project change pre-service school librarians' understanding of teacher-librarian collaboration, especially science-focused teacher-librarian collaboration, and what specific features of the project contribute to these changes?
- Research Question 2: What issues emerge during the collaborative process, and how do participants address those issues?
    - Subquestion 1: Do any issues emerge during the collaborative process that are specifically related to the assignment's focus on science content, and how do participants address those issues?

Literature Review

Collaboration Defined

Unlike in the general education field, where no single definition of teacher collaboration has been dominant (Friend 2000; Schmoker 2004; Welch 1998), in the school library field there is fairly widespread agreement about what instructional collaboration between teachers and school librarians is and what it looks like in practice. Patricia Montiel-Overall's definition of TLC is often cited:

> a trusting, working relationship between two or more equal participants involved in *shared thinking*, *shared planning*, and *shared creation of innovative integrated instruction*. Through a shared vision and shared objectives, student learning opportunities are created that integrate subject content and information literacy by co-planning, co-implementing, and co-evaluating students' progress throughout the instructional process in order to improve student learning in all areas of the curriculum. (2005a, 32, emphasis in original)

Several models have been proposed to delineate different types or levels of collaboration, acknowledging that the intensity, duration, and nature of individual collaborative partnerships may vary (Dickinson 2006; Loertscher 2000; Marcoux 2007; Montiel-Overall 2005a). These models lack a consistent terminology for different levels or forms of collaboration; for example, "coordination" is the term applied to the lowest (least intense) level of TLC in Montiel-Overall's model but to the second-highest level in Marcoux's model. Despite these differences of vocabulary, the similarity of these models in terms of their organization and how they describe the lowest and highest levels of collaboration between teachers and school librarians testifies to the relative uniformity of the concept of collaboration in school library literature as compared to education literature. To maintain internal consistency, Montiel-Overall's model of TLC and its corresponding terminology is used in this study and discussed in more detail below.

In addition to sharing a fairly consistent conceptual understanding of what teacher-librarian collaboration is, researchers and policymakers in the school library field also share a conviction, supported by empirical research, that collaboration is beneficial for student achievement, for teachers' and librarians' professional development, and for the school library program in general. Among other benefits, researchers have posited that collaboration among educators (including school librarians) can:

- help reduce the complexity of teaching and learning (Darling-Hammond 2006; Friend 2000; Little 1990; Montiel-Overall 2005a),
- create a sense of community within a school (Barlow 1991; Evans-Stout 1998; Schmoker 2004),
- build individual teachers' knowledge and be an effective method of professional development (Moolenaar 2012; Vescio, Ross, and Adams 2008),
- provide students with models of the collaborative process, which may help students develop 21st-century skills that effectively transfer from school to the workplace (Montiel-Overall 2005a; *American Libraries* 2014),
- increase student learning and student achievement (Goddard, Goddard, and Tschannen-Moran 2007; Moolenaar, Sleegers, and Daly 2012; Van Garderen, Stormont, and Goel

2012; Lance, Rodney, and Schwartz 2010; Rodney, Lance, and Hamilton-Pennell 2002), and

- create advocates for the school library program among teachers, students, and parents who have experienced positive impacts of teacher-librarian collaboration (*American Libraries* 2014).

Despite these and other posited benefits, collaboration between teachers and school librarians is not universally practiced, due, in part, to a number of barriers affecting practitioners at all grade levels and in all content areas. Time constraints on teachers and school librarians (Lindsay 2005) and the longstanding culture of isolation and autonomy among teachers (Hartzell 1999) are frequently cited as impediments. Another often-cited obstacle to teacher-librarian collaboration is teachers' and administrators' lack of understanding of school librarians' instructional and teaching roles (Hartzell 2002; O'Neal 2004; Miller 2005; Kimmel 2011). In addition to these general barriers to TLC, grade-level or subject-specific barriers have also been investigated, including those that may act to prevent or limit science-focused TLC.

TLC in Science

Although many leaders in the LIS field have presented compelling rationales for school librarians to improve the quality and quantity of their collaborations with science teachers, science-focused instructional collaboration between school librarians and teachers remains rare (Hoffman and Mardis 2008; Schultz-Jones and Ledbetter 2009). Marcia A. Mardis stated, "No other context is as underappreciated as a revolutionizing force in science learning as school libraries," noting that despite high-profile national efforts to improve science education in the United States, "we cannot educate enough scientists to meet our national needs, our children are not inspired to learn about science, and [school librarians] lack the collections and collaborations to motivate more and better science learning" (2009, 10).

Many authors and organizations have enumerated reasons for school librarians to attend to this issue. Chief among these reasons is the emphasis that national standards for school librarians now place on collaboration with classroom teachers in all subject areas as the primary way for school librarians to teach the information-literacy curriculum (AASL 2009). Thus, it is a professional expectation that school librarians work with science and math teachers in addition to teachers in the humanities and social sciences. Second, several authors have noted strong similarities between science and information literacy (e.g., Abilock 2003; Schultz-Jones 2010; Young 2013), observing that both disciplines emphasize discovery and inquiry, teach similar process and research skills, and encourage the development of student dispositions such as resilience, critical stance, curiosity, and social responsibility.

School librarians and classroom teachers share responsibility for the general absence of science-focused TLC. On the school library side, many school librarians come from humanities backgrounds and may lack science content knowledge, and, therefore, may feel unprepared to collaborate with teachers in science content areas (Mardis 2005; Hoffman and Mardis 2008). Contributing to this lack of science knowledge and confidence among school librarians is the fact that professional journals in the school library field rarely publish substantive articles related to science (Mardis 2006). School librarians may also perceive among science teachers a lack of interest in collaboration with librarians (Schultz-Jones and Ledbetter 2009). On the teacher side of the spectrum, secondary science teachers may be particularly reluctant to invest time in collaborative efforts because a comparatively high percentage of them are teaching out-of-field (meaning that they do not hold a degree or full credential in the subject they are teaching) or

have entered the teaching profession without an academic background in education; thus, these teachers might be struggling to keep up with the daily demands of practice (National Science Board 2012). In elementary schools, the analogous issue is that many teachers enter the field with little previous experience in science and have low self-confidence in their own scientific knowledge and ability (Tosun 2000; Appleton 2006). This factor, along with increased emphasis on the tested subjects of reading and math, may contribute to the diminishment of instructional time for teaching science in the elementary setting (Goldston 2005; Griffith and Scharmann 2008) and, thus, fewer opportunities for TLC on science-themed lessons and units.

Pre-Service Interventions

Some studies have attempted pre-service interventions with either teachers or school librarians (but, notably, not both). These interventions focused on improving students' understanding of teacher-librarian collaboration and/or the school librarian's instructional roles, although none of these studies have focused specifically on science collaboration. Given ample evidence suggesting that pre- and in-service teachers are largely unaware of the collaborative and instructional roles of school librarians (e.g., Hayden 2000; Kimmel 2011; Miller 2005), it is unsurprising that most of these articles on pre-service interventions focus on improving pre-service teachers' knowledge of the training, expertise, and roles of the school librarian. In the school library field several anecdotal articles have been published that describe this type of intervention (e.g., Church 2006; Roux 2008; Wallin and Small 2012). In addition, empirical studies have investigated course-based efforts offered in schools of education to improve pre-service teachers' understanding of the school librarian's instructional role (Asselin and Lee 2002; Asselin 1999, 2000; Dow, Davis, and Vietti-Okane 2013; Moreillon 2008). However, while all of these courses in some way exposed pre-service teachers to practicing or former school librarians, none involved partnering pre-service teachers with pre-service school librarians or other forms of cross-class collaboration.

Comparatively few studies have examined pre-service education for school librarians related to collaboration, despite evidence that in-service school librarians are often reluctant to embrace, or even practice, the instructional partner role (Todd 2008). Joette Stefl-Mabry and Jennifer Goodall Powers (2005) reported anecdotally on a study in which graduate students in a school library program were paired with undergraduate students in a Web-development course to create short, technology-rich curriculum units that addressed a genuine student need as submitted by practicing K–12 school librarians in the area. Judi Moreillon (2013) conducted a content analysis of three sections of an online LIS graduate course focused on the school librarian's instructional partner role to see which features of the course impacted students' development of this role. Students reported that the requirement to work collaboratively with three to four classmates over the course of the semester played the largest part in supporting their personal development of this role. Candidates also noted that a collaborative lesson planning assignment, completed in pairs, supported them in this role. The majority of the students enrolled in this course—but not all—were current or former classroom teachers, so the course did offer opportunities for school library students without teaching experience to interact with students from education backgrounds, providing more-authentic collaborative experiences than would be the case in an LIS course taken entirely by students new to education.

Several other studies have examined the coursework and curriculum of school library Master's degree programs, and these studies suggest that TLC collaboration is a component, if not a centerpiece, of most of these programs (Harada 1996; Latham, Gross, and Witte 2013; Neuman

2001; Tilley and Callison 2001; Moreillon, Kimmel, and Gavigan 2014). One notable finding of these studies is that school library programs are typically self-contained and offer little interdisciplinary coursework, such as courses cross-listed with schools of education or assignments that partner school library students with education students for collaborative work (Latham, Gross, and Witte 2013; Neuman 2001; Tilley and Callison 2001).

Theoretical Framework

The design of this study and of the students' assignment itself was informed primarily by Montiel-Overall's theory of teacher-librarian collaboration (TLC) (2005a; 2005b). The TLC model proposes four levels or "facets" (Montiel-Overall 2007) of collaboration between teachers and school librarians, levels that vary in terms of intensity, effects on student achievement, purpose, types of activities involved, and requirements for success. These four levels, in order from least to most intense, are Coordination, Cooperation, Integrated Instruction, and Integrated Curriculum. As a way to help students understand the variety of forms that TLC might take in practice, this model was introduced to school library students at the beginning of the project described in this paper.

Montiel-Overall applied TLC Theory in a case-study examination of teachers, university educators, and school librarians who worked together to create professional development workshops for cohorts of elementary school teachers and librarians (Montiel-Overall 2010). Her work resulted in an extension of the TLC Theory: a model of the collaboration process itself, shown in figure 1. This process model, while not taught to the school library students, was used to interpret study findings.

As shown in figure 1, TLC starts with a beginning phase that lays the groundwork for higher-level collaboration. In the next phase relationship-building activities lead to the development of trust and respect; these activities allow collaborative partners to enter the iterative productive phase of their partnership. In this phase participants share knowledge and expertise and work to build consensus related to their shared goals. This process continues until a final outcome is reached. The diagram in figure 1, based on two figures in Montiel-Overall's 2010 paper, was created by one of the researchers for this paper.

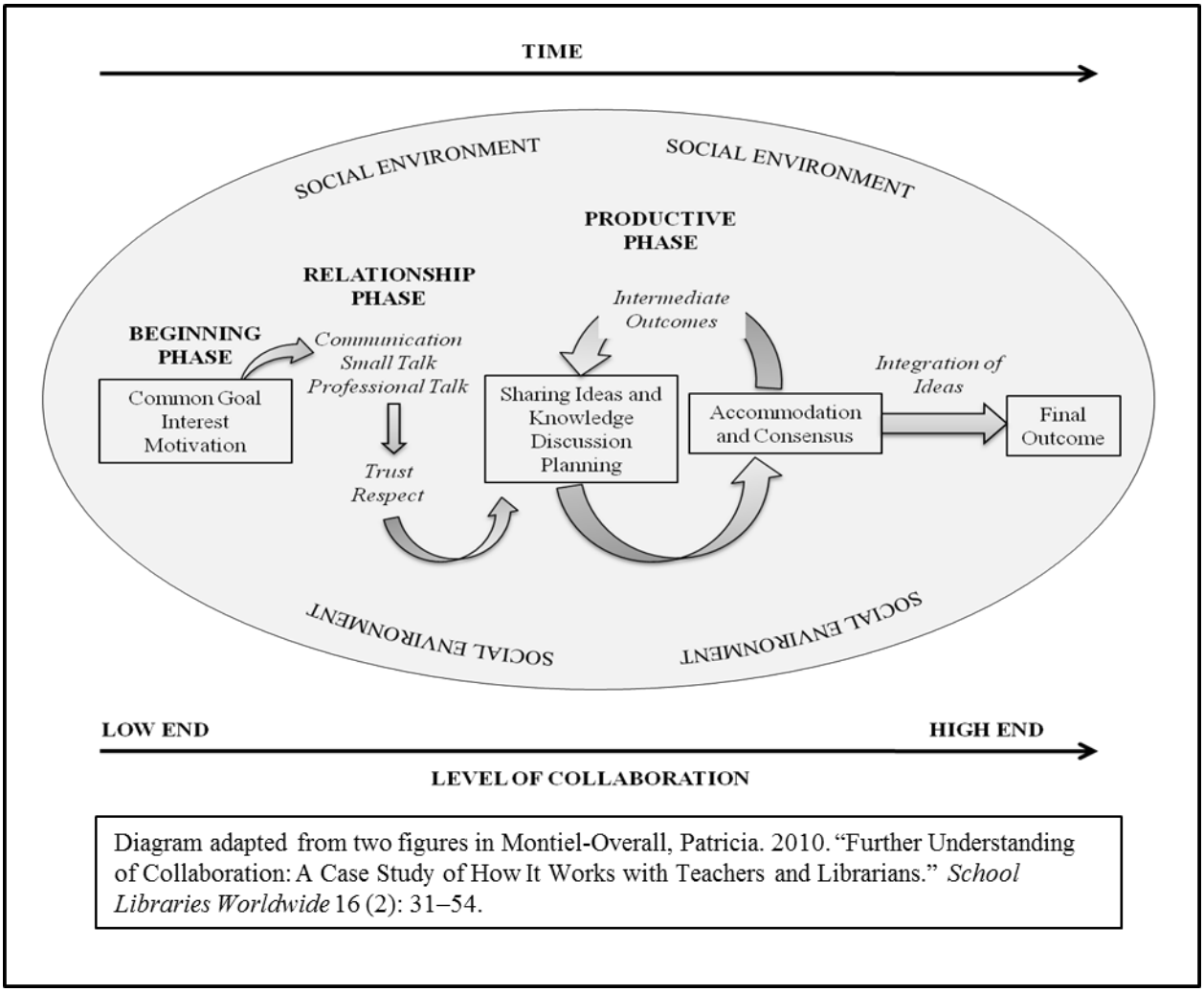

Diagram adapted from two figures in Montiel-Overall, Patricia. 2010. "Further Understanding of Collaboration: A Case Study of How It Works with Teachers and Librarians." *School Libraries Worldwide* 16 (2): 31–54.

Figure 1. The process of teacher-librarian collaboration (TLC).

Methods

Design-Based Research

This study reported here represents the first iteration of the design-based research cycle. Based on findings from this study, successive iterations of this project will refine the design of the assignment as well as the study itself. Design-based research (DBR) was developed in the field of education and is based on the work of Ann L. Brown (1992) and Allan Collins (1992). DBR emphasizes the role of context, and design-based studies typically implement an instructional intervention in a naturalistic setting over successive iterations. The results include both tangible products (in the form of refined interventions, typically lesson or unit plans) and new theoretical knowledge (Hoadley 2004; Barab and Squire 2009). In contrast to either laboratory experiments or ethnographic research, DBR studies in education involve simultaneously implementing, modifying, and studying an instructional intervention along with the associated learning and cognition that the intervention produces in students (Bell 2004; Sandoval and Bell 2004). In design-based research, the researcher is often a participant-observer (Lincoln and Guba 1985). The design-based approach has been successfully implemented by researchers from a wide

variety of backgrounds and theoretical perspectives (Bell 2004). DBR studies have been implemented in K–12 settings as well as in postsecondary settings, with science as the most common subject-area focus (Anderson and Shattuck 2012). Design-based research is particularly well suited to this study because the collaborative lesson plan assignment will be refined over the course of future semesters, and because we wish to look closely and critically at the assignment as well as at broader elements of our local context in light of existing theoretical work on collaboration.

Participants and Context

This project grouped one pre-service school librarian with three to five elementary science-methods students. The school library participants for this study included seven graduate students enrolled in Curriculum Issues and the School Librarian, a required course for students in the school library track of the Master of Science in Library Science (MSLS) program (taught by Author 1). See table 1 for a description of school library student participants. (All participant names are pseudonyms.) Total course enrollment was nine students; two chose not to participate in the research study. The course is a critical component of the school library program and focuses on the instructional role of the school librarian by examining state and national standards, curriculum, learner characteristics, instruction design, assessment, and collaboration, among other topics. The elementary science-methods course (taught by Author 2) with which the Curriculum Issues and the School Librarian course was partnered to complete the assignment is required for education majors during the semester immediately before their student-teaching experiences. That methods course includes a field-based component and stresses inquiry-based and constructivist principles of teaching and learning.

Table 1. School library student participants.

Pseudonym	**Place in School Library Program**	**Academic Background**	**Professional Background**
Rebecca	third-semester youth services student	undergraduate degree in applied math, minor in English	public library assistant, academic library intern
Jennifer	first-semester school library student	undergraduate degree in English and religious studies, minor in information science	academic library intern, part-time jobs as nanny and camp counselor, school library volunteer
Mandy	second-semester school library student	undergraduate degree in information science and psychology	retail, academic library intern
Lisa	first-semester school library student	undergraduate degree in French	full-time elementary teacher's assistant
Jane	continuing-education student	undergraduate degree in French and art history, Master's degree in library science (youth services concentration)	event planner, executive assistant, florist, public librarian
Mark	first-semester school library student	undergraduate degree in comparative literature, unfinished PhD program in comparative literature	teaching assistant in college English department
Rachel	first-semester school library student	undergraduate degree in sociology	English teacher (overseas), survey instrumentation specialist

Project Overview

Instructional design has traditionally been a focus of both the science-methods course and the school library curriculum-issues course. Both courses have included lesson plan assignments in past semesters, and the courses share similar commitments to inquiry-based teaching, backward design (Wiggins and McTighe 1998), and technology integration. In past semesters, school library students wrote an inquiry-based lesson plan designed to be taught and assessed collaboratively with a classroom teacher. However, because most students have traditionally lacked teaching experience, imagining the role of a collaborative partner was a challenge and weakened the authenticity of this assignment. Collaboration with school librarians was not part of the lesson plan assignments in past semesters of the elementary science-methods course.

For the project reported here, education students were instructed to create a science-focused unit plan consisting of at least five lesson plans. The specific content areas (for example ecosystems or weather) for each unit plan were assigned to PSTs by their mentor teachers—elementary

educators who would be supervising the PSTs' student teaching experiences the following semester. School library students worked with each PST in their groups to collaboratively write one of the five lesson plans with the goal of addressing both information-literacy standards and elementary-science standards. Lesson plans could represent any level of teacher-librarian collaboration, from simple resource sharing to coteaching. Groups had two opportunities to work on their lesson plans together during class time and were provided with access to a private wiki where they could communicate and share materials online outside of class time. At the end of the semester, school library students prepared brief (approximately ten-minute) presentations, delivered to only the school library class, focused on their experiences with the project.

Data Sources

A variety of data were collected before, during, and after the lesson plan design project. Data sources relevant to the questions explored in this article were:

- Work Samples: Student work samples included completed lesson plans, presentations, and instructional artifacts such as resource lists or PowerPoint slides.
- Classroom Observations: Authors 1 and 2 circulated during the two in-class work sessions to monitor group progress and answer questions. During these sessions, we took field notes focused on the interactions among group members and how student groups approached the assignment itself. In addition, we wrote reflective memos after each work session to capture etic, interpretive data (Creswell 2004).
- Semi-Structured Interviews: Pre-service school librarians were interviewed twice, once before the assignment began and again at the conclusion of the project. Pre-project interviews focused on the participants' backgrounds and career aspirations, their understanding of the roles and responsibilities of the school librarian, and their understanding of collaboration between teachers and school librarians, especially as it relates to science content areas. These interviews were conducted between the first and third class sessions. Post-project interviews were conducted after the project's due date and focused on participants' experiences with the assignment, their understanding of the school librarian's roles and responsibilities, and their understanding of collaboration between teachers and school librarians, especially as it relates to science content areas. All interviews were audio recorded and transcribed to facilitate analysis. Each interview lasted approximately thirty minutes.
- Instructor Notes: In Christopher M. Hoadley's discussion of the rigor of design-based studies, he stated that the researcher "often documents what has been designed, the rationale for this design, and the changing understanding over time of both implementers and researchers of how a particular enactment embodies or does not embody the hypothesis that is to be tested" (2004, 204). Before the project began, the instructors documented the designed intervention by preparing assignment instructions and timelines, and annotating these with notes providing the rationale for various features of the assignment. As the assignment progressed, the instructors took note of any changes that occurred in implementation, reasons for those changes, and proposed changes for future iterations of the assignment.
- Questionnaires: Pre- and post-project questionnaires were given to PST participants; in the full study, these questionnaires provided both quantitative and qualitative data. Only

one question from these surveys (an open-response item asking participants about their strengths and weaknesses as a science teacher) is relevant to the issues considered here.

Data Analysis

All data were analyzed using the concurrent mixed-methods triangulation design (Creswell 2008; Tashakkori and Teddlie 2003), in which qualitative and quantitative data collection occur simultaneously and each data set is given equal weight, consideration, and priority in the final analysis. (Although only qualitative data are considered here, the full study employed mixed methods; quantitative data in the form of survey responses is not included in this article as it does not pertain to the research questions addressed here.) To assist with confirmation, cross-validation, and corroboration of the findings, each research question was addressed by multiple data sources, providing triangulation of the conclusions (Tashakkori and Teddlie 2003). Qualitative data were analyzed following the grounded theory approach (Glaser and Strauss 1967; Corbin and Strauss 1990) and the constant comparative-coding method in which data are analyzed as collected as well as at the end of the project (Creswell 2004). The constant comparative method involves the inductive development of codes from raw data (open coding), interconnection of codes into categories (axial coding), and connection of categories to themes to create a coherent narrative (selective coding). Authors 1 and 2 independently coded all qualitative data and met several times to compare codes and emerging themes, define and collapse codes and themes, and discuss conclusions emerging from the data.

Findings

Findings are reported below and organized by research question.

Research Question 1: How Does the Collaborative Lesson Plan Design Project Change Pre-service School Librarians' Understanding of Teacher-Librarian Collaboration, Especially Science-Focused Teacher-Librarian Collaboration, and What Specific Features of the Project Contribute to These Changes?

At the beginning of the semester, school library students had limited conceptions of collaboration between teachers and school librarians and of the instructional role of the librarian. In pre-project interviews, when asked to describe school librarians' expertise, only one student mentioned collaboration by name and three others mentioned teaching—specifically, teaching research skills. Rebecca noted that prior to the first class session, she never realized the extent of the school librarian's teaching role because as a K–12 student she had not personally observed this role being practiced by her own school librarians. When asked about their comfort level with TLC, most school library students said that they felt comfortable with the idea of collaboration, but none provided details or examples about what TLC might look like in practice. Jennifer said that she felt like she would be able to collaborate with teachers in any content area, "but I just don't really know yet. I just haven't… studied enough of it so I feel like I'm not prepared in any way yet."

In the pre-project interviews no school library students expressed discomfort with science-focused TLC. Three students did mention math as an area where they might feel less confident, not because of a lack of personal knowledge but because it was more difficult to think of ways that the school librarian could add value to math lessons.

Work session observations and instructor notes showed that in general, school library students seemed well prepared for each work session. Each PSL brought instructor-supplied collaborative planning worksheets to the first work session, and all but one was observed using these sheets to frame discussions with their group members. Following the first work session, school library students debriefed with Author 1 in class and shared how the experience differed from what they had expected. (See discussion of RQ2 for more about expectations and whether they were met.) Between the first and second work sessions, most PSLs had collected resources, written preliminary plans, and/or researched their group members' topics and brought this material with them to share with the PSTs.

In their presentations and post-project interviews, PSLs who participated in the study expressed that the assignment gave them a more-realistic view of collaboration between teachers and school librarians. Several students described TLC as leveled, in line with models of collaboration such as Marcoux's pyramid (Marcoux 2007), which had been discussed in class. Mandy explained that working with a group of PSTs instead of with one individual teacher allowed her to experience first-hand varying levels of collaboration; one of the lesson plans she worked on represented low-level resource sharing and the other represented collaboration at the integrated instruction level with a clear teaching role for the school librarian. In some cases, due mainly to challenging issues of communication, preparation, and PSTs' lack of knowledge about the school librarian's instructional role (see next section), library science students lowered their expectations about the types of collaborations that might be feasible for them as beginning school librarians. In her post-project interview, Jane defined TLC as "any time that you can get a teacher to come and talk to you about their lesson" and noted:

> I think a lot of us came in thinking we're gonna be great; we're gonna be super-awesome at this; all of our collaboration is gonna be at that top level of the pyramid, and I think that this really was a really good practical lesson in bringing our expectations down for what it's really gonna look like.

Jennifer and Rachel noted that the project made them more likely to approach beginning teachers as potential collaborative partners, "because it's like they don't know yet either" (Jennifer, post-project interview). Specifically, Jennifer noted that the fact that PSTs in her group did not come into the first work session with firm plans for their units made her realize the opportunities involved with working with new teachers who don't already have established unit plans in place for the year. Rachel commented in her class presentation that she "can't imagine new teachers turning us down…. 'cause they're gonna be feeling overwhelmed."

Despite the fact that before the project began no PSLs expressed apprehension about the science focus of the lesson plan, several of them found this focus to be more challenging than they had initially assumed. (See subquestion 1 section below for more detail.) Nearly all school library students reported that they felt it would have been easier to work with teachers on a language arts lesson versus a science lesson because both they and the PSTs might have had more and better ideas for how to integrate library content into this subject. However, several participants noted that, although collaborating on a language arts lesson may have been easier, it would not necessarily have been more valuable. For example, Mark noted:

> I definitely think that I could have done a better job, even for the lower grades, if it had been language arts. But… I liked the project, from that standpoint…. I definitely see that I'd need to… train a little more for, like, the science and math type of collaboration.

He went on to note that the numerous examples of science-focused collaborative lesson plans provided or discussed in class helped him to broaden his conception of the possibilities of science-focused TLC. Similarly, Jane stated:

> I mean, I didn't see it at the beginning of the semester, but I think science is actually a much more natural fit for libraries than you think. So on my end, definitely as we progressed through the semester it became easier for me to see how we could fit in.

Research Question 2: What Issues Emerge During the Collaborative Process, and How Do Participants Address Those Issues?

Themes

Three themes emerged from the data related to this research question: communication, preparation, and knowledge of school librarians' roles.

Communication

All school library student participants reported that they had little or no contact with their PST group members outside of the two in-class work sessions. What communication did occur was limited to brief e-mails exchanging materials, information, or lesson plans (completed or partially completed). Lisa's post-interview comment was typical: "Outside of the class I had—I had no real communication with my student teachers. I just was kind of sending out this lesson plan, hoping that it worked out okay for them."

The course wiki, which included private pages for each group, was introduced to all students at the beginning of the project, but no students used this site. Several school library students independently set up a Google document and/or sent out a group e-mail at the beginning of the project to attempt to initiate out-of-class communication with their PSTs; however, in most cases these efforts did not bear fruit. In at least two cases, lack of communication led to school library students not receiving necessary information or materials to complete their project until just days before the project's due date. In her post-project presentation, delivered one week before the due date, Mandy remarked, "I still haven't gotten anything from them, so I'm gonna send that kind of 'Mom' e-mail of 'I need your things!' like, this afternoon after class."

One exception to the generally negative data about communication within student groups was Rachel, who described in her post-project presentation how she was able to establish a sense of camaraderie with her group members by using education terms discussed in the school library course. "I felt like I was speaking their teacherly language. They were like 'oh, you know standards!'… and I thought, 'OK, this is how they communicate.' I was glad that I did that." However, while this student was able to establish positive and productive communication with her group members during the work sessions, like the other school library students she reported that her group "didn't collaborate outside of our meeting time."

Preparation

In addition to communication, preparation (of both sets of students) emerged as a second issue that impeded progress for some groups. The education students' mentor teachers at their placement schools were supposed to assign each student a topic for their unit plan (for example, weather or ecosystems). In a few cases, students had not been given their topic assignments by the first work session. In many other cases, students had not yet spent any time looking into

relevant standards or existing curriculum materials related to their topic, or thinking about learning goals for the units planned for their science students. For this reason, all but one school library student reported that the first work session was less productive than they had hoped. For example, Lisa remarked:

> I guess the main thing that most people ran into and that I also ran into was just a kind of lack of preparedness. [The pre-service teachers] were not really at the same place in… designing their unit, and thinking about what the different lessons would be. So that was a little difficult because [I was] trying to bring ideas into kind of like a void. There wasn't really much there to kind of fit things into.

Two school library students also reported that they felt unprepared for the first work session because of their own inexperience with collaboration. As Lisa concluded, "It was kind of new for all of us, and so we just kind of had to find our way." Participants reported that preparation issues had largely resolved themselves by the second work session. A number of students also noted that having collaborative planning sheets on hand at the first work session was critical for them and helped them to obtain and organize all the information they could get from their PST students.

PSTs' Lack of Knowledge about School Librarians' Instructional Role

A final issue that emerged as an obstacle for a number of groups was the PSTs' lack of knowledge about the school librarian's instructional role. (In one case, the mentor teacher for two PSTs was also unaware of this role.) Nearly all school library students expressed that PSTs in their groups initially had little idea what the school librarian could do for them. Where PSTs did have ideas, most were centered on resources or on what Rebecca called "stereotypical things that you think the librarian's expert in," namely, Internet safety, citation, and resource evaluation. In work sessions PSTs were observed as being mostly open to collaboration ideas put forth by their PSL group members but not always forthcoming with ideas themselves. This observation was confirmed by school library students in the presentations and post-project interviews. As Jennifer summarized, "I think in general they were surprised that we could help them. I was asking them, like, what they wanted from the library and they were just like, 'I have no idea what the library can offer.'" Although before the first work session PST students had been provided with a brief reading on the instructional role of the school librarian, only one PST student seemed to be knowledgeable about the school librarian's instructional role; that particular student had taken an elective course (Young Adult Literature) in the library school in a previous semester. She was observed actively advocating for school librarians to her classmates during the first work session, telling her group members that school librarians can offer "so many new and different resources" and curriculum ideas that she "never would have thought of" on her own.

In response to the PSTs' lack of knowledge about the expertise and instructional role of school librarians, several school library students reported that they took on a teaching role for some portion of the work sessions in which they explicitly communicated what a school librarian can do for classroom teachers. Some school library students felt that the project was a success in terms of PSTs' learning more about school librarians' instructional roles. Jane stated, "I feel like we really raised awareness of libraries among student teachers. I feel like it's something that they don't get very often, if at all, and I felt really great that I was able to do that."

In her group Lisa encountered a unique issue related to a mentor teacher in the school to which two of her collaborating PSTs had been assigned. In the first work session Lisa worked with these two students to develop a preliminary plan involving a significant technology component. However, between the first and second work sessions, the students discussed the plan with their mentor teacher, who vetoed the idea because she didn't think the school librarian had any role to play in classroom technology. Instead, she requested that the students rewrite the plan to have the librarian teach research skills only. In her post-interview, Lisa commented:

> I was a little familiar with the school they were coming out of, and I knew that it was a school with a ton of resources and like a really great library, and so I was kind of surprised that coming from that background a teacher would still… have this more, kind of like, outdated idea of what the librarian would be doing.

Because Lisa did not feel comfortable challenging the mentor teacher's perceptions, she adjusted her plan to focus on research skills and removed the technology component.

Despite the issues noted above, all groups except Rebecca's were ultimately able to develop lesson plans that integrated science and school library resources or content. In Rebecca's group, because the PSTs did not initially know exactly what content they would be covering in their lesson plans, at the first work session the PSTs expressed a preference for a more-general standalone contribution from the school librarian that could work with any science content. Although they did know their unit topics by the second work session, at that point the PSTs in that group remained committed to their original idea, and Rebecca was willing to go along with their plan even though she admitted in the post-interview that her group's experience "was kind of collaboration but… it wasn't really good collaboration, at least for my group."

The lesson plans created as a result of this project varied in terms of the level of TLC represented, from simple resource provision up to plans that included a significant teaching and evaluation role for the school librarian. While some library students expressed regret that their plans did not represent high-level collaboration, others noted that the project gave them a more-realistic view of TLC and that they enjoyed having the opportunity to work at and observe, via their classmates, varying levels of collaboration.

Subquestion 1: Do Any Issues Emerge during the Collaborative Process That Are Specifically Related to the Assignment's Focus on Science Content, and How Do Participants Address Those Issues?

As stated above, in pre-project interviews no library school students who participated expressed discomfort or anxiety related to the science content focus of the assignment. Although no students had academic or professional backgrounds in science (see table 1), most explained that they felt it is less important for school librarians to know subject-area content than it is for them to know where and how to find relevant and accurate resources about that content. For example, Jane explained that "I don't think it's a librarian's job to be a specialist in a subject; it's a librarian's job to help the students get the information they need from the resources that you have and to match…that content with the resources." One exception was Rachel, who thought that having a strong base of content-area knowledge was very important, especially for elementary school teachers, because "elementary school kids are gonna come ask you questions" and because she felt a broad base of content knowledge would help the school librarian be perceived as an instructional leader in the school. (Notably, Rachel also reported having the best

communication with her group members, as discussed above.) Mandy and Lisa both said that they would view working with a teacher in an unfamiliar content area as a learning opportunity.

However, despite an initial absence of concern about the science focus, lack of science content knowledge among both PSLs and PSTs did emerge as a challenging issue for several groups. In the pre-project questionnaire, pre-service teachers were asked to describe their strengths and weaknesses as science teachers. Most PSTs expressed that, although they were enthusiastic about inquiry-based and hands-on instruction, they also harbored insecurities related to their personal knowledge and understanding of science concepts. For example, one science-methods student responded that "a strength would be my drive to create inquiry-based learning experiences that allow students to get involved with the material rather than just reading about it in a textbook and answering worksheet questions. A weakness would be that I have always viewed science as my worst subject, so I am not confident in my understanding of some science content areas."

In their post-interviews and class presentations, several school library students discussed the lack of content knowledge on both sides as being an obstacle to successful completion of the project. Mark commented, "I don't think we really—any of us—felt comfortable with the material…. I guess from the perspective of both parties, like you can only contribute so much as you know." Jane stated, "There was just a poor understanding of the science involved on both of our sides. I'm not a scientist; they're not scientists. So that added a layer of complexity to it." School library students noted that this bidirectional lack of content knowledge made it difficult to establish learning goals for the lessons or to brainstorm lesson ideas.

In general, school library students felt that the lesson-planning process would have been easier—though, as discussed above, not necessarily more valuable—had they collaborated on an English language arts lesson instead of a science lesson. Participants noted that not only might the content knowledge have been less of an issue in that case, but the PSTs may also have had a better idea of how the school library might fit into their plans:

> I think the students might have had a better idea of what we could do for them…. I don't think they connect the library much to science…. I also feel like a lot of them, they actually weren't really that comfortable with science themselves. So I think that kind of contributed even more to the fact that they're just—they didn't quite get what we could do for them in that case. And I think sometimes even librarians have difficulty with the science, just in general. (Rebecca, post-project interview)

Participants addressed their own lack of science content knowledge in one of two ways. Some students took it upon themselves to research the science topic(s) that were the focus of their group members' unit plans. In several cases, students used the school library websites at their group members' placement schools to complete this research, thereby simultaneously improving their own command of the content and locating potential library resources for the pre-service teachers and their students. This was not always a straightforward venture, however, as at least one student (Mandy) found that she lacked the content knowledge necessary to evaluate the relevance and accuracy of the resources she was able to locate online. Other participants followed a wait-and-see approach in regards to their own lack of content knowledge. In some cases, participants reported that their group members' knowledge of the science content improved between work sessions such that by their second meeting, the PSTs had a much better personal grasp on the science and firmer ideas of student learning goals, allowing the group to move forward with ideas for integrating the school librarian and/or library resources into their plans.

Discussion and Recommendations

Overview

The data presented above led us to conclude that, in general—and despite some design issues that will be modified for future iterations of the project—this assignment was successful in its stated goal of improving pre-service school librarians' understanding of collaboration between teachers and school librarians, particularly science-focused TLC. At the end of the project, school library students held more nuanced conceptions of TLC and were more aware of their own abilities and needs related to TLC. Students were able to learn about TLC, particularly science-focused TLC, from both their successes and challenges during the project.

Planned Modifications

Design-based research studies are iterative in nature, and design specifics are expected to vary between iterations (Barab and Squire 2009; Hoadley 2004; Sandoval and Bell 2004); these studies recognize that designs may always be improved, and this project is no exception. In particular, when we analyzed our results in light of Montiel-Overall's (2010) process model of teacher-librarian collaboration, we noted that communication and common goals, both of which Montiel-Overall placed as precursors to productive work, seemed to be stumbling blocks for our groups due to the issues and challenges described above. Therefore, we plan to implement the following changes to the assignment before the project is repeated with students in the next semester both courses are offered:

- To improve communication within groups, we will require all students to post at least twice to the course wiki site. We will provide students with suggestions and examples for what and when to post to help ensure that interactions on this site advance and enrich the collaborative process.
- To improve preparation for the first work session, we will move this work session later in the course so that all PSTs will have an assigned unit topic. In addition, we will require some preliminary work from both sets of participants. All students will be asked to complete—before the first work session—a graphic organizer based on the backward-design process to identify relevant standards and potential student learning goals for unit topics. In addition, school library students will collectively complete community analyses of each placement school represented by the PST participants.
- To improve PSTs' understanding of the instructional role of the school librarian, additional readings and multimedia material will be incorporated into their interactive digital course textbook. This material will be required reading for them before the first work session. In addition, we may preface the first work session with a brief mini-lesson on teacher-librarian collaboration.

Specific Recommendations

Some features of the project emerged as particularly helpful for students in terms of helping them to develop knowledge of and competency with TLC, particularly science-focused TLC. We would recommend that others wishing to implement a similar assignment consider these design elements:

- Provide multiple opportunities for students to work together face-to-face.
- Allow students to create lessons representing any level of TLC.
- Have each school library student work with multiple PSTs or develop multiple lessons with the same PST to encourage experience with multiple levels of TLC within the same project.
- Debrief following each work session to gauge students' progress and address any emerging issues.
- Situate students' lesson or unit plans within an existing local school, preferably the one where PSTs will be completing their student teaching, so that collaborating PSTs and PSLs can access that school's library catalog and use the school's actual resources in their lessons.
- Provide school library students with collaborative planning sheets or similar organizing documents to help frame the first work session.
- Provide multiple examples of collaborative lesson plans, especially science-focused lesson plans, to school library participants (and, ideally, all participants) prior to the beginning of the project.

Further Research

A number of other research avenues might be pursued based on the results of this study. As noted in the results section, Rachel was the only participant who valued content knowledge as vital to successful collaboration between teachers and school librarians, and she also reported having the most-effective communication and camaraderie with her group members. Future research might investigate whether there is a relationship between these variables.

The findings related to pre-service school librarians' initial lack of understanding of the instructional role and TLC present another opportunity for study. Research might address whether and how various instructional approaches used in pre-service programs for school librarians develop their students' knowledge of these roles and processes.

Additional studies may investigate similar assignments designed with content areas other than science as the focus; for example, pre-service school librarians might partner with pre-service teachers to design a math lesson or unit plan. Such a project might extend the findings of this study to address collaboration in STEM (Science, Technology, Engineering, and Math) broadly versus only in science, the focus here.

Conclusion

Don Latham, Melissa Gross, and Shelbie Witte (2013) noted the logistical difficulties of implementing a cross-class assignment such as this one, even as they also pointed out the potential benefits of such an assignment. This assignment demonstrates the value of working to overcome logistical hurdles for the purpose of providing students with an authentic opportunity to collaborate with students in an education program. Mandy summed up this benefit in her class presentation as follows: "[one] of the positives about this whole collaboration experiment is the real-world experience that we're getting…. I mean, as much as we can hypothesize and do

hypothetical role-playing scenarios, actually talking to someone who's not in library school and trying to kind of get their side of it was really, really helpful for me."

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