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Reciprocal mentoring "in the wild": A retrospective, comparative case study of ICT teacher professional development

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Abstract
For teachers in the 21st century it is become critical that they develop the skills to be able to teach in a world that is being transformed by technological innovations. These skills include effectively teaching in blended learning environments with high-quality online learning resources available on the internet. Chief among the challenges faced by these teachers is that mid- and late career teachers, unlike pre-service teachers, do not have adequate technology knowledge. A challenge for pre-service teachers is that they do not have the pedagogical and content knowledge to be able to effectively implement their technology knowledge in the classroom. This retrospective comparative case study was undertaken to understand reciprocal mentoring (RM) relationships that can occur between in-service teachers and pre-service teachers during implementation of a technology based lesson. The transfer of knowledge between the members of the RM dyad is described through the lens of technological pedagogical content knowledge.

INTRODUCTION

In the United States (US), as in many places in the world, there has been an increasing focus on integrating online/internet communication technology (ICT) and the use of a blended learning environment into primary and secondary education. Rapid technological innovations offer a wealth of potential for transforming education, in particular with regard to helping to support the development of critical 21st century teaching and learning skills (Computing Research Association, 2005). For teachers, these skills include effectively finding, sharing, and teaching with the vast wealth of high-quality online learning resources increasingly available on the Internet, and the emerging cyber-infrastructure for education. Of necessity this often includes learning how to effectively teach within a blended learning environment (Bonk, et al, 2002; Clark & James, 2005; Osguthorpe & Graham, 2003).

However, these tremendous opportunities also come with a significant number of challenges. Chief among them is that most mid- and late- career teachers, unlike their students and new teachers, are not digital natives. While experienced teachers may possess a vast and effective repertoire of teaching strategies and lesson plans, these were

typically designed around the notion of temporally and physically constrained resources (e.g., textbooks) within the confines of a single classroom. The distributed and limitless access provided by the Internet turns these assumptions on their head – and challenges these teachers to rethink their practices to support blended learning approaches.

The study reported in this chapter sits at the nexus of these issues. In the context of a 5-year research project, largely funded by the US National Science Foundation, we have been developing simple tools to help teachers to better design and share classroom activities that use high-quality online learning resources. We have designed accompanying teacher professional development experiences for both in-service (practicing) and pre-service (student) teachers. The purpose of these activities is to help develop teachers' design capacity with online resources in order to improve classroom practices and student learning. Not surprisingly, we have observed large differences between the in- and pre-service teachers both in terms of their ability to acquire the necessary technological skills, and their ability to effectively apply these in the service of instruction. In general, young, pre-service teachers easily acquire the necessary ICT skills but are unsure how to use these in pedagogical contexts. Conversely, experienced teachers often struggle with learning new ICT skills, yet have the classroom skills and experience to be able to use them to promote student learning.

Moreover, an interesting dynamic can emerge when a pre-service teacher, armed with a vast repertoire of ICT skills, begins student teaching and works with an experienced, mentoring teacher. Here, both members bring potentially complementary skills to the table, which can result in a mutually and reciprocally beneficial relationship.

To begin to address these interrelationships, we undertook a retrospective comparative case study to examine reciprocal mentoring relationships that developed between three pairs of teachers, or *dyads*. All teachers participated in professional development workshops with blended learning components, in which they learned to use a software tool, called the Instructional Architect, to design activities using online learning resources. The pairs consisted of an experienced in-service teacher and a pre-service student teacher. The particular focus of the case study was on understanding and characterizing the mutual transfer of technological and pedagogical content knowledge between the two members of the dyad.

The next section of this chapter describes the theoretical framework, which was informed by two strands of research: reciprocal mentoring (RM), and teacher knowledge. We then describe the ICT tool and professional development in our study, study context and methods, then present case study findings from three teachers dyads.

THEORETICAL FRAMEWORK

Reciprocal Mentoring

A typical mentor relationship is a hierarchical, one-way relationship with guidance coming from someone with more experience (the mentor) to someone of less experience (the mentee). As such, the relationship is primarily of benefit to the mentee (Ballantyne, Green, Yarrow & Millwater, 1999; Clarke, 2004; Kochan & Trimble, 2000; Mullen, 2000). In contrast, reciprocal mentoring (RM) is more of a mutually beneficial exchange in which both members of the mentoring relationship contribute to the

experience and learning of the other (Clarke, 2004; Kochan & Trimble, 2000; Mullen, 2000).

Wildman, Magliaro, Niles and Niles (1992) identify seven activities that can occur within in-service and pre-service partnerships. One of those activities is collaboration, specifically where the beginner contributes to the mentor's experience as a teacher. This kind of interaction within mentoring relationships is found throughout the literature and defined in many different ways. For example, it has been defined as co-mentoring (Jipson & Paley, 2000; Kochan & Trimble, 2000), collaborative mentoring (Mullen, 2000), mentorships (Gilles & Wilson, 2004; Grisham, Ferguson & Brink, 2004), and lastly, reciprocal mentoring (Dawson, Swain, Johnson, & Ring, 2004; Gonzales & Thompson, 1998; Swain & Dawson, 2006; Thompson, Shmidt &, Davis, 2003). While all of these authors have slightly different definitions, the common thread throughout is that both people in the mentor partnership bring something to the learning process of the other person.

When considering the partnership itself, one factor that allows reciprocal mentoring to take place is supporting relationship building between the two individuals involved in the mentorship (Dawson & Nonis 2004; Jipson & Paley, 2000; Swain & Dawson, 2006). This relationship building enables the partners to develop trust (Jipson & Paley, 2000; Mullen, 2000), respect (Swain & Dawson, 2006), and a support system between the two (Gonzales & Thompson, 1998).

There are many benefits that arise out of a reciprocal mentoring relationship. For example, when university faculty members and graduate students come together, faculty members are able to learn much needed technology integration skills, and graduate students are able to learn both about the subject area of the faculty and professional skills they will need when they become faculty members themselves (Dawson & Nonis, 2000; Dawson, Swain, Johnson & Ring, 2004; Gonzales & Thompson, 1998; Swain & Dawson, 2006; Thompson, Shmidt, & Davis, 2003). Other advantages to these partnerships within the faculty-graduate student context are that it is time saving for faculty members, there are increased confidence levels with using technology, and there is greater relevance regarding what is being learned (Dawson & Nonis 2000; Gonzales & Thompson, 1988).

Within the in-service/pre-service teacher relationship, similar and additional advantages have been documented. Learning takes place at a deeper level, teachers outside the mentorship dyad feel energized by the work being done, and the school administration is able to see the pre-service and in-service teacher partnership in new ways (Gilles & Wilson, 2004; Grisham, Ferguson & Brink, 2004). Pre-service teachers are able to move from a theoretical framework of teaching to understanding practical applications of that framework, and they are able to have authentic leadership experiences within the classroom (Bullough et al., 2002; Dawson & Nonis 2000, Thompson, Schmidt & Davis, 2003). In-service teachers are able to learn new ways of approaching curriculum from their pre-service teachers, have experiences of leadership, and through their reciprocal mentoring relationship, end up re-evaluating their own teaching practices (Bullough et. al 2002; Gilles & Wilson, 2004; Grisham, Ferguson & Brink, 2004; Thompson, Schmidt & Davis, 2003). Despite the rich level of research about RM partnerships, to our knowledge none of the existing work has examined naturally occurring (as opposed to engineered) cases of RM.

Technological Pedagogical Content Knowledge

One dimension to consider in an investigation of RM is changes in the underlying teacher knowledge base and practice. Pedagogical content knowledge (PCK) is a framework developed by Shulman (1986) for understanding the different kinds of knowledge encompassing the practice of teaching. In defining PCK, he first established the idea of content knowledge (CK), which he described as not just basic facts and concepts but also include the structure of the subject being taught and the explanatory frameworks that organize and connect ideas within that subject. Pedagogical knowledge (PK) is defined as an understanding of methods for teaching and learning and how those methods encompass educational purposes, values and aims. Included in PK are things such as knowledge of evaluation frameworks, the targeted learners, and basic classroom practice (Shulman, 1986; Mishra & Koehler, 2006). Pedagogical content knowledge is where PK and CK intersect. PCK includes an understanding of the kinds of knowledge that the target learners already have about the content being taught, ideas and preconceptions about the content, and knowledge of strategies to help learners overcome these preconceptions and ways for incorporating newly gained knowledge into what they already know (Shulman, 1986).

Technological pedagogical content knowledge (Mishra & Koehler, 2006) is an extension of PCK. When Shulman first developed the notion of PCK, the use of technology did not have the focus in educational practice as it does today. Essentially, not only do educators have to learn new *technological* practices, but they also have to adjust their current information technology use (e.g. knowledge of how to use overheads and projectors, whiteboards, and text books) and to integrate these new practices into their existing *content knowledge, pedagogical knowledge* and *pedagogical content knowledge* practices. This intersection has been termed *technological pedagogical content knowledge* (see Figure 1). Mishra and Koehler emphasize that these knowledge areas are not distinct, but overlap and are mutually constitutive in multiple and complex ways. The inclusion of technological knowledge is a particularly good fit given that this research occurred in the context of a technology professional development workshop; further it seems evident that TPCK is a critical dimension for effective teaching in a blended learning environment.

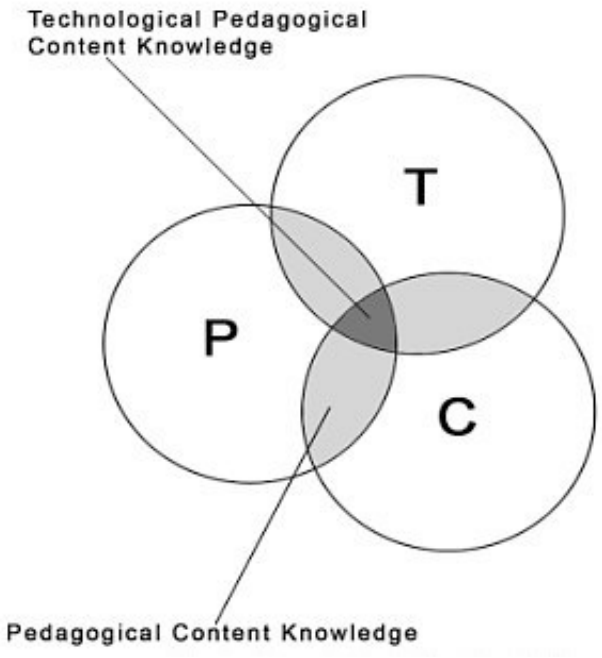

Figure 1: The TPCK Model, adapted from Mishra & Koehler, 2006

ICT Professional Development Context: The Instructional Architect

The teachers in the present study all participated in professional development workshops (described next) in which they learned to use an ICT tool called the Instructional Architect (IA). ICT has been defined as an amalgamation of computing and communications (Ducatel, Webster, & Herrmann, 2000) and perhaps more broadly as any electronic means of sorting, showing, saving or modifying knowledge (Bruneau & Lacroix, 2001).

The Instructional Architect (http://IA.usu.edu) is a simple, Internet-based tool designed to help teachers find and use learning resources available on the Internet. It is especially designed to support teachers in finding high quality resources in the U.S. National Science Digital Library (NSDL.org), and elsewhere in the Web. With the IA, teachers can discover, select, sequence, annotate, and reuse online learning resources on the Web in order to create instructional resources for their students, for example, lesson plans, study aids, homework – collectively called *IA projects* (Recker, 2006). Figure 2 shows an example of a simple, teacher-created IA project: the background shows teacher content and instructions, while the foreground shows an online learning resource (in this case, a simulation of weather).

Design, development and evaluation of IA have been ongoing since 2002. From 2002 to January 2008, over 2,700 users have registered, 5,400 projects have been created, and 20,500 external online resources have been added to the database. Since August 2006, IA projects have been viewed over 258,000 times. Results from evaluation efforts indicate that teachers are positive about the NSDL, the quality of discovered learning resources, and the value of the IA (Recker, Dorward, & Nelson, 2004; Recker et al., 2005; Recker et al., 2007; Recker & Palmer, 2006; Recker et al., 2007).

While the intention of the IA and the focus of the professional development workshop is on increasing the utility of online learning resources for classroom educators, there are ancillary benefits as well. For example, by creating student activities (or IA projects) teacher work becomes a form of communication. Each created project is an overt example of more tacit teacher epistemological beliefs and pedagogical practices. By examining the efforts of others, teachers are able to discover how their colleagues are approaching teaching with online resources. The IA search interface allows teachers to search projects by keyword, subject area, grade level, and educational standards. Teachers can use other created projects either as ideas for their own lessons, as a source of online resources, or even send their students to another teacher's project. In this way, the IA serves as an infrastructure for teachers to share their practices.

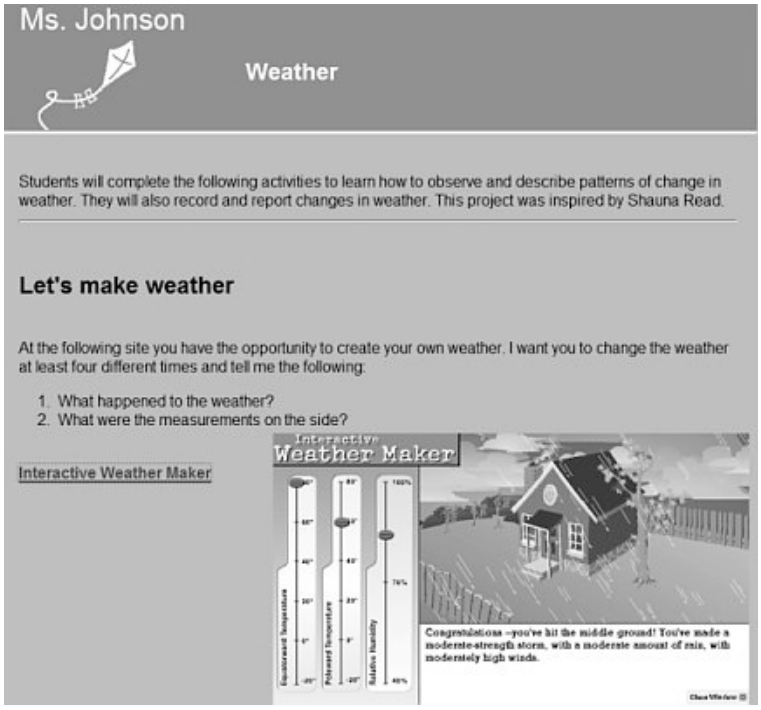

Figure 2. An example of an Instructional Architect project with an overlay of the online resource linked to from the project.

ICT Teacher Professional Development Model

The goals of our professional development program are to help teachers learn about the concepts of repositories (or digital libraries) of online resources, how to search them, how to design instructional activities using the Instructional Architect, and how to integrate these capabilities into their teaching practice (Recker et. al, 2005).

Specifically, the teacher professional development workshop curriculum consists of the following core components, which are structured as two 4-hour workshops, separated by classroom implementation activities:

1. A motivating example. An interesting learning resource from the National Science Digital Library (NSDL) (e.g., an interactive simulation of a frog dissection) is demonstrated to the participants. The example also shows the use of a learning

resource in an instructional setting. The specific example is modified to fit the target audience.

2. Instruction on how to find learning resources in the NSDL, including keyword and Boolean searching, advanced searching, and browsing by collections. Depending on the technical expertise of audience, the amount of modeling is increased or reduced.

3. Participants identify an authentic instructional problem, need, or situation. They then practice search techniques to locate resources related to their selected objectives.

4. Participants then work either on their own or with their pre or in-service teacher partner to design IA projects that address the identified problem. Examples include labs, assignments, interactive group work, research, resource lists, and homework.

5. Participants then implement their project with their students on their own or with the support of their partner. Examples of implementation activities include working as a whole class group to move through the project and online resources, having the project be one learning center of many, and having the students go through the project on their own while making notes on what is being learned.

6. Participants reconvene in a second workshop to reflect on their experiences designing activities using online learning resources and discuss various methods and strategies for integrating online resources into their classrooms.

PURPOSE OF STUDY

Past research has investigated the nature of RM partnerships in the context of technology professional development (e.g., Dawson, Swain, Johnson, & Ring, 2004; Gonzales & Thompson, 1998; Swain & Dawson, 2006; Thompson, Shmidt, Davis, 2003). These studies intentionally designed reciprocal mentoring as part of the intervention. However, to our knowledge, there are no studies that have described RM as it occurs naturally, or 'in the wild', between pre-service and in-service teachers. Therefore the purpose of this retrospective case study was to describe the characteristics of reciprocal mentoring partnerships, and address the following research questions:

- What elements of reciprocal mentoring partnerships were present or absent within the teacher dyads?
- What knowledge characteristics were present within each member of a pre-service/in-service dyad when reciprocal mentoring did occur, and what characteristics were present when it did not occur?

METHOD

This present study used a retrospective comparative case study. The comparison was undertaken because the researchers wanted to begin to understand not only the reasons for or barriers to reciprocal mentoring occurring, but also the transfer of knowledge that takes place when it does occur. To create the comparisons, all data

sources were analyzed using the constant comparative method (Glaser & Strauss, 1967) to contrast each pre-service / in-service teacher dyad in the study (Huberman & Miles, 2002).

Typically, a retrospective case study reports findings from a phenomenon over an extended period of time (DeVaus, 2001). Our usage of the term here is in reference to the fact that the methods and data collection occurred after the phenomenon of interest took place. As noted by Yin (2003), case studies can be retrospective in nature because they report on phenomena as past events. In this study, the focus was on a pronounced and clearly mutually beneficial exchange between a pre- and in-service teacher. From there, two additional cases were selected as they showed a range of RM alignment within the initially collected data (Yin, 2003). Lastly, while we are making cross case comparisons, through those comparisons we seek only to describe the participants and the phenomenon apparent within the dyad.

Context

The setting for the study was Sarah Smith Lab School (SSLS). Part of the strategic master plan for the school includes an emphasis on educational technology integration. This includes a dedicated technology and professional development center, teacher technology workstations, and a basic computer literacy program for students and faculty at the school. The school is based on an experiential constructivist framework and the teachers are given the freedom to develop their own, standards based, curriculum, rather than relying on pre-fabricated curriculum. Research on K-5 schooling is an everyday occurrence at Sarah Smith, and the Sarah Smith community is very comfortable about having researchers in and around the school.

The relationship between the lab school and a nearby university supports a simultaneous renewal partnership. Simultaneous renewal is a principle developed by John Goodlad where a partnership is created between a university and a local school or school district. The University benefits through having researchers and students practice what they are learning and conducting investigations in a school setting. The school benefits through having access to ongoing professional development and the constant introduction of new ideas from the university into the school and classroom (Goodlad, 1994).

Under the guise of technology integration and the development of blended learning environments within the school, this simultaneous renewal relationship gives pre-service teachers an authentic context to learn their skills and allows the in-service teachers to take advantage of the advancement of technology use in the classroom that is being explored at the university and taught to the pre-service teacher (Dawson, Swain, Johnson & Ring, 2004; Gilles & Wilson, 2004; Thompson, Shmidt, Davis, 2003; Johnson-Gentile, 2000; Dawson & Nonis 2004; Swain & Dawson, 2006). As Sandholtz, Ringstaff and Dwyer (1997) put it, "technology is a catalyst for change in the classroom process because it provides a distinct departure, a change in context that suggests alternative ways of operating" (p.47). This is a particularly good fit for an investigation of RM because much of the existing research on RM took place within the context of a simultaneous renewal partnership between a college of education and a school or school district (Bullough et. al, 2002; Dawson & Nonis, 2004; Gilles & Wilson, 2004; Swain & Dawson, 2006; Thompson, Shmidt &, Davis, 2003).

Participants

The participants in this study were three dyads of pre-service and in-service teachers. The three pre-service teachers were all pursing elementary education degrees and were completing the final block of their student teaching. All had previous exposure to the Instructional Architect during practicum classes in their final year of study, and also during a technology course during their second or third year.

Carol, the in-service teacher in dyad A, taught second grade children and her participation in the professional development workshop had resulted in a first time online lesson. Bronwyn, the in-service teacher in dyad B, taught first grade and regarded herself as having experience in creating online lessons, and had designed her own curriculum around online resources. Anna, the in-service teacher in dyad C, taught first grade, and prior to participating in the professional development workshop, had some experience in creating online lessons, mainly through using specific websites that had been explicitly shared with her by others.

Data and Instruments

At the start of the study, all teachers completed an online pre-survey about their use of online learning resources, level of comfort with technology, and beliefs about the use of technology in the classroom. They then participated in a 4-hour professional development workshop (described above) in which they learned how to use the Instructional Architect, learned effective searching techniques in the National Science Digital Library, and participated in discussions about how to design effectively using online resources.

Classroom observations were conducted to assess the implementation of IA projects with students, with two researchers at each observation: one doing open coding of classroom activities, the teacher, the students, and other adults (including student teachers); the other doing interval coding. Reflection papers were then written by the in-service teachers describing their IA projects and their perspectives on implementing their projects in the classroom. Finally, teachers completed a post-survey.

After the principal data collection ended, it was expanded to support the retrospective comparative case study by including a focus group interview of the pre-service teachers. Questions centered on their prior level of expertise with technology, their working relationships with their in-service teachers during planning and implementation of the IA lesson, and benefits in terms of new knowledge as a result of their work with their in-service teacher on the lesson. Table 1 provides a complete list of data sources, whether collected for the planned study or as additional data for the retrospective case study, target participants, and relationship to the research questions.

Research Question	Data Collection Methods
What elements of reciprocal mentoring partnerships were present or absent within the teacher dyads?	Focus group (pre-service; additional data) Reflection paper (in-service; planned) Observation (in- and pre- service; planned) Pre-survey (in-service; planned) Post-survey (in-service; planned)

What knowledge characteristics are present within each member of a pre-service/in-service dyad when reciprocal mentoring occurs, and what characteristics are present when it does not occur?	Focus group (pre-service; additional data) Reflection Paper (in-service; planned) Observation (in- and pre- service; planned) Pre-interview (in-service; planned)

Table 1. Research questions and data collection methods used to answer them.

Analysis

Data was analyzed overall by four researchers. The initial analysis was conducted by three researchers, who used the constant comparative methodology (Glaser & Strauss, 1967) to do a thematic analysis of the data into emergent themes that described the data. Note that while constant comparative analysis is typically an approach used in grounded theory, it is not our claim or contention that this work constitutes grounded theory. There is precedent for the use of constant comparative analyses in contexts outside of grounded theory, for example within Delphi studies (Brill, Bishop, & Walker, 2006; Kramer, Walker, & Brill, 2007).

As a first step, all of the existing data were open coded into researcher labeled themes. On a second pass through the data, themes were then collapsed when data failed to differentiate between them. Once this initial analysis was completed, the three researchers gathered to compare and discuss their coding. After a consensus among the three researchers on the themes was achieved, a fourth researcher entered the analysis. This member had completed a literature review of the existing literature and did an analysis of the data based on constructs pulled from the literature about what factors lead to successful reciprocal mentoring partnerships. This purpose of this phase was to identify themes in the literature and map them to the data. Themes not represented in the data were added to the coding sheet. The next step taken was with the initial three coders who went back to the raw data and searched for any instances of the non-represented themes from the literature. One instance was found by consensus from all three researchers and added to the coding sheet. Data were then grouped by dyad and mapped to one of the two research questions.

FINDINGS

The findings focused on two major characteristics of the participants and these were the relationship between the dyad members and the knowledge transfer that occurred between them. The relationship characteristics were drawn from literature about reciprocal mentoring relationships, while knowledge transfer was viewed through the lens of TPCK. Specifically, knowledge was analyzed in terms of technology knowledge (TK) and pedagogical content knowledge (PCK). As a point of clarification, we did not focus on the transfer of basic computer literacy, but rather on any experience where the knowledge transfer was directly related to the educational goals of the instructional content being taught by the dyad.

The description of each dyad begins first with a discussion of the relationship characteristics within the dyad, then knowledge transfer, and ends with a summary of how the two sets of characteristics impacted the reciprocal mentoring relationship. Table 2 at the end of the section summarizes the findings.

Dyad A

This dyad was comprised of Dana**,** the pre-service teacher, and Carol, the in-service teacher. In terms of knowledge, Carol appeared to have high technological pedagogical content knowledge. She was seen during a classroom observation walking around the room helping the students with their technology problems. Carol also noted in her reflection paper, "I had no difficulties designing the activities and I found the frame to build projects was very user friendly and self-explanatory." Further, in an interview with her, Carol stated about her use of online resources:

> "I use all online resources and I have searched and weeded through lessons that are out there. They use multi media and are hands on with lots of activities. Lessonplan.com has almost a million lesson plans. I use Google and UEN [Utah Education Network]. I bookmark my favorite resources.

Relative to Carol, the pre-service teacher, Dana, exhibited low technological knowledge. Dana reported not knowing as much technology as she thought she needed. She offered, "I'm getting better with technology, but I'm not where I'd like to be" (focus group interviews with pre-service teachers). Dana reported gaining classroom management skills "by watching her [Carol]" (focus group interviews with pre-service teachers), but here again it was not in terms of a teaching situation/problem where they had collaborated.

Carol's already held technological knowledge was significant within the reciprocal mentoring dynamic because, within a pre-service / in-service dyad, where the pre-service teacher is in the relationship to hone her teaching skills, there was nothing that Dana could offer to the technology based lesson.

Between the members of Dyad A there appeared to be little communication during the planning and implementation of the lesson. Dana, the pre-service teacher, noted that Carol, the in-service teacher, knew how to use the technology and "put it together the night before. I didn't work closely with her" (focus group interviews with pre-service teachers). Further, in her reflection paper, Carol made no mention of her pre-service teacher even helping with the implementation part of her online lesson and observations of the implementation of the lesson back up this implication.

Dyad A did not appear to display any reciprocal mentoring relationship characteristi; in fact, this dyad showed negative characteristics for reciprocal mentoring. The lack of communication and any hint of a working relationship during planning and implementation of the lesson is the most glaring indicator from the data that reciprocal mentoring did not occur. Also, when considering the knowledge of the two members, even if there had been communication between them during planning and implementation of the lesson, it is unlikely that any significant transfer of knowledge from pre-service to in-service teacher could happen, because the in-service teacher appeared to hold all the necessary elements of technological pedagogical content knowledge.

Dyad B

This dyad was comprised of Maggie**,** the pre-service teacher, and Bronwyn, the in-service teacher. There was evidence that Bronwyn trusted Maggie:

"With Word documents, looking up information. I guess I just felt like once we found a site we wanted all the kids to use, she would have me go through and set it up. She would have me write down the site… she was more hesitant and didn't know quite where to go."

When asked about her feelings about technology in a pre-interview, Bronwyn reported that she hated technology, but she was willing to leave her comfort zone in order to be able to better reach her students.

Maggie, the pre-service teacher, reported that she would help Bronwyn, as they were using technology at various times, "with Word documents, looking up information (focus group interviews with pre-service teachers)." With regard to using an Internet browser Maggie said:

> "She [Bronwyn] would click on "go' like 5 times, and I would tell her just to wait. She wasn't quite sure about if it was working, where I could look down and see if it was" (focus group interviews with pre-service teachers).

As far as transfer of knowledge was concerned, the pre-service teacher reported gaining classroom management skills throughout her time in the classroom, but did not report gaining pedagogical content knowledge. Maggie said, when asked about what she learned said:

> "We learned about inquiry - seeing the teacher let them do it. One of us would go look up the answer to their question. I couldn't see how it would work being a single teacher, how could you stop with every student. Sometimes she would stop and just look it up on her own and slip it to them and they would love that. She would grab on to any question. I'd heard about that but not seen it done. It was good to see how she was able to do that. Also, how to manage 25 kids with just being one teacher. She would have just one center that needed her. For that age it was a really good way, because she couldn't always teach the full class. It was good to see things that she was trying that I'd never seen" (focus group interviews with pre-service teachers).

This dyad displayed more characteristics of a reciprocal mentoring relationship than Dyad A, but, as is described below, fewer reciprocal mentoring characteristics than Dyad C. Although there was transfer of knowledge between the pre-service and in-service teachers in the areas of pedagogy knowledge (PK) and technology knowledge (TK), these knowledge transfers did not appear to occur within an integrated discussion of a teaching scenario. Also, while the dyad exhibited some relationship characteristics pertaining to reciprocal mentoring relationships, those characteristics, again, took place outside of a teaching with technology integration plan. So, while there were some characteristics of reciprocal mentoring between Bronwyn and Maggie, the relationship did not appear to have the richness of interactions seen in the reciprocal mentoring literature to be considered a strong RM partnership.

Dyad C

Two characteristics of a reciprocal mentoring relationship are a willingness to be open and an ability to trust. Reflecting on these two characteristics, Anna, the in-service teacher in the dyad, stated in her reflection paper:

> "While at a community council meeting on Wednesday afternoon, our early-release work day, I asked my student teacher to go in and update each skill site with new games that were increasingly challenging. This became necessary after seeing some of my students easily figure out the more challenging games from last week" (reflection paper of in-service teacher).

In terms of suspending the difference between the expert, Anna (the in-service teacher), and the novice, Mary (the pre-service teacher) during the focus group, Mary stated:

> "Once she [Anna] got the concepts down well, she wouldn't forget them… just to add resources was harder. Adding resources, making folders [in the Instructional Architect], gets complex. Once she got reminded, once I cued her, she would remember.

Regarding a supportive relationship, Mary talked about working with Anna during the focus group and said "I helped her through a lot of it."

Knowledge transfer of technological pedagogical content knowledge in the reciprocal mentoring partnerships happened in terms of their specific teaching situation/problem. Mary, the pre-service teacher in the dyad, said the following about what she learned from her in-service teacher, Anna: "I've just learned so much behavior wise, content wise, it just brings it all together" (focus group interview with pre-service teachers). Mary commented on working with Anna, her in-service teacher, about planning and putting together the lesson:

> "She would look for resources, we would look for the resources, and if we found something cool we would copy and paste the URL. I would help her make it happen. She sometimes would forget where to go into to do something and I would have to remind her" (focus group interview with pre-service teachers).

Mary was clearly making a contribution with her technological knowledge. This was also noted by Anna who described Mary's role in terms of finding resources to use in the online lesson (in notes from a classroom observation). Anna made contributions centered on her pedagogical content knowledge. As they collaborated with online lessons and considered possible resources which had been discovered by Mary, Anna was the one who discussed whether or not each would be appropriate for their second graders and why (in notes from a classroom observation). This observation is significant in that Anna was not only willing to rely on Mary's technical knowledge, but on her emerging pedagogical knowledge to handle a task by herself on which they had previously collaborated.

The in-service teacher reported having the chance to use technology with the support of her pre-service teacher. This self reported experience demonstrated the positive outcome associated with a true reciprocal mentoring activity. Anna stated in the conclusion of her reflection paper:

> "Honestly, I was rather reticent about getting started with this project but eventually found it to be worthwhile. My colleague is very good at finding online resources so I often rely upon her for ideas. This gave me a chance to try it myself with the help and support of my student teacher, Beth [the computer teacher] and the IA folks in our classroom."

This dyad exhibited the greatest number of characteristics of reciprocal mentoring. The relationship exhibited the most characteristics for establishing a successful reciprocal mentoring partnership and the knowledge transfer between Mary and Anna consistently took place within discussions of a specific teaching and learning situation. The trust and openness within the relationship coupled with the consistent discussions within the technological pedagogical content knowledge framework appeared to enable a rich reciprocal mentoring relationship to occur within the dyad.

Dyad	Pre-Service Teacher Characteristics	In-service Characteristics	Reciprocal Mentoring Relationship
Dyad A	Low TK, learned PK	High TPCK, no reported learning from pre-service teacher, little communication within the relationship	No elements of RM relationship.
Dyad B	Had TK but shared it as a technological support person, learned PK	Had PCK, TK, learned basic technological knowledge, trust and suspension of distinction between expert and novice	Elements of RM relationship
Dyad C	Had TK, Learned PCK	Had PCK, some TK, learned TK. Was open and trusted re-service teacher	Strong elements of RM relationship

Table 2. Summary of findings.

Summary

In our strongest case of reciprocal mentoring 'in the wild,' we observed that the pre-service teacher had high technological knowledge and low pedagogical knowledge, whereas the in-service teacher had low technological knowledge and high pedagogical knowledge. As the in-service teacher in this dyad noted: "Honestly, I was rather reticent about getting started with this project" (reflection paper) and that she had "never used the wireless lab." Whereas the pre-service teacher said, "I felt really comfy. I used it 3 or 4 times, it was easy to modify projects, add new things. (focus group interviews with pre-service teachers)" Further, the data indicated that both members in Dyad A were open to mentoring, had trust in the relationship, and both were given the opportunity for mentoring.

Several themes emerged from the findings that appear to characterize the strength of the observed reciprocal mentoring relationship. Our findings suggest that the elements needed for the potential of a reciprocal mentoring partnership to occur included high

technological knowledge in the pre-service teacher, low technological knowledge in the in-service teacher, high pedagogical knowledge in the in-service teacher, and low pedagogical knowledge in the pre-service teacher, an openness to mentoring, the opportunity for mentoring, as well as a sense of trust within the dyad, and encouragement from the in-service teacher. In short, reciprocal mentoring seemed to occur when the dyad exhibited relative complimentary expertise. This complimentary expertise may lead to a mutual need within the dyad. In contrast, when reciprocal mentoring partnerships did not occur, the in-service teacher displayed high TPCK.

DISCUSSION AND RECOMENDATIONS FOR PRACTICE

It is likely that the complementary knowledge that both members brought to the partnership, and the personal interactions between the pre-service and in-service teachers played a direct role in facilitating RM partnerships. However, drawing a direct causal connection given our data collection and methods is a tenuous proposition at best. Therefore, it is our intention to forward these findings as possibilities only. That said, a number of factors seemed to co-occur with our observed instance of RM.

As previously noted the possibilities of knowledge transfer occurring between the members of the dyad is one potential factor for reciprocal mentoring. Each member must have knowledge that the other member does not have and seeks to gain. In the case of this study we have defined those types of knowledge as content knowledge (CK), pedagogical knowledge (PK), technological knowledge (TK) and the frameworks that bring those types of knowledge together - pedagogical content knowledge (PCK) and technological pedagogical content knowledge (TPCK) (Shulman, 1986; Mishra & Koehler, 2006).

There are other potential factors. The in-service teacher, the member of the dyad who has the most power in the relationship, must be willing to learn from the pre-service teacher (Grisham, Ferguson & Brink, 2004). In addition, both partners must be able to support the other (Dawson & Nonis, 2000; Gonzales & Thompson, 1998). Finally, there must be respect and trust between the two members of the partnership (Swain & Dawson, 2006; Bullough et. al, 2002; Jipson & Paley, 2000; Kochan & Trimble, 2000; Mullen, 2000)

Reciprocal mentoring appeared strongest in dyad C. In this dyad, the pre-service teacher reported high technological knowledge and was able to apply it to the Instructional Architect lesson being taught in the classroom. While the in-service teacher did possess some technological knowledge, she reported and displayed greater strengths in pedagogical content knowledge within the lesson taught using the IA. She was also open to learning from her pre-service teacher, and she trusted her as well to work on later expansions to the lesson independently.

While the members of dyad B did show some transfer of technical knowledge from the pre-service teacher to the in-service teacher, that knowledge was not related to an instructional situation and the data did not indicate that any collaboration occurred between the members of the dyad on the IA lesson. Potential for a mutually beneficial exchange of knowledge and expertise existed, because the pre-service teacher had more technical knowledge than the pre-service teacher, however that potential did not emerge into a full RM partnership. The question remains as to why this is the case.

In dyad A there was no transfer of knowledge from the pre-service teacher to the in-service teacher. This relationship was more typical of a one-way mentor relationship (Wildman, Magliaro, Niles & Niles, 1992), at least within the context of the design and implementation of the IA activity. One possible conclusion is that while mutually beneficial expertise may be a minimum component for RM, it seems consistently present when RM occurs, but its presence alone does not guarantee that RM will happen.

In conclusion, there is great potential in reciprocal mentoring relationships to facilitate the transfer of technological pedagogical content knowledge, if both members of the dyad possess complementary expertise, and are open to such transfer of knowledge from the other member of the dyad. Further investigation is warranted to better understand the dynamics of knowledge transfer in this relationship within the context of blended learning environments. Effective TPCK within such environments contains many elements that are less relevant within the typical classroom. These include, for example, strategies for effective online communication, strategies for moderating online discussions, etc. It is possible that reciprocal mentoring is an important means for the development of such knowledge.

LIMITATIONS

Due to the retrospective nature and the context of the study, there are important limitations. First, the researchers were not able to collect data on the phenomenon of the intersection of reciprocal mentoring and technological pedagogical content knowledge as it was occurring because it was not a part of the intent of the original study. Data collected was based on recollections of participants after the fact, rather than during the occurrence of the phenomenon.

The inability of the researchers to properly triangulate the data is another limitation (Merriam, 1988). While we were able to conduct follow up interviews with four of the six pre-service teachers that were in the classrooms at SSLS during the time of our original study, we did not have adequate data to properly triangulate the experiences of the pre-service teachers. This limitation of data collection impacts the findings of this study.

We note that the teachers and students at SSLS have high access to ICT through a rich blended learning environment. Sarah Smith is a well-funded school that has two full portable laptop carts, a full desktop lab and every classroom that the researchers visited had at least three computers in the back of the room for the students to use. Wireless Internet access is available in each classroom (although there were accessibility concerns for dyad A). Furthermore every classroom has the ability to project digital images and sound using a multimedia station that is controllable by the adults in the classroom. Many K-5 schools in the United States do not have access to the kind of resources that these teachers have. We recognize that this kind of access to technology will not be available in every school in the country, which will, obviously, inhibit teachers at those schools to bring online educational resources into their classrooms.

The teachers at Sarah Smith have more control over their curriculum than teachers at other schools. There are no standard textbooks in the school and while the teachers must teach according to defined educational standards, they select materials at their own discretion. This makes them more amenable to teaching in different ways, and using different materials. Also they are encouraged by their administration to constantly seek

out new and innovative ways to teach. One factor that must be present for reciprocal mentoring to occur is that in-service teachers must be open to learning new things (Grisham, Ferguson, & Brink 2004) and this is the standard environment at Sarah Smith. Limitations at other K – 5 schools due to curriculum and material constraints may reduce the in-service teachers' willingness and or ability to be open to learning from the pre-service teachers that they are working with.

Lastly, we note the uniqueness of the context of the lab school. These schools are partnerships between a university and the school where the university provides funding for the school and the members of the school community allow research to occur within the school. Most students sign waivers at the beginning of each school year for the research that will occur at the school. The school benefits from this simultaneous renewal relationship (Goodlad, 1994) through access to the new ideas and methods being researched at the university and the university benefits by having easy access to a K – 5 population on its campus. Researchers are able to pilot materials and methods at the school and beginning school practitioners and researchers are able to build their knowledge within the friendly environment of a community that is used to their presence. The researchers knew from the start of the study that the setting of the study would be a limitation. Any study that occurs within the confines of a lab school, if generalizeable, will only be able to be generalized to other lab schools, which make up a very small portion of schools within the United States.

CONCLUSIONS, FUTURE WORK AND RECOMMENDATIONS FOR FUTURE RESEARCH

This retrospective case study has led the researchers to consider the use of reciprocal mentoring as a means for carrying out technology-based, blended learning teacher professional development.

The purpose of the professional development is to help teachers gain knowledge of how to use ICT to design online lessons and learning activities. Our study showed by working collaboratively, some teachers mutually benefit from collaboration, especially when one member of the dyad is lacking technology skills.

In the spring of 2008, we will be conducting an examination of 4 teacher dyads. As opposed to RM partnerships 'in the wild' these can be characterized as RM partnerships 'in the zoo.' It is our intention to have the pre-service teachers expose their in-service teachers to ICT, rather than disseminating technology tools through a professional development workshop. Data on transfer of technological pedagogical content knowledge and the reciprocal mentoring relationship will be collected through the use of a structured journal that will be filled out at the beginning of the study, a pre-survey on technological skills, a reflection paper, and a post interview after all other data have been collected. This study will help the researchers bolster findings from this retrospective and give guidance for moving forward with a new look at a teacher professional development model.

Recommendations for future research include replications of this study with greater numbers of participants, conducting research investigating why reciprocal mentoring 'in the wild' does not occur-- even when mutual benefits for both members of the dyad are apparent, and examining reciprocal mentoring through a multi-cultural lens.

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