School-University Partnership as Professional Development: The Evolution of a Leader in Elementary Science Education

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Abstract: This article details a professional growth opportunity between a university faculty member and an elementary classroom teacher, enhanced by their participation in a professional development program designed by the university’s PDS. The partnership was rooted in the design and implementation of STEM kits within the elementary teacher’s school. The design and implementation of these kits served as a professional development activity for the teacher while also increasing the quality and quantity of exposure of STEM learning for her students. The partnership expanded from this project to include other leadership opportunities for the teacher, resulting in personal and professional growth and an enhanced view of the role of PDS.

KEYWORDS: professional development, elementary education, science education, STEM, school-university partnerships, PDS

NAPDS NINE ESSENTIALS ADDRESSED:
2. A school-university culture committed to the preparation of future educators that embraces their active engagement in the school community.
3. Ongoing and reciprocal professional development for all participants guided by need

The Watson College of Education (WCE) at the University of North Carolina Wilmington maintains a larger than average Professional Development System (PDS), serving 12 districts, 143 schools, and over 2,000 partnership teachers. This partnership involves support in varying intensities, from professional development and pre-service teacher support to more in-depth faculty-school partnering and research. This paper explores one such faculty-school partnership, highlighting the ongoing collaboration between the authors, Lynn, a WCE faculty member in elementary science education, and Victoria, a fifth grade classroom teacher, over the course of two years as part of a WCE PDS initiative called the Master Teacher Program.

The Master Teacher Program was designed to be an intentional, mutually beneficial collaboration that works to develop and promote teacher leadership at various levels (Lewis, Garrett-Dikkers, Sikma, & Fink, 2018). The program used a cohort based model and the goal was to enhance leadership opportunities beyond the scope of the teachers’ individual classrooms and engage the teachers in the principles of constructivist leadership (Lambert et al., 2002). The three-year program pairs P-12 classroom teachers nominated and accepted into the program...
(Master Teachers) with college faculty (Master Teacher Associates) whose areas of expertise match the teachers’ identified areas of interest. The Master Teachers take part in over 30 hours of collaborative professional development (Flinders, 1992; Zigo, 2001) with their Master Teacher Associates on topics self-selected by the pair. The pairs also collaborate to design and implement one or more growth opportunities in the Master Teacher’s classroom, school, or district. Lynn and Victoria began their collaboration in advance of their Master Teacher Program partnering, but their work was enhanced by their participation in the program.

Literature Review

Elementary Science Education

Reform documents in science education like The Framework for K-12 Science Education (NRC, 2012) and The Next Generation Science Standards (NGSS Lead States, 2013) emphasize the need for instruction to be rooted in inquiry, providing opportunities for students to interact with both the content and processes of science. Engaging students in the authentic practices of science, which include problem solving, communication, collaboration, and critical thinking helps them develop an in-depth understanding of the content while preparing them to be scientifically literate citizens (NGSS Lead States, 2013). However, this is difficult for many teachers, particularly at the elementary level, to implement because they lack any formal science training and a first-hand understanding of what scientists do (Duschl, Schweingruber, & Shouse, 2007). This style of teaching is often also in direct opposition to the more traditional teaching approaches many teachers experienced in their own learning as students (Schwartz, Lederman, & Abd-El-Kalick, 2000). As a result, elementary teachers rarely implement this type of reform and those who do are often considered as going against the grain (Capps & Crawford, 2013; Carlone, Haun-Frank, & Kimmel, 2010).

Research suggests that elementary teachers feel uncomfortable teaching science and are inadequately prepared (Banilower et al., 2013; Fulp, 2002; Jeanpierre, 2006), often expressing anxiety and negative attitudes about teaching science (Tilgner, 1990; Westerback, 1982). This low self-efficacy in teaching science is well documented in the literature (Cakiroglu, Capa-Aydin, & Hoy, 2012; Kazempour & Sadler, 2015; Schoon & Boone, 1998). Typically, elementary pre-service teachers do not take many college-level science courses during their teacher preparation programs, with roughly 5% of the elementary teaching force holding some sort of science-related degree (Banilower et al., 2013; Epstein & Miller, 2011). Only 36% of teachers meet the National Science Teachers’ Association’s recommendation for elementary teachers to have courses in life, Earth, and physical sciences (Banilower et al., 2013). As a result, they report a vast difference in the level of preparedness they feel towards teaching science compared to other subjects. In a national study of science and mathematics teachers done by Banilower et al. (2013), 81% of elementary teachers reported feeling very well prepared to teach English language arts and 77% felt the same way towards math, compared to 47% and 39% towards social studies and science, respectively.

Standardized testing and accountability pressures have had a negative impact on science, marginalizing it when compared to other subjects (Jones, Jones, & Hargrove, 2003). Under No Child Left Behind (NCLB), reading and mathematics were tested in grades 3-5, but science was only tested in grade 5 and did not weigh as heavily in schools’ performance ratings.
Consequently, time allocated for science in elementary classrooms dropped significantly to make more time for instruction in reading and mathematics (Blank, 2013; Dee, Jacob, & Schwartz, 2013; Diamond & Spillane, 2004; Jones, et al., 2013; McMurrer, 2008). In a study examining science teaching time in the year prior and following the implementation of NCLB, McMurrer (2008) found that 53% of districts in the U.S. cut instructional time in science by an average of 75 minutes per week. In 2012, 39% of K-3 teachers and 33% of 4-6 teachers reported teaching science three or fewer days per week, with a similar percentage in each grade range reporting they teach science some weeks, but not every week. In K-3, teachers spent an average of 89 minutes per week on reading compared to only 19 minutes in science, and 4-6 teachers spent 83 minutes per day on reading compared to 24 minutes in science (Banilower et al., 2013). The Every Student Succeeds Act (ESSA) of 2015, which replaced NCLB, did little to address this, with similar stipulations placed on reading and mathematics testing requirements.

Despite this, it is imperative that elementary teachers make time for science. This is particularly true for teachers in low income and urban settings, where teachers often believe their students are incapable of handling science instruction and need more work on basic skills (Spillane, 2000; Spillane, Diamond, Walker, Halverson, & Jita, 2001). Contrary to this thinking, students from these populations benefit from inquiry instruction (Cuevas, Lee, Hart, & Deaktor, 2005). Students who have had exposure to a solid science foundation in the elementary years make more learning gains when compared to students who did not start their science education until secondary school (Nelson & Landel, 2007). Teachers must have a willingness to create time for science instruction and acknowledge that all students have the right to be engaged in meaningful science instruction in order to be effective at teaching science (Gess-Newsome, 1999).

Efforts to improve teachers’ delivery of reform-based instruction in science must recognize that these constraints exist and can add complexity to how and if reforms are enacted. Change efforts should be done in a stepwise manner, providing incremental goals and gains that are meaningful to the teacher (Jones & Eick, 2007; Loucks-Horsley, 1998). Such an approach provides more opportunities for the teacher to experience success in the implementation. Efforts should also be in context, as it is through the context of their teaching environment that teachers create practical knowledge (Darling-Hammond, 1994; Van Driel & Beijaard, 2001). Approaches to this include peer coaching and collaborative action research (Van Driel et al., 2001).

Professional Development Schools can provide opportunities for support in the implementation of inquiry-based instructional reform efforts. They provide opportunities for collaboration between teachers and university faculty that can result in authentic professional development in situ, including collaborative action research and curriculum development (Darling-Hammond, 1994; Van Driel et al., 2001).

Professional Development

Several lists exist outlining the qualities found in effective professional development (e.g., Berman, Desimone, Porter, & Garet, 2000; Hawley & Valli, 1999), though they all differ in their content and intended audience. Through an examination of twelve such lists, Gusky (2003) identified five themes that existed across a majority of these lists. These themes include the following qualities of professional development: it should enhance teachers’ content and pedagogical knowledge; it should provide sufficient time and/or resources, it should be school or
site-based, it should foster collegiality amongst participants, and it should build leadership
capacity. Any professional development effort, including those directed at science reform,
should aim to include these components.

Curriculum development can serve as a powerful professional development initiative for
teachers (Miller, 1992; 2005; Sparks & Loucks-Horsely, 1989). It provides teachers with a
meaningful problem to solve, and can result in teachers seeking out and acquiring specific
knowledge and skills to address their needs.

Teachers conducting an inquiry project themselves, using research techniques to drive
their decision-making processes and reflection about their teaching can also be a powerful form
of professional development, even for elementary teachers who already feel confident in their
content and pedagogical knowledge (Akerson & McDuffie, 2006).

Collaborative labor between university-based educators and practicing educators in
which research goals are set aside and engagement and growth as co-members is emphasized can
lead to transformational professional development (Flinders, 1992; Carlone & Webb, 2006; Zigo,
2001). In this type of partnership, participation in the activity has the potential to transform
involved participants’ views.

The Partnership

The authors met in the spring of 2016 when Lynn was supervising a student intern in
Victoria’s fifth grade classroom. During observations and subsequent conversations in
Victoria’s classroom, Lynn noticed Victoria’s passion for teaching science. In the state this study
takes place, Victoria is required to teach science daily because fifth grade is the only elementary
grade that has to take a state assessment in science. However, it was clear she approached the
subject with an enthusiasm and zeal that many other elementary teachers lack. Additionally, she
served as a boundary spanner, providing activities in her classroom and school over and above
what was required to advocate for science (Buxton, Carlone, & Carlone, 2005). This included
starting and coaching a Science Olympiad program after school and assisting students across her
grade level with science fair projects. Victoria initiated these activities in spite of a lack of
confidence in her science content and pedagogical knowledge. When asked why she pursued
these activities and prioritized science in her classroom, she expressed her belief that science was
important for every student to participate in because it provided them with skills and knowledge
they would need for “real life,” like problem solving and resilience. She emphasized her belief
on the importance of engaging her own students, a majority of whom were on free and reduced
lunch, in science activities daily.

The same semester, the PDS office at WCE issued a call for proposals for a small grant
for faculty who were partnering with a teacher, school, or district on a project. Because of their
shared passion for science, Lynn approached Victoria and asked if there was any project she
wanted to propose, and, when funded, the partnership began.

The STEM Project

With the grant money they were awarded, Victoria decided she wanted to create a
“STEM resource lab” at her school in the following school year, which entailed creating and
housing kits centered on STEM activities. She wanted the kits to include adaptable activities that
could be checked out by all of the K-5 teachers in the school. She believed that in order for the teachers at her school to utilize the kits, they needed to include all the materials and resources the teachers would need to implement the activities, include literature and ways to integrate literacy strategies, and be easy to execute. Lynn’s role in the project was to serve as a guide and resource, helping with any content or pedagogical questions that would arise.

Before the 2016-2017 school year began, Lynn was informed that Victoria was selected to participate in the Master Teacher Program, which would begin in September and allow the Lynn the opportunity to be her faculty Master Teacher Associate. She knew that the program would require Victoria to collaborate with her on a growth opportunity, ideally one that would be mutually beneficial. One of the main goals of the program is to empower teachers as formal leaders, leading in their schools, districts, and within WCE’s teacher education community (Lewis et al., 2018; Lambert et al., 2002). With this in mind, Lynn shifted Victoria from thinking about the project as resources she would be making available to her school, to an opportunity that could enrich her own teaching and professional growth. Specifically, Lynn approached the partnership from a transformational leadership perspective (Burns, 1979). Lynn wanted to gently but intentionally push Victoria outside her comfort zone, motivating her to do more than she originally intended or thought possible (Bass & Avolio, 1994). This meant approaching the partnership from a coaching or mentoring standpoint bottom-up rather than a hierarchical one of “university faculty as expert” (Bass, 1985; Bass & Avolio, 1994; Van Driel, et al., 2001).

Together, they redesigned the project to become more of an action research project rooted in Victoria’s classroom that would (hopefully) eventually spread to the rest of the school. With permission from her principal, Victoria volunteered her plan time once a week to implement a STEM kit as an extra special to the three fifth grade classes. Students at her school attend a different special each day on Tuesdays through Thursdays, and on Fridays, they have a special for the second time during the week (e.g., they may attend Art on Tuesday, Music on Wednesday, PE on Thursday and then have Art again on Friday). Instead of attending their special on Fridays, the fifth grade classes alternated with Victoria’s STEM special on a three-week rotation. For example, on the first Friday of the month, she taught the STEM kit to her class during their allocated special time. On the second Friday, she taught one of her colleague’s classes during that time, and on the third, she taught the final fifth grade class. Throughout this cycle, Victoria wrote reflections on each of the lessons and kits, making improvements after each implementation to both the content of the kit and its delivery. This translated to notes and modifications in the lesson plans included within the kits for any teachers who wanted to use them. Lynn and Victoria met regularly to process her reflections and improve instructional approaches.

Focused on expanding Victoria’s growth and leadership outside of her classroom and wanting to positively impact the amount of science instruction taking place in the school, Lynn encouraged Victoria to try and recruit other teachers in her school to use the kits. In November, Victoria provided a whole-staff professional development session on one of the kits she created. She demonstrated the kit, explained how the activity could be modified for lower grade levels, and requested that teachers check out and implement the kits themselves and provide her feedback. Lynn and Victoria were both hoping this would result in a small cohort of teachers across grade levels that would collaborate to create additional kits. Though she had several teachers check out the kits and provide feedback, she only had three teachers who indicated that
they wanted to participate in kit creation, and that did not end up happening because they could not find the time to meet due to other obligations.

Victoria continued to create and implement kits throughout the school year and encouraged colleagues to come observe her teach them, in hopes that seeing students actively engaged in and enthusiastic about learning science would entice them to use the kits in their own classrooms. She had a few teachers who did observe her and several who used the kits, but most did this at the end of the school year when students were done with state testing.

Even though this limited colleague involvement was not the outcome Lynn and Victoria had hoped for, Victoria still felt empowered by the outreach with other teachers. Providing professional development and collaborating with other teachers about the project, even though it was limited, made her feel like she had something to offer to her colleagues. Though she has always valued collegial collaboration, typically it has been limited to teachers within her own grade level team. This particular aspect of her experience opened her eyes to the value in collaborating across grade levels, as she was able to partner with teachers she did not know shared an interest in science and helped build their science teaching efficacy, thus positively impacting students beyond her own classroom.

The implementation of the STEM kits had a positive effect on Victoria’s instruction and her students. Over the course of design and implementation, her pedagogical content knowledge in science improved, as did her comfort level with STEM-related content. Prior to implementing the project, she viewed her lack of formal science training as a hindrance because she believed she needed to have an in-depth understanding of the content she was teaching in order to effectively implement a lesson. Now, she views this lack of training as a strength, as it frequently forced her to model for students how to obtain answers to the questions they have, together. This created a non-threatening environment in which teacher and students were learning together and students felt safe asking questions.

Instructionally, as a result of the year implementing the project, Victoria now intentionally includes more hands-on, inquiry-based activities in science to help her students learn content. She utilizes problem based learning more frequently, encouraging questioning and collaboration amongst students during these activities, pushing them to dig deeper into the related content. She promotes trial and error whenever appropriate and rather than teaching to “one right answer,” she encourages students to think of multiple possible outcomes. She believes that the kit activities helped her students understand that they can learn from their peers; through watching other students test out solutions, they could gain ideas on how to improve their own. She believes this helped build a strong sense of community in the classroom, shifting the focus from individual contributions to more of a team approach where it benefitted them to listen to their peers. She has witnessed less competition during activities and more collaboration. This also altered how she assesses student work. When possible, she now highlights where students went wrong and requires them to think about how they could fix it. She is hoping this approach promotes risk taking and teaches her students that failures can lead to success, provided we learn from our mistakes.

For Victoria, the most rewarding outcome of the STEM project was the influence it had on her students. The enthusiasm her students had for STEM during the year of implementation was over and above anything she had witnessed before. For nearly every activity that they completed, students would continue learning outside the classroom in some way. For example, following a catapult-building activity, a student, who often struggles with behavior and attention,
brought in a catapult he had made at home; he wanted to use different materials to see if it made a difference in the device. Many students wanted to stay behind after the class period ended, giving up their recess to continue the activity. The other two fifth grade teachers would often share how excited their students were about what they were doing with Victoria in STEM. Even more importantly, every student, regardless of learning level, language proficiency, or behavioral need, was engaged during every activity and able to feel successful. She had several high-needs students in her classroom during the time of implementation, including students with autism, behavioral IEPs, and students who spoke very little to no English. These students were able to collaborate during the activities and show what they knew in ways that are not necessarily afforded to them in other subject areas assessed primarily through writing.

**Partnering Beyond the Project**

The philosophy behind the Master Teacher Program was for the partnering and projects to be mutually beneficial for both the Master Teacher and the Master Teacher Associate. For Lynn, the kit implementation project was a way for her to stay connected to what was occurring in elementary classrooms in the area. It also helped ground her science methods course in real-time experience. Victoria’s classroom and school were referenced often during class discussions, providing authentic scenarios for students to consider. These scenarios helped illustrate how course material related to practice and how teachers can overcome time and confidence issues in their own classrooms.

Wanting her students to benefit more from her partnership with Victoria and wanting to push Victoria to start viewing herself as more of a teacher-leader, Lynn invited Victoria to observe and serve as a guest lecturer in her science methods course during the class meeting on inquiry lesson planning. This worked twofold: Victoria wanted to learn more about the type of lesson planning instruction students were receiving at the university and how she could improve her own instructional delivery in science, and Lynn wanted to strengthen the portion of the class meeting that covered standards. Together, they designed a class meeting that met both of these outcomes while also providing students with learning experiences that bridged theory and practice. For the half of class, Victoria observed Lynn model and lecture on 5E lesson planning and was able to help answer student questions about real classroom implementation. For the last half, Victoria lectured about science standards, providing students with resources she utilizes in her planning and modeling how to use standards to develop lessons. As a result of this class meeting, Victoria began intentionally incorporating more inquiry into her classroom, both with the STEM kits and in her everyday science instruction. She also continues to guest lecture in Lynn’s class every semester, providing students with an opportunity to learn about standards usage from an expert and ask questions about inquiry teaching from someone who implements it regularly in their classroom.

This particular experience boosted Victoria’s confidence and made her feel extremely valued. Despite decades in the classroom, Victoria has never viewed herself as someone who has the knowledge to teach others how to teach. Sharing what she does at the college level has brought teaching to a whole new level for her, because it validates what she does every day and makes her feel like she is making an even bigger difference in her teaching. Instead of just reaching her 30 elementary students, she feels that she is potentially impacting the future students of the pre-service teachers enrolled in Lynn’s course, and perhaps even their colleagues.
This has altered her view of the university, as she now sees it as a partner in educating students, rather than a separate entity. She feels that the university actually views her as a partner in preparing future teachers instead of just a classroom teacher for an intern placement.

In another attempt to push Victoria outside of her comfort zone, Lynn encouraged Victoria to submit a proposal to present her work at a national conference. This is something Victoria never would have considered doing, as she was self-conscious about public speaking and only ever saw herself as someone who attends conferences, not someone who presents. The proposal was accepted, and together, they presented on the STEM resource lab project, with attendees ranging from university faculty to practicing teachers, many who reached out to her afterward to share resources. They have also presented together at a regional conference.

These experiences, too, have positively impacted Victoria’s confidence. She is now more willing to share ideas publicly, and has found that people are interested in what she has to share. She sees the value in disseminating her work and doing so has helped her create and learn from a network of other teachers and professors across the country. The collaboration with Lynn has also given her the confidence to do the same with others. She has reached out to other university faculty and initiated partnerships to enhance her students’ learning in other areas. This is something she never would have done prior to this partnership.

The creation of the STEM kits by Victoria was a catalyst of the change that took place during and parallel to their implementation. These changes started small, affecting Victoria’s classroom and her grade level, but eventually became large, through presenting at the university, local, and national levels. At the end of the 2016-2017 school year (during which the STEM project was implemented), Victoria was awarded Elementary Teacher of the Year in her county. She believes this partnership enabled her to achieve this title, as it pushed her to think of herself as more than “just” a classroom teacher. She now views herself as more of a change agent, both in her school and within the profession.

Lynn and Victoria are currently collaborating on creating mutually beneficial learning experiences for their students. They are hoping to bring Victoria’s students to the college so they can have an on-campus learning experience, ideally on a topic like experimental design that would allow Lynn’s students to learn alongside them. They are also working on ways to involve Lynn’s students in Victoria’s classroom, possibly through project partnering or creation of a student-created “STEM Day.”

**Conclusion and Implications for School-University Partners**

The curricular development process of designing and implementing her STEM kits resulted in an improvement in Victoria’s science content and pedagogical content knowledge. This was a bottom-up inquiry experience for Victoria; she was in complete control of what she did and how she did it. As her faculty partner, Lynn served as a coach and mentor, providing sustained support towards improving and enhancing the activities and instruction, rather than as instructional expert. This approach honored Victoria’s knowledge of her own classroom context and practice and pushed her to make incremental improvements to her instruction. It also allowed her to see the value of her own knowledge and expertise, realizing she could successfully implement change in her classroom and school without relying solely on an “expert other.” Through this work, she became a self-created science specialist in her school (Gess-
Newsome, 1999; Schwartz et al., 2007) and enhanced her role as “boundary spanner,” (Buxton et al., 2005) by providing professional development activities to her colleagues.

The collaboration and coparticipation (Carlone et al., 2006) of the authors throughout this partnership strengthened and enhanced Victoria’s identity as a teacher-leader. Lynn carefully crafted opportunities for Victoria that would push her outside of her comfort zone and classroom without letting her fail. These allowed Victoria to truly see value in her knowledge and expertise and recognize the importance of her role in the larger teaching community, at the university and beyond.

The unexpected outcome of this partnership was the impact on Victoria’s view of the university and PDS. Rather than seeing it as a transactional relationship, she now views the PDS as a true partnership, one that values her worth and also provides her with ample opportunities to improve her practice and enhance her students’ learning. She has become an advocate for the PDS, encouraging other teachers to consider how they can collaborate with faculty in a way that is mutually beneficial. This speaks to the power of the Master Teacher Program.

Though this paper only highlights one partnership and the growth opportunities associated with it, it speaks to the possibilities created by an intense, in-depth partnership between university faculty and classroom educators. This partnership has resulted in positive outcomes for both the faculty and teacher participants, but also for their students and the PDS.

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