Principal Perceptions Regarding the Impact of School-University Partnerships in Primary Science Contexts

Andrew Gilbert, George Mason University
Linda Hobbs, Deakin University
John Kenny, University of Tasmania
Mellita Jones, Australian Catholic University
Coral Campbell, Deakin University
Gail Chittleborough, Deakin University
Sandra Herbert, Deakin University
Christine Redman, University of Melbourne

ABSTRACT: This research effort investigates principal perceptions regarding the impact of science-focused school university partnership programs in primary school contexts. Utilizing a multiple case study design, this research effort analyzed the nature and structure of the partnership efforts across five established science-focused partnership programs in the Australian states of Victoria and Tasmania. Analysis of interview data from principals across twelve separate school partner sites indicated that principals depicted that partnership arrangements increased their staffs valuing of science and was a mechanism for teachers to reflect on their practices. Consequently, principals often viewed partnerships as an additional level of professional development. Most importantly, principals articulated that the partnership programs were an important aspect of the school-based culture and they harbored strong desires to continue the partnerships well into the future. Implications for partnership development and key elements of trust, mutuality and reciprocity are discussed.

NAPDS Essentials addressed in the manuscript: 3. Ongoing and reciprocal professional development for all participants guided by need; 4. A shared commitment to innovative and reflective practice by all participants; 8. Work by college/university faculty and P–12 faculty in formal roles across institutional settings

It was with great trepidation that I (lead author) approached my first partnership meeting with an Australian primary school. I was navigating new terrain as a recent immigrant to a country that I was just getting to know. My knowledge of Australian school culture was on a steep learning curve and now I had to help carry out a sophisticated partnership program during my first few weeks in the country. The meeting set me at ease as both the veteran principal and grade 4 lead teacher walked me through how they typically approached the process of working with our preservice teacher (PST) teams. During this meeting the teaching schedule, science unit topics, PST teaching expectations and other key issues quickly coalesced through a seeming collective institutional memory and an overlapping vision for the processes that should comprise the partnership activities. These school-based partners also described how they saw the enactment of the partnership as deeply connected to the school community itself. In my written reflections on this meeting, I was struck by how the lead teacher articulated that she felt working with university students was "a rite of passage" for the grade four children. Furthermore, the principal articulated that the parents appreciated the program and wanted to make sure to get the university team to school early on the first day so that we could get a group photo for the school newsletter. This palpable school-based excitement, surrounding the partnership work, was cultivated for over a decade before I arrived on the scene.

We start with this brief vignette as a representation for the key roles that our school-based partners played in the partnerships that are described across the varied institutions in this research endeavor. Partnership arrangements are embedded and accepted as part of an Australian culture of apprenticeship, so much so that Kruger, Davies, Eckersley, Newell, and Cherednichenko (2009) argued that school-university partnerships are "distinctively Australian" (p. 13). In a similar vein, the Australian Academy of Deans of Education (ACDE, 2004) argued that teacher education must 'relate professional experience to theoretical insight. The relationship between theory and practice needs to be seen as mutually informing' (p. 3). Such commentary on teacher education highlights the need for preservice teachers to engage with their intended profession in highly authentic ways. The standards of the Australian Institute for Teaching and School Leadership (AITSL, 2011) clearly expect university schools of education to look at their programs and offerings structurally, as they articulate that universities must actively build meaningful partnerships 'involving shared respon-

sibilities and obligations among teacher education providers, schools, teachers, employers, and teacher regulatory authorities' (p. 4).

Australia is obviously not alone in the desire to lessen the distance between teacher preparation and classroom practice, there has been considerable attention focused on these issues in the United States (Holmes, 2007; NCATE, 2010; AACTE, 2018), the United Kingdom (NCCPE, 2014) and across Europe and Asia (de mora & Wood, 2014). Much of this research is rightfully aimed at the impact on pre-service teachers and classroom students (Castle, Fox, & Souder, 2006). However, as part of this study, we investigated how school principals perceived the educational value of partnerships and their vision for how those activities impacted on school culture and community. Principals are often the sole school-based decision maker in terms of beginning a school-university partnership; consequently, building deeper understanding for why principals would take on the responsibility of adding a partnership to already heavily burdened schools is an important avenue for research. Therefore, this paper examines individual principal perceptions regarding the sustained, science-focused partnerships carried out in their schools across numerous Australian primary school contexts.

Literature Review

Operationalizing Partnerships

Partnerships can have large variations in both concept and design particularly when involving entities with well-developed institutions, such as public schools and universities. Each partnership is therefore unique in terms of the participants, expertise, expectations and other aspects that impact the interaction of individuals across each institution. For the purposes of this study, we subscribed to the definition by Rossner and Commins (2012) where, "the concept of a genuine university-school partnership connotes a collaboration of professional conversations, collegial learning and aligned processes" (p. 2). In order to maintain both meaningful and sustainable partnerships across complex institutions with a multitude of goals is a complex task, which can sometimes generate tensions if not carefully managed and maintained (Baker, 2011; Strier, 2011).

Successful partnerships, if they are to avoid these aforementioned tensions, must generate and sustain relationships where partners have a similar vision, provide access to available resources, and build communication strategy that values all stakeholders in decision-making processes (Argyris & Schon, 1996). This is an essential aspect of partnership construction since partners inhabit differing social locations with differing access to resources, pedagogical content knowledge, time, etc. (Prins, 2006). Consequently, building effective communication strategies that include establishing direct contact between the participants, and reducing the supervisory aspect of the relationship between the pre-service and in-service teachers is essential to facilitate moving the relationship toward one of mutual learning (Murphy, Beggs, Carlisle & Greenwood, 2004). This builds essential dynamics, where partners that engage in open dialog and shared goals have demonstrated positive impacts on teacher practice (Alemán, Freire, McKinney & Bernal, 2017). In many cases, existing literature tells us that if the above challenges are not addressed, they can seriously impede a partnership (Houseal, Abd-El-Khalick & Destefano, 2014; Ledley, Haddad, Lockwood & Brooks, 2003).

Role of Partnerships in Science

The partnerships described in this piece were all squarely focused in a science context, which provides a particular set of challenges that have been a persistent challenge for primary educators. The challenges largely stem from the unique abstract, conceptual and procedural demands, which is of even more concern for primary preservice and inservice teachers who often do not carry favorable views toward science (Brand &Wilkins, 2007; Mulholland & Wallace, 2003). Multiple studies have consistently reported that upper primary and middle grades students are 'turned off' (from science) because science at the primary level often takes on the role of filling children with isolated science facts, if taught at all (Gilbert, 2013; Milne, 2010; Tytler, Osborne, Williams, Tytler, Cripps-Clark, 2008). There are indications that a large proportion of primary teachers have little confidence concerning their own background knowledge in science, which consequently impacts their willingness to teach science. These are critical areas of concern particularly when we consider that the development of children's content understanding is typically associated with the quality of teaching they experience (Darling-Hammond, 2006; Hattie, 2009).

Houseal, Abd-El-Khalick, and Destefano (2014) argued that science-based partnerships offer particular challenges not often faced by other partnership arrangements. These include issues associated with content understanding, access to resources, and communication barriers related to content. Further research has articulated other instances of disconnects including, incomplete understanding of the nature of science (Akerson, Morrison & McDuffie, 2006; Marcum-Dietrich, Marquez, Gill, & Medved, 2011) and an increased emphasis on literacy and numeracy that often pushes science to the periphery in many primary schools (Berliner, 2011; Rosenshine, 2015).

Partnership arrangements in science contexts offer challenges for both school and universities that can affect the development and sustainability of reciprocally beneficial partnerships. However, partnerships also offer viable support and resources to provide solutions to these particular challenges facing science teaching at the primary school levels.

Role of Partnerships on School Communities

Gorodetsky and Barak (2008) argued that developing partnership programs that connected PSTs, teacher educators and in-service teachers had profound impacts on schools, namely by

developing an "edge community" (p. 1915). This new space was a place for PSTs to take on the challenge of practice, which provided a lens for in-service teachers to reconsider their own pedagogy and how they engage with children in their classrooms. This provided a space where the interrogation of classroom approaches became acceptable without the worries that often accompany formal evaluation. These take on even greater meaning in terms of the challenges faced in science contexts. Alemán et al. (2017) further articulated that partnerships provided a powerful potential to transform schools communities. However, this comes with a warning that:

> If the leadership in a school or district is not invested in the change process, teachers will consider the training or the partnership as another fleeting educational idea and fail to take on the new ideologies/pedagogies. The more local district and school leadership are invested in the new policy and its implementation, the longer the program will continue (n.p., 2017).

For this reason, principal perceptions of these partnerships were the focus of the following research effort. The partnerships involved have been sustained for many years and represent why they were chosen for inclusion in this study. Better understanding of the school communities' perceptions of long-term partnerships are important for those wishing to develop future partnerships as well as considering ways to better craft experiences for all partners.

Theoretical Framework

In terms of investigating the perceptions and impacts of partnerships on school communities, we drew from Lave and Wenger's (1991) conception of *legitimate peripheral participation* where communities of practitioners create situated activities to help both PSTs (and ultimately primary students) pursue knowledge as a member of a legitimate community of learners where, "participation is about being located in the social world" (p. 36). This acknowledges the complex realities that exist within a community of learners and provides participants with opportunities to engage with content that was not only meaningful to their lives but also carried out in a way that encourages multiple voices to participate. As such, we directly framed this work around the partnership research of Kruger et al. (2009), who argued there are three key factors of successful partnerships: *trust*, *mutuality* and *reciprocity*. Trust requires that each stakeholder fully commits their expertise toward the shared goals; mutuality depicts the degree to which each partner understands that these gains are only attainable through working together; and reciprocity speaks to the extent for which each stakeholder values what the other brings to the partnership. These aspects represented what we considered to be the most essential aspects for professional relationships established within a partnership program and framed the foundation for analysis of this research effort including the methodological approach and analysis of findings.

Method

The Partnership Project

The partnerships involved in this study were a collaborative between primary schools and science education researchers from five universities across the Australian states of Victoria and Tasmania (See Table 1). These collaborations represent different models of school-based delivery of science education involving school partnerships, each with a history of successful implementation and evaluation. Common to all participating cases was a commitment to providing PSTs with an authentic science teaching experience where the PSTs plan, teach, and evaluate a sequence of science lessons for a group of children on-site at schools. These units were vetted by university faculty and were steeped in a constructivist mind set that incorporated an inquiry approach. In all models, PSTs used the 5E instructional model that scaffolds science inquiry through clearly delineated stages: engage, explore, explain, elaborate and evaluate (Bybee, 1989; 2002). This model provided the context for planning and reflection as an on-going process in an effort to facilitate links between theory and practice with the goal of developing meaningful science instruction.

Partnerships are good candidates for case study research because they are well-bounded and defined, where individual cases can be utilized as the unit of analysis (Yin, 2014). We chose to study each individual partnership and then compare cases through multiple case study analysis, providing more robust findings than any one single case (Stake, 2006; Yin, 2014). This approach also provided a meaningful platform to compare and contrast differences in cases while simultaneously investigating the overall impact of all cases being studied (Baxter & Jack, 2008). The multiple case study design allowed both the common and unique features of individual cases to be considered, and thus enabled the incorporation of a range of contexts. Stake (2006) further indicated the importance of case selection in terms of diversity of context in order to demonstrate 'how the program or phenomenon appears in different contexts' (p. 27). The range of contexts represented in this project included programs from metropolitan, regional, and rural campus locations; small and large pre-service teacher cohorts; school-based approaches embedded in coursework and practicum; and partnership approaches ranging from cooperative to collaborative (Kruger, et al., 2009). This diversity ultimately lent to the credibility, transferability and dependability of these findings (Bogdan & Biklen, 2007).

After compilation and reflection on our collective approaches, the research team designed the data collection model that included interviews (PSTs, in-service teachers, and principals), observations, and school-based curriculum created by PSTs. Due to space limitations and the focus of the research question, this effort is focused solely on the impacts on school

Table 1. Comparison of Models of School-Based Primary Science Education Units

Institutional Structures	*Deakin University*	*RMIT University*	*University of Melbourne*	*University of Tasmania*	*Australian Catholic University - Ballarat*
Degree program	B.Ed	B.Ed B.Ed/Disab Master of Teaching	B.Ed / Master of Teaching	B.Ed (Primary) B.Ed (Early Childhood)	B.Ed
Program size	450	280	165	72	24
Required/elective credit	Required	Required	Required	Required	Elective
University class/ tutorial structure	2 hours of tutorial at school each week	1 hour of tutorial at primary school during teaching weeks, 3 hour university tutorials & workshops during non-teaching weeks	2 hour lecture and 1 hour workshop at university each week during semester.	1 hour lecture at university	3 hour tutorial each week during nonteaching weeks
School context	Urban and Suburban contexts	Urban-high need, language minority schools	Urban-high need, language minority schools	Rural and suburban contexts	Rural and suburban contexts
Science teaching time in schools	8-9 hours	8 hours	9 hours (min)	10 hours	9-12 hours (min)
Ratio of primary students to PST	7:1	5:1	24:1 (whole class)	12:1 (pair of PSTs for whole class)	24:1 (whole class)

personnel as perceived by school principals involved in the partnership program. For more detailed information regarding the formation of the partnerships, development of theoretical frameworks and the systematic approach to growing these programs please see Jones et al. (2016).

Data Collection and Analysis

The research team compiled the detailed descriptions of their program procedures and structures in the initial case studies. This process provided insight into the diversity and complexity of the approaches, pedagogies, and issues associated with each of the different programs. Because this effort was focused solely on school partners and the associated impacts of the partnership on their school sites, we focused our analysis on semi-structured interviews carried out with 12 principals from across our partner sites. The participants were purposively selected based on their connection to the partnership and represented a relatively homogeneous population in terms of their professional identities (primary public school principals). The numbers of participants provide an appropriate level of data saturation considering the focused nature of the study and the common experiences of the interviewees (Guest, Bunce & Johnson, 2006).

Reduction of data involved a categorical analysis of the interview transcripts using NVIVO, then a closer thematic analysis where the following key themes emerged: partnership related themes of trust and reciprocity, risk taking, communication and feedback; school impact themes of the valuing of science and strategic relationships with schools; teacher education theme of integrating education research into practice; and themes relating to PST shifting identities, learning, and valuing. This initial round of reduction, using NVIVO, led to the second phase of data analysis where the research team met to review categories and subjected the data set to multiple complete readings in an effort to challenge categories and look for gaps and overlaps in the NVIVO reduction. In some cases categories were collapsed with others, while occasionally more nuanced categories emerged.

This process of generating possible categories, confirming or contradicting those categories with multiple sources of data, and subsequent modification continued in an iterative process until the final analysis was reached (Bogdan & Biklen, 2007). The goal was to develop robust categories representing the most impactful aspects of the partner relationship. An outcome of the study was the development of the "STEPS Interpretive Framework" that provided language around the development, maintenance and evaluation of different types of education-based partnerships (Jones et al., 2016). An analysis of partner school perspectives contributed to the development of this framework. Presented here is one part of that analysis focusing on principal perspectives on why they enter and remain in partnership with the university and what benefits they glean from their involvement.

Findings

Our assumption was that principals were uniquely positioned to best understand the overall context of their schools and the types of teaching taking place within their buildings. The research team was interested in principal perspectives due to their deep understanding of issues facing their schools. In addition, understanding the challenges and benefits that principals envision as they work in school-university partnerships will provide important insights for how university partners can best meet the needs of teachers and children. We also frame that it is essential to better understand principal perspectives since they often make the final decisions on whether to enter into a school-university partnership. The findings presented here focus on the three most populated and robust themes that emerged from the analysis: *Reasons for joining a partnership, maintaining partnerships, and long-term implications*. Specifically, the cross-case analysis provided insights into how principals perceived the program, the reasoning behind why they originally entered into the partnership, and why they continue support the program. The following excerpts are representative of the types of statements that supported the emergent themes.

Reasons for Joining a Partnership

At some of the universities, the school-based approach to teaching primary science teacher education had been employed for some time, as one institution for over 25 years. Some of the schools have been involved for some time. The research team was interested in how and why partners would take on the additional responsibilities of interacting with a university partner, considering the many demands on their time. The data presented here are representative of the key sub-themes that emerged: building staff confidence, providing more science to students, innovative approaches, and giving back to the profession. Principals articulated goals for their involvement and highlighted the associated impacts they perceived this work would have on staff, students, and school communities. In addition, the principals recognized the value of what science had to offer within the curriculum, but they recognized that teachers often lacked confidence with science. Many principals conceptualized the partnership activities as an opportunity for staff professional development:

> Increased awareness, confidence amongst staff. Greater commitment to science as a learning area... Our teachers learning through participation, able to acquire some new resources, which will assist them teaching science within our curriculum. – Jock, Principal Wood Glen.

Jock saw the partnership building teacher self-confidence and he envisioned it would impact how his teachers viewed their science teaching practice.

Other principals articulated a similar desire to link the partnership activities to how it could positively impact the quality and science opportunities offered by their classroom teachers, such as, "As a means of having more science formally in our curriculum offerings" (Tim, Principal Ocean Shoals Primary) and "Opportunities to bring new ideas to curriculum and new ways of doing things. Opportunities for staff to take on leadership roles" (Fionn, Principal Rolling Hills Primary). The principals in these partner schools clearly articulated a vision of staff taking on 'new ways' of approaching science and simultaneously offering more science to children. They saw this as an important aspect of engagement with an area of curriculum they knew was not being addressed as deeply as possible. They hoped that being involved in this program would offer opportunities to engage with science, and in a few cases science was also a strategic curriculum priority for their school.

These insights provide clarity about why principals would provide access to their schools; they envisioned a heightened level of professionalism for their teachers, where the partnership provides a professional development opportunity enabling teachers to spend more time conceptualizing their science practices within partnership teams. However, there also existed a palpable sense of duty for principals to give back to pre-service programs as a sense of duty.

> I think we have a professional responsibility to be part of training pre-service teachers... and it is another opportunity for pre-service teachers to get real-life experience in something important. – Coral, Principal – Broad View Primary

This commitment moves well beyond visions of their own school buildings sensing a broader commitment to helping to prepare future teachers.

Perceived Benefits of Partnerships

Interestingly, principals articulated notions of enthusiasm and ownership about how they envisioned teachers engaging in science and science teaching. This is in direct contrast to the typical vision painted of in-service teachers with regard to science related content in the literature as described by Howes (2002). Principals expressed seeing not only the value of what science had to offer in the curriculum, but also recognized that in-service teachers' confidence levels could be positively impacted through partnership approach.

> I found that that's been one of the benefits of the program is that our teachers actually are feeling more confident about teaching science and working with the kids in that regard. We have so much PD surrounding literacy and numeracy and we have coaches in the region who come out and do that sort of stuff, but

> science has not necessarily had the same. – Felicity, Deputy Principal, North Side Primary

Felicity articulated how the program offered teachers an opportunity for professional development in science by working collaboratively with the PSTs as colleagues, as this proved to be one way for teachers to see inquiry approaches in action with children.

> The benefit for our teachers is that they can see if contemporary teaching of science is being instructed in the colleges and being brought to our schools, our teachers can see in a sense, even though these are only beginning teachers, they can still be modeling best practice teaching in terms of small group work, questioning techniques, use of equipment, referring to resources, and so on. – Mick, Principal – Massey Primary

This becomes an important notion for principals looking for efficient and positive ways to incorporate development opportunities for staff. Here PSTs provided professional development to in-service teachers by proxy as they carried out their units (including theory and pedagogy) informed by close university support.

> It's about the ownership, they've got the ownership of the program and it's great. It builds on the skills that I've been doing here as well. I wouldn't have thought to do solar ovens this year, that was a really interesting one, and there was a couple to do with the water wheels as well, bloody fantastic. – Daniel, Asst. Principal, Bushside Primary

This provides some powerful reminders for PSTs that the content and pedagogy learned in a university context does have an important place in 'real' classrooms. Jock, Principal of Glen Wood primary drives homes this point, "…the increased enthusiasm for science across all stakeholder groups was obvious. Great concept." To this end, the time spent developing lessons along with university staff provided PSTs the confidence to enter into classrooms and carry out these approaches, and the principals recognized that this confidence was contagious across their own staff, impacting those who often shied away from innovative science practice.

Maintaining Long-Term Partnerships

Principals highlighted an important notion about building school culture over time. This happened in two ways: the consistent preparation and expectations in terms of inquiry-based science, and the overall longevity and sustainability of the relationships between partners (many of the partnerships involved were maintained over several years within the same school context). The feedback was consistently positive, and many principals reported increased enthusiasm for science across the school, especially where these partnerships have been ongoing for a number of years:

> I think we've seen it evolve over the time…there are opportunities there that continue…and more people are seeing the benefits, the engagement of the kids and as the understanding of the pedagogy develops…well we can keep working together on this and get something out of it. -Trev, Principal – Long View Primary

Importantly, and despite logistical difficulties, the partnerships were considered a part of the school fabric where principals envisioned continued working relationships between partners well into the future.

> …for me there were a lot of upsides to the actual program. Number one is we had some expertise in the teaching of science, number two it covered our quota on our curriculum for science and it kind of up-skilled our staff on what to do and what to look for and how to run science lessons. -Aaron, Principal – Field Primary

Field Primary had been involved in the program for many years, and over that time their involvement has expanded beyond the science program to included opportunities for the PSTs to be involved in a 'science night' also the teacher educator worked closely with the school to deliver other science learning experiences for the students – this is an example of a long term partnership that had become embedded and valued because of the school's need to have support in offering a vibrant science curriculum. At another school where the program had been running for many years, the university involvement was more or less restricted to the science program despite offers to assist the school in other ways due to other priorities at the school. These two different examples illustrate the different trajectories that these partnerships can take, and that is not necessarily the amount of time in such partnerships but a willingness to work together and that there are identified needs that each other can meet.

Principals indicated their original expectations of program benefits were met: in-service teachers' increased confidence with science content, and their professional development in terms of science pedagogy. Principals added they would like to develop closer links between the school and university with a goal of exploring more sustainable outcomes and finding ways for this experience to have a wider impact in the school. Suggestions to improve the effectiveness of the program included: providing greater opportunities for substantial feedback, extending the partnership approach to other curriculum areas, recognizing the program as mutually beneficial, and coordinating the partnership program with the practicum to take advantage of the relationships built up between the university and the school.

> In terms of the partnership, we'd want it to be seen as something that will be ongoing and something that's of huge benefit to both parties, so that it's not you're coming in and just doing this and then going again, but our kids get a benefit from it, and our teachers will get knowledge and make connections with you, and also that they can help your students too. So kids, staff, and the universities and the schools should all get some benefit out of it; so it's a win/win for us all. -Michael, Principal – Rolling Hills Primary

This principal highlighted the need for continuity of the partnership so that each year the school can expect and plan for the university partnership. A risk factor inherent in this partnership work is that the number of PST enrollments can change over time and from semester to semester. Universities needed to be cognizant of PST numbers and flexible in how placements were made as to ensure that schools were offered consistent opportunities for partnering. Where on-going commitment is demonstrated, mutual benefit is more likely to arise. Under these circumstances, and as indicated by Michael above, the program has the potential to serve not only as professional development opportunities as teachers work collaboratively with PSTs as colleagues, but it also offers this development through positive and cost effective ways.

Maintaining these relationships over the long-term relied on both the willingness and ability for partners to share areas of concern and ways to improve the program. As an example of this openness, we highlight the suggestions of Olde Towne Primary principal:

> I think there'd be some benefit if there was some sort of feedback or discussion at some point throughout the program that involved the classroom teachers, to talk about what the students [PSTs] were doing what they were observing and then feed that into the classroom teacher and have some discussion there about the why's and the wherefore's. – Arabella, Olde Towne Primary

A key feature of the work across programs was the reciprocal nature of all parties to listen and learn from one another. These suggestions became the basis for future approaches that worked to more clearly define the types of communication between teachers and PSTs. Interestingly, Arabella's suggestion does not just signify a measure of trust with the university teams by advocating for new approaches, but also indicated a clear respect for the value of PSTs teachers thoughts, ideas and observations of practice.

The notions of value, continuity and open communication were key factors impacting long-term sustainability of partnership arrangements. This typically manifested through a willingness of schools and universities to continue to be engaged and responsive to one another's needs. Apart from 'need' other factors that influenced whether schools chose to continue related to whether schools felt that the effort and time required translated into quality learning experiences for primary students as well as professional support for teachers.

Discussion

The partnerships described in this paper refer to programs that are not usually part of standard practicum arrangements, but as part of PST science education coursework and/or methods courses. While these partnerships had been ongoing in most of the universities involved in the study, through our analysis we were struck by the ways these approaches impacted on the partner schools, as interpreted through the perception of principals. The principals reported that the partnerships were a catalyst for science content growth for both their students and teachers. This growth stemmed mainly from the collaboration within and across partner groups: the two-way communication needed for developing and maintaining trust, acknowledgment of the risks, and in achieving reciprocity where each partner was willing to contribute to meeting the needs of the other. Kruger et al. (2009) argued that there are three key factors of successful partnerships: trust, mutuality and reciprocity.

In keeping with Kruger et al. (2009), in a broader analysis of the partnerships involved in this study, trust, mutuality and reciprocity were identified in a set of principles of partnership practices as part of the "STEPS Interpretive Framework" (Jones et al., 2016). The activities and collaborations between university and primary school identified by the school principals embodied these factors. These factors, we argue, are what has made these partnerships so long lasting. These findings support Alemán et al. (2017) concerning the essential nature of buy-in from the school-based administration as well as purposeful clarity for roles and expectations that is communicated across all members of the partnership. These are typical features of successful partnerships in terms of longevity.

Trust

Partner schools welcomed PSTs into their classrooms outside of the formal university practicum, and before the PSTs had finished their university coursework. This is testament to several factors: schools' recognition of their important role as part of initial teacher education, trusting university faculty to amply prepare PSTs for the experience, willingness to make classrooms available for 1-2 hours a week, provision of classroom spaces, and a willingness to provide feedback to PSTs. This trust was built over time and through ongoing partnerships between the university and school staffs. Principals articulated that this trust laid the foundation for the work done within the program, and all aspects of the work together had to be woven within this fabric of trust. These trusting relationships were important not only between staff, principals, and teachers, but for PSTs and their mentor teachers as well. The latter of these will be part of a future manuscript depicting the impacts on teachers at these sites.

Mutuality

Mutuality depicts the degree to which each partner understands that working together leads to gains for every party involved. The key element from the partnerships was the shared decision-making process crafted at each school site in an effort to meet each partner's needs. This shared process included listening and sharing ideas about the goals of each entity in terms of standards, content, and engagement. It also involved working through and respecting the crowded calendars and schedules of each institution. As a result of these efforts, principals clearly articulated the benefits they recognized for their schools. For example, Rolling Hills' Principal (Michael) requested greater integration of the PSTs into other content areas. This illustrates the power he attributed to the partnership process where the benefits should be extended well beyond science. Furthermore, it speaks to the idea that content-focused partnerships could be an essential first phase in developing more meaningful and integrated PDS models once the relationship between university and primary school site has been established.

Reciprocity

The notion of reciprocity speaks to the value each partner holds for the other (Kruger, et al., 2009) when carrying out partnership activities. This concept grows directly from trust and mutuality, where if those categories have been properly developed, the reciprocity becomes a logical conclusion of partnership efforts. Principals celebrated the partnerships as part of the school fabric as they heralded the programs in school newsletters, conversations with parents and students, as well as school and class websites. When university students arrived at school sites, there existed a palpable excitement with the primary children in the classrooms and courtyards where they would call out and run up to the science teams and excitedly ask questions directed to the PSTs. As a result, principals saw the value of the relationships and envisioned a continued working partnership well into the future.

Other researchers have also articulated the essential role of reciprocity in successful partnerships; those with relationships of equality demonstrated through a shared vision, equitable use of available resources, and a balance of power between stakeholders in decision-making processes (Argyris & Schon, 1996). Furthermore, sustaining partnerships requires reciprocity in communication, and schools must realize potential benefits in order to commit to and remain in partnership with a university program (Peterson & Treagust, 2014). Raising school and university awareness of these types of successful partnership arrangements legitimizes their use, and demonstrates that they can be practically sustained.

Sustained Engagement

Measuring successful partnerships cannot be done unless the programs have been in place for a number of iterations, and it is ultimately a long-term exercise (Burton & Greher, 2007). Most programs involved in this project have been in place for more than a decade. They have consistently carried on despite changes in staffing at the schools and universities involved. This longevity speaks to the value of the partnerships for all stakeholders. It promotes the idea that schools and universities can negotiate an arrangement that suits them, and highlights the importance of schools and universities working together in the preparation of new teachers. With recent concerns about the effectiveness of teacher education and the positioning of universities, this project is demonstrative of a best practice that can be applied and modified to suit varied situations.

Conclusions

These partnership programs explicated the many facets regarding the creation, development, and maintenance of science-focused partnerships. We argued that such partnerships were valuable, possible, and sustainable over the long-term in a range of contexts. The findings uncovered the myriad of reciprocal benefits perceived by school principals involved, while simultaneously meeting university goals of preparing teachers for future science practice. The school-based science programs were initially designed to specifically focus on PST development. However, as the partnership relationships continued, it became apparent that there were benefits beyond the PST experience. This study was an attempt to better understand the principal perceptions regarding what benefits they envisioned as part of engaging with science-focused partnerships. The findings point to an increased valuing of science by school communities, professional development for teachers through engagement with PST projects, and additional time and experiences for children to participate in inquiry-based science.

A major strength of this approach was that it simultaneously addressed two key areas of national concern in Australian education: first, the promotion of more effective practical teaching experiences are an important vehicle to bridge the often referred to "gap" between university teaching and actual classroom practice; secondly, the principals clearly articulated a perceived increase in confidence and competency of both in-service and pre-service primary teachers to teach science. This is particularly important given the introduction of the Australian Curriculum and the mandatory requirement for science to be taught at all year levels. These findings also have clear implications for programs beyond Australia and offer insights for how to build and operate partnerships in other contexts.

An important conclusion from this research effort was that these programs were not simple approaches, and required sustained commitment from all parties. A commitment on behalf of the university is required for time, resourcing, and access to schools, all of which are common barriers when embarking on and maintaining these programs over the long-term. In addition, there must be a commitment on behalf of the schools to recognize the needs of the universities in terms of time, space, and supervision or feedback for PSTs.

All partnership models, described in this project, were initiated by the primary science teacher educators who devoted time to establishing partnerships with schools, modified the curriculum of the science education units to incorporate the school-based experience in response to school feedback, and facilitated the development of PST unit planning in order to create positive primary student learning experiences. In many cases, the off-site model meant facing challenges brought on by the institutional structures of the universities that housed the teacher education programs; for example, scheduling students' time at school sites around PST university schedules regarding their other coursework. Other challenges included the increased resources, cost, and time associated with university faculty attending off site schools, travel time and expense, as well as time spent meeting and facilitating at school sites.

This research study has identified key perceptions of school principals that spoke to broad-based benefits for their staff, students and broader school community. Partnerships steeped in trust, mutuality and reciprocity were critical for sustained partnership engagement. The data demonstrated that partnerships built over time have the potential to help each partner better understand the needs, challenges and successes of the other. Indeed, partnerships are essential for teacher education, especially for enhancing primary science teacher education. Given the limited opportunities for PSTs to observe science being taught and to teach science as part of their teacher education programs, Peterson and Treagust (2014) advocated for primary science teacher education to incorporate reciprocal relationships with schools to improve science teaching. The recent TEMAG report (2015) has directed teacher education to embrace university-school partnerships, and introduce "subject specialisms", especially in science, mathematics and languages, into Australian primary teacher education. The school-based approach to primary science teacher education is one way of responding to both of these directions. The data presented in this paper show that these partnerships offer benefits to the in-service teachers involved in such partnerships, but also in building relationships between universities and schools. Schools play an essential role in teacher education. Partnerships that maintain professional integrity and recognize the essential roles of both universities and schools are needed to enhance learning and raise awareness to the joys and value of teaching traditionally marginalized subjects, such as science, in primary schools. SUP

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❖ ❖ ❖

Dr. Andrew Gilbert - Associate Professor of Science Education at George Mason University. His main research interests include partnerships, pre-service teacher development of inquiry-based science instruction and social justice.

Dr. Linda Hobbs - Senior Lecturer of Science Education at Deakin University. Her research interests include partnerships in primary teacher education, out-of-field teaching in secondary schools, and STEM education.

Dr. John Kenny - Senior Lecturer in Science Education at the University of Tasmania. John's broad research interests include science education and higher education policy.

Dr. Mellita Jones – Lecturer, Australian Catholic University, where she teaches in Science Teacher Education. Her research is concerned with effective teacher education where her focus has been on school-university partnerships.

Dr. Coral Campbell - Associate Professor with the School of Education, Deakin University, Australia. Coral's research interests are in early childhood and primary science, design technology, and environmental education.

Dr. Gail Chittleborough - Senior Lecturer in Science Education at Deakin University. Gail's major research focus has been in the use of models, representations and digital resources in learning.

Dr. Sandra Herbert - Senior Lecturer in the Faculty of Arts and Education at Deakin University. She is interested in high quality preparation of primary and secondary teachers.

Dr. Christine Redman - Senior Lecturer at Melbourne University. Her research and teaching span Science, Technology and ICT education.