School-based pedagogies and partnerships in primary science teacher education: the Science Teacher Education Partnerships with Schools (STEPS) project

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School-based pedagogies and partnerships in primary science teacher education: The Science Teacher Education Partnerships with Schools (STEPS) Project

Final report 2015

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List of acronyms used

ASERA: Australasian Science Education Research Association
GPP: Guiding Pedagogical Principles
GUSP: Growing University-School Partnerships
PCK: Pedagogical content knowledge
PET: Partnership Evaluation Tool
PNT: Partnership Negotiation Tool
PMT: Partnership Monitoring Tool
PST: Pre-service teacher
RPP: Representing Partnership Practices
STEPS: Science Teacher Education Partnership with Schools
Executive summary

This report documents the outcomes of a project exploring, analysing, collaborating and generating new ways of thinking about university-school partnerships and the experiences that they enable. The Science Teacher Education Partnerships with Schools (STEPS) Project team consisted of eight science education academics from five universities and eight campuses: Deakin University (lead), The University of Melbourne, RMIT University, University of Tasmania and Australian Catholic University.

Project context

Research has shown that many primary school teachers lack confidence and avoid teaching science; so often pre-service teachers (PSTs) have little or no opportunity to teach science in their normal practicum (Tytler, 2007). The STEPS Project team members came together due to a common interest in attending to this situation through the use of university-school partnerships to provide an authentic science education experience for PSTs. The project has relevance to two significant areas of research and inquiry in the teacher education domain:

- on-going concern, nationally and internationally, about the effectiveness of teacher education programs in preparing PSTs for the classroom and calls for more in-school time for PSTs (Chubb, 2013; TEMAG, 2014); and
- widespread national and international concern about the state of science education in primary schools and the preparedness of PSTs to teach science (Tytler, 2007).

In response to both of these concerns, the STEPS Project team undertook a meta-analysis of the university-school partnerships from five universities in order to understand the methodologies, informing theories, and principles associated with establishing and maintaining strong working partnerships, focusing explicitly on science teacher education. The purpose was to provide a language and set of materials to support others interested in embarking or improving on such partnerships. This meta-analysis focused on the five independently developed models of school-based approaches to primary science teacher education currently existing at these universities and utilised by members of the project team to enhance the learning of PSTs in science education. In each model, PSTs attend local schools to plan, teach and reflect on their experiences; these experiences are not the typical practicum arrangements of each university but occur within science education units and focus explicitly on the development of teacher identity and professional practice as teachers of science.

An extensive literature review of the research on partnerships in learning, science education and teacher education supported our view that the authentic nature of the learning embedded in these five programs assisted PSTs to link the theory and practice of education, to build their confidence to teach science and better understand the complexities of the teaching process. This was further corroborated by data from all stakeholders: school principals, PSTs, participating teachers and teacher educators.

The STEPS Project intended to:

- synthesise the variety of teaching and reflective practices including informing theories of existing successful school-based science teacher education programs;
• document exemplars of innovative pedagogies that represent the range of contexts, constraints and affordances that lead to quality student outcomes;

• create an Interpretive Framework informed by contemporary practice that can guide improvement of science teacher education programs;

• determine sustainable methods for establishing and maintaining effective school-university partnerships generalisable across a range of contexts; and

• facilitate uptake of innovative school-based practices within the sector for the purpose of improving the educational outcomes of science teacher education programs, and teacher education programs generally.

Collaboration and sharing between the project team was an important process leading to collective insights documented in a series of case studies. The success of this project relates directly to the harnessing of the combined wisdom and experience of these academics committed to the implementation of school-based science education for PSTs. Their commitment is based on the strong belief that authentic experiences in science teaching for PSTs lead to improved long term gains in science learning for primary school children and their teachers.

Analysis of the five successful models of the school-based approach involved PST surveys, and interviews with university and school key stakeholders in the partnerships. In order to widen the applicability of the project, other Australian science teacher educators using similar approaches were also interviewed. In addition, an extensive annotated bibliography was developed, collating and reviewing the current state of research in this field.

**Project outputs**

In examining the variety inherent in each of the five independent science education programs as case studies, the project team identified key pedagogical principles for and factors that affected the formation and effectiveness of the partnerships. Ultimately this led to the development of an Interpretive Framework, which is a four-part framework for describing: 1) the processes of growing partnerships involving initiating, maintaining and evaluating a partnership; 2) a typology of partnerships that recognises value in all; 3) pedagogies or practices that can emerge because of partnerships in primary science education; and 4) how a partnership can lead to growth and change. These parts inform a set of action planning tools that can be used to support partnership negotiation, maintenance and evaluation.

The first two parts of the framework—represented as the Growing University-School Partnerships (GUSP) and Representing Partnership Practices (RPP)—are the organising elements of the Interpretive Framework. They underwent extensive discussion within the project team and trialling and dissemination to wider audiences of educators through conference presentations, a pre-conference workshop, and journal articles, as well as application to other projects focusing on partnerships. This process led to iterative improvements and the development of the other parts of the Interpretive Framework, all of which are described in this report.
The suite of STEPS outputs is described in detail in Chapter 4 of this report. They should prove useful for teacher educators and schools who wish to explore partnership arrangements further. The resources are accessible through the STEPS Project website: http://www.stepsproject.org.au. In addition to the GUSP and RPP, the various resources include: an annotated bibliography (Speldewinde, 2014); narratives that illustrate the GUSP and RPP; partnership principles capturing the underpinning theories and ideologies that guide quality partnerships; vignettes to speak to particular stakeholders exploring partnerships; Guiding Pedagogical Principles (GPP) that capture pedagogical principles underpinning the practices that can be enabled by partnerships; a growth model outlining how partnerships foster change and growth; action planning tools to negotiate, monitor and evaluate partnership arrangements; and a promotional video available to view on the project website.

Key findings
Through the language and illustrations of practice included in the Interpretive Framework and other outputs, the project articulates the mutual benefits involved when using university-school partnerships to support teacher education, and the specific roles played by different stakeholders in partnership initiation, maintenance and evaluation. The analysis has shown that such learning experiences enhance PSTs’ understanding of links between theory and practice, and build their professional identities and confidence to learn and teach science. The project also identified the potential of these arrangements as professional learning opportunities for teachers in the classroom.

The report draws attention to the notion that partnerships are only valuable if they have impact; but that the intended impact depends on the need and rationale, and what each partner is willing to contribute. The Interpretive Framework describes that developing successful university-school partnerships involves appreciating that it is a process requiring ongoing attention to the changing needs and institutional requirements, and where the relationships involve a degree of risk taking and trust, reciprocity and mutuality, respect, adaptability and responsiveness. There are a diversity of types of, and purposes for, partnerships.

The premise of the university-school partnerships represented in the Interpretive Framework is twofold: 1) the teacher educator’s role in shaping PSTs’ experiences and teaching PSTs how to effectively and critically reflect on their experiences is essential; and 2) school-based teaching experiences are essential for the development of PSTs’ professional identity and practice, and not just in the traditional formal practicum arrangements. While schools play an essential role in teacher education, the expertise provided by university teacher educators is needed to foster PST learning. Partnerships that maintain professional integrity and recognise the essential roles of universities and schools are needed to enhance learning and raise PSTs’ awareness of the value of teaching marginalised subjects, such as science.

Application and Impact
The STEPS resources have been designed to be applicable to a variety of institutions in and beyond Australia. The Interpretive Framework has applications beyond the STEPS Project as a framework for assisting interested parties to initiate, maintain, grow, and/or evaluate projects. In particular, any partnership that is based on an educative process can benefit.
A key strength of this project was that it simultaneously addressed two key areas of national concern in education: the promotion of more effective practical teaching experiences that bridge the theory practice gap that be-devils many teacher education programs; and the confidence and competency of primary teachers to teach science. Both are pertinent at a time when the introduction of the Australian Curriculum is mandating that science be taught at primary schools, and that the proportion of time spent teaching science should be raised from an average of three percent closer to the European average of 9.5 percent (Chief Scientist, 2013).

It is too early to assess the ongoing effects of this project, and potential plans to extend the project and explore its applicability to other areas are underway. However, given the range of research data and literature that informs the project, the team is confident the outcomes are valid and can make an important contribution to the development of more effective university-school partnerships. Furthermore, the release of this report is timely given the current reviews into the structure of teacher education programs and the recent publication of the report by the Federal Government, *Action Now: Classroom Ready Teachers* (TEMAG, 2015) that stresses the importance of university-school partnerships in teacher education. A program of research and promotion of the *Interpretive Framework* is planned. A series of Roundtables in May 2015 will be a key mechanism for disseminating the STEPS outputs and facilitating uptake in the sector.
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Chapter 1. The STEPS Project: Context and aims

Partnerships between universities and schools are becoming increasingly relevant in teacher education. TEMAG (2014, 2015) encourages universities and schools to find new mutually beneficial ways of working together. The STEPS Project was a collaboration of seven primary science teacher educators from five universities: Deakin University (lead institution), RMIT University, The University of Melbourne, Australian Catholic University, and University of Tasmania. The focus of the collaboration was to analyse their school-based approaches to teaching primary science education units. These approaches, while not necessarily new, are innovative and exemplary practice and achieve quality learning outcomes for pre-service teachers as well as benefits for participating schools.

1.1 Project Aims

The project aimed to undertake a meta-analysis of the methodologies, informing theories, and principles associated with establishing and maintaining strong working partnerships with schools designed to provide PSTs with an opportunity to plan and implement a science learning sequence to a group of primary school children, and reflect on their experiences. Together these teacher educators explored, analysed, and collaborated to generate new ways of facilitating productive partnerships.

The STEPS Project intended outcomes were:

- Synthesis of the variety of teaching and reflective practices and informing theories used in school-based science teacher education programs;
- Documentation of exemplars of innovative pedagogies that represent the range of contexts, constraints and affordances that lead to quality student outcomes;
- Creation of an Interpretive Framework informed by contemporary practice that can guide improvement of science teacher education programs;
- Sustainable methods for establishing and maintaining effective school-university partnerships generalisable across a range of contexts; and
- Facilitation of the uptake of innovative school-based practices within the sector for the purpose of improving the educational outcomes of science teacher education programs, and teacher education programs generally.

The deliberations of the STEPS Project team informed the development of resources, principles, models, and an Interpretive Framework designed to guide the establishment and maintenance of university-school partnerships. The stated project deliverables were:

1. An Interpretive Framework, including written principles relating to establishing and managing partnership arrangements, critical success factors, and structures designed to enhance critical reflective practice
2. Case studies of effective practice
3. A Project website, with a publicly available annotated bibliography
4. Newsletters sent out to all participants and stakeholders
5. Publications and presentations, both national and international

The project provided significant answers to issues concerning the relationship between university teacher education, schools and PST practice arrangements. The outcomes present and advocate for a discipline-based partnership for science teacher education, with
significant potential for other curriculum areas and other partnership arrangements. The exploration of the quality of the learning experiences for PSTs, centred in evidence-based reflective practice, has informed current concerns about defensible teaching standards and knowledge of pedagogies.

1.2 Context and rationale
Recent commentaries and policies on teacher education have highlighted the need for PSTs to engage with the teaching profession in authentic ways (TEMAG, 2015). STEPS investigated science teacher education units delivered through a school-based approach. These innovations in primary teacher education pedagogy bridge theory and practice within partnerships between the academy and the profession. In these collaborative programs PSTs design and implement science curriculum in primary schools as part of their coursework. Central to this approach is PSTs’ guided reflection on their practice supported by academics in partnership with teachers (Kenny, 2010).

Each model of school-based delivery of science education provided by the project team had a history of successful implementation and evaluation, and a common commitment to bridging theory and practice through authentic teaching experiences. These models were generally locally developed, grounded in particular contexts, and reflect the teacher educators’ knowledge and beliefs about science teaching and learning. The efforts of these partnerships have clearly provided a pathway to excellent science practice in primary contexts. Well-defined and sustained partnerships built on respectful, reciprocal relationships deeply impacted science contexts in primary schools.

Each model accords with acknowledged features of good practice, including:

- a close relationship between educational theory and classroom practice;
- productive partnerships between universities and schools in teacher education, involving academics, school teachers and leaders, PSTs and school children; and
- centrality of reflective practice focusing on the development and implementation of curriculum, the relational and instructional elements of the pedagogical contract, and the development of PSTs’ professional identity.

The focus on science education is grounded in the reported disengagement of school students from science, and concerns about the amount and quality of science teaching in primary schools (Dobson, 2003). A large proportion of primary teachers have low levels of confidence and background knowledge in science, which impacts both their willingness and ability to teach science effectively (Tytler, 2007). By providing opportunities for PSTs to successfully teach science to children, these low levels of self-efficacy about their ability to teach science should improve (Campbell, 2006; Kenny 2010). While there is little evidence to date about the sustained impact of these types of programs on in-service teacher practice, the incorporation of partnerships into science teacher education provides benefits for PSTs’ confidence to teach science and to develop their science pedagogical content knowledge (PCK) (Kenny, 2010, 2012). Integration of theory and practice through the key role of reflection better prepares PSTs to “handle the problems of everyday teaching through theory-guided action” (Korthagen, Loughran, & Russell, 2006, p. 1021). Effective reflective practice using concrete examples has the potential to bridge the theory practice divide (Loughran, 2002). The role of the university lecturer is crucial in supporting PSTs when designing authentic learning experiences (Howitt, 2007). Teacher educators are also
essential in facilitating PSTs’ reflection, assisting them in recognising those aspects of their experiences that are important for enhancing teaching and learning (Loughran, 2006). Indeed, Darling-Hammond (2000) has noted that more effective teachers emerge from teacher education when extended practicum experiences and university coursework are tightly integrated.

However, providing mastery experiences alone is not sufficient if meaningful understanding of science teaching and learning is to be achieved (Korthagen, et al., 2006). The research literature points to critical success factors that are required for productive relationships, but many of these factors arise from specific programs. The STEPS Project was designed to establish critical success factors that are inclusive of a variety of partnership arrangements and pedagogies, and to situate these within a coherent partnership model: the Interpretive Framework.
Chapter 2. Locating the project in current literature

The STEPS Annotated Bibliography (Speldewinde, 2014) maps the literature pertinent to the project. It provides both the theoretical foundation for the group analysis of data, and more importantly, serves as a rich repository of information for educators wishing to create and sustain their own partnerships. The annotated bibliography is published on the project website and has an ISBN. The following categories emerged through the dual process of building the annotated bibliography and data reduction processes:

- Theory and Practice
- Partnerships
- Reflection
- Confidence and Identity
- Science teaching/Science education
- Placement
- Feedback on the model

The final version of the annotated bibliography directly connects the practical classroom efforts across the five institutions with theoretical literature regarding the development of meaningful and sustainable partnerships.

2.1 The state of primary science education

The quality of science education has been the focus of a number of research projects nationally and internationally (see, for example Dobson, 2003; Tytler, 2007). These studies consistently report that there is a decline in student engagement with science across the middle years of schooling, and that, in the primary years, science is often approached in a manner that is disconnected from the lives of students (Keys, 2005; Tytler et al., 2008). In particular, the relevance of science to young people’s lives and the particular pedagogies being adopted by teachers of science has been questioned. There are indications that a large proportion of primary teachers have low levels of confidence and background knowledge in science, which impacts both their willingness and ability to teach science effectively (Tytler, 2007).

These are critical areas of concern when considered in combination with other studies which show that the development of children’s understandings is fundamentally tied to the quality of teaching (Darling-Hammond, 2000; DEST, 2003), thus highlighting the need for significant improvements in current and future primary teachers’ attitudes, personal efficacy and ability to teach science effectively.

In Australia, there has been a long history of science instruction in primary schools suffering from low teacher confidence, poor knowledge, and a packed curriculum and time restrictions. In addition, the more pressing issues of literacy and numeracy often push science to the periphery in many primary schools (see for example critiques offered by Goodrum, Hackling, & Rennie, 2001; and Tytler, 2007). As a result, the image of a burgeoning “crisis of interest” in science education is being promulgated (Chubb, 2013) in response to a picture of school science that often misses the possibilities for engaging science approaches in favour of sanitised, and predictable forms of science that permeate...
primary science teaching (Tytler, 2007). In Australia, time taught teaching science lags far behind other content areas, which is reflected in achievement levels below other developed nations (Marginson, Tytler, Freeman, & Roberts, 2013; Peterson & Treagust, 2014). Poor teaching practices and limited opportunities directly impact student engagement with school science and teaching: “considerable evidence of student disenchantment with school science in the middle years, and a growing concern with a current and looming shortage of qualified teachers of science” (Tytler, 2007, p. 1).

2.2 Partnership theory

The STEPS Project provided evidence that in-service teachers who worked in partnership with PSTs viewed their participation as professional learning, and that the most productive relationships arose when a good professional relationship was established between the PSTs and their in-service colleagues.

In the simplest terms, partnerships can be viewed as two or more entities working toward a shared vision. For the purposes of this study we defined the notion of partnership as the “concept of a genuine university-school “partnership” [that] connotes a collaboration of professional conversations, collegial learning and aligned processes” (Rossner & Commins, 2012, p. 2). This definition for partnerships rests on the essential work of Kruger et al. (2009), who argued that there are three key factors of successful partnerships: trust, mutuality and reciprocity. Trust is constructed as understanding between stakeholders that there should be benefits to be gained for each stakeholder; mutuality depicts the degree to which each partner understands that working together does lead to gains for each; and reciprocity speaks to the value each partner holds for the other (Kruger, Davies, Eckersley, Newell, & Cherednichenko, 2009). Successful partnerships are ones that convey an affinity for an equal relationship demonstrated through a shared vision, equitable use of available resources, and a power balance between stakeholders in decision-making processes (Argyris & Schon, 1996).

School-university partnerships provide the basis for these school-based experiences. Formal practicum arrangements offer obvious partnership opportunities and have been the subject of a variety of Australian Learning and Teaching Council (ALTC) funded projects. For example, the project lead by Calvin Smith (funded 2011) examining the impact of “work integrated learning” on work-readiness is underscored by the need for strong links between universities and the profession (Smith, Ferns, Russell, & Cretchley, 2014), as is the project lead by Ryan and Jones (2012) exploring practicum arrangements in rural and regional areas. The ALTC project “Practicum Partnerships: Exploring models of practicum organisation in teacher education for a standards-based profession” (Ure, Gough, & Newton, 2009) found a range of tensions and ambiguities inherent in traditional practicum partnership arrangements, and made a number of recommendations concerning the need for closer collaboration between universities and schools; clarification of the purpose of the practicum; and conceptualisation of effective teaching and teacher development. Their draft recommendations included a call for research on “increasing the links between the placement experience and the academic content of programs to create more informed knowledge about the application of pedagogy” (p. 56). In accordance with these recommendations, the STEPS Project was able to make headway through connecting science content directly with school-based placements. This provided powerful insights for
the benefits on PSTs’ performance and confidence in both constructing science curriculum and enacting inquiry-based science pedagogy.

Establishing direct contact between the participants early, and reducing the supervisory aspect of the relationship between the pre-service and in-service teachers, contributes to the relationship becoming one of mutual learning (Jones, 2008; Kenny 2012; Murphy, Beggs, Carlisle, & Greenwood, 2004). This mutuality also helps to reduce the “threat” of assessment PSTs often associate with the normal practicum, which can impede their willingness to trial different approaches in the classroom (McNamara, Jones & McLean, 2007). While this research points to critical success factors leading to productive relationships in specific programs, the STEPS Project established critical success factors that are inclusive of a variety of partnership arrangements and pedagogies, and these are situated within a coherent Interpretive Framework (see Section 4.4).

The STEPS Project has provided significant answers to issues currently occupying the minds of teacher educators and key policy makers concerning the relationship between university teacher education, schools and PST practicum arrangements. These partnerships are not intended to replace traditional practicum arrangements but rather to form discipline-based partnerships as an important adjunct to current practicum organisation. The STEPS project focussed on science in particular, but potentially provides guidance for the establishment of partnership arrangements for other curriculum areas and other educative partnerships. In addition, the STEPS approaches to assessment of students centred in evidence-based reflective practice, informs current concerns about defensible teaching standards and knowledge of pedagogies.

2.3 Self efficacy and Identity theory in relation to partnerships

Central to the school-based approaches used by the STEPS team is to provide experiences that might disrupt students’ negative perceptions of science, and to foster at least “provisional identities” (Ibarra, 1999) in relation to science where they can begin to see themselves as being able to teach science. The school-based experiences provided the basis for future experiences once they enter primary schools. According to Dewey (1938, p.37):

> every experience affects for better or worse the attitudes which help decide the quality of further experiences, by setting up certain preferences and aversions, and making it easier or harder to act for this or that end. Moreover, every experience influences in some degree the objective conditions under which further experiences are had.

A teacher’s work and identity, or “sense of self” (Helms, 1998), is directly related to their knowledge and appreciation of the subject (van Manen, 1990; Hobbs, 2012). For some PSTs with negative or limited experiences with science, seeing science through the children’s eyes can lead to a new appreciation for science, new motivations to engage with science around them, and a transformed identity and self-efficacy for teaching science.

In his seminal work, Bandura (1977) purported that mastery experiences, those experiences of personal accomplishment, are one of the most influential sources of efficacy information. Furthermore, an individual’s perceived efficacy is a strong determining factor in: the types of activities and settings in which individuals elect to participate (Bandura, 1977); their resilience and perseverance to overcome perceived barriers (Goddard, 2003); and the types of strategies with which they select to teach (Jones & Carter, 2007). This suggests that, if
provided with opportunities to successfully teach science to children, PSTs’ low levels of self-efficacy and belief about their ability to teach science would improve. Subsequently, mastery experiences with guidance in the selection of appropriate science teaching strategies should increase PSTs’ willingness to plan and conduct science lessons and improve their selection of suitable activities. Evidence from experience with the five models suggests that the approach is effective in increasing PSTs’ confidence and interest, and capabilities in teaching science. However, providing mastery experiences alone is not sufficient if meaningful understanding of science teaching and learning is to be achieved. Korthagen et al. (2006) argued that learning does not occur through the experience, but rather through reflection on experience and through interaction with others. Furthermore, effective reflective practice using concrete examples has the potential to bridge the theory practice divide (Loughran, 2002), an element that teacher education courses are often criticised as lacking (Darling-Hammond, 2006; House of Representatives Standing Committee on Education and Vocational Training, 2007; Parliament of Victoria, Education and Training Committee, 2005).

Darling-Hammond (2006) offered the view that the integration of course-work and fieldwork assists PSTs to develop a deeper understanding of theory by applying concepts learnt in course work, and thereby better supports student learning. This integration of theory and practice through the key role of reflection enables PSTs to “handle the problems of everyday teaching through theory-guided action” (Korthagen et al., 2006, p. 1021). In fact, Darling-Hammond (2006) asserted that teacher education programs need to provide opportunities for PSTs to analyse and apply theory, reflect on their subsequent practice, and have further opportunities to retry and improve.

The literature discussed in this chapter provided the theoretical framing for the STEPS project. The next chapter describes the approach taken to bring together the experiences from the project team to develop the Interpretive Framework informed by this theoretical framing.
Chapter 3. Project approach

The STEPS Project adopted a multiple case study methodology. In keeping with Yin (2009), our study involved a number of single cases where each site was “the subject of an individual case study, but the study as a whole covers several [sites] and in this way uses a multiple-case design” (Yin, 2009, p. 53). For the STEPS project each university campus acted as an individual case(s) of school-based science teacher education. Across the five universities, eight campuses were involved in the study (three campuses from one university, two campuses from another, and one campus from each of the remaining universities), providing an ideal number of cases for a multiple case study design (Stake, 2006). Data generated at each site was combined through a multiple case analysis.

Careful selection of the cases was also important in the design with the diverse range of approaches and experiences informing the project outcomes, thus consistent with holistic case study design (Yin, 2009). Holistic case study design allows both the common and unique features of individual cases to be considered, incorporating a range of contexts. Stake (2006) 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 the STEPS Project included programs from metropolitan, regional, and rural university campus locations; small and large pre-service teacher cohorts; school-based approaches embedded in coursework and practicum; and different partnership approaches ranging from complementary to collaborative (Kruger et al., 2009). Representing this diversity of contexts was essential in ensuring that the Interpretive Framework would be transferable and applicable across a range of contexts, enhancing the potential for greater uptake within and beyond other teacher education programs.

3.1 Developing the Interpretive Framework

The Interpretive Framework is a four-part framework for describing:

1) the processes of growing partnerships involving initiating, maintaining and evaluating a partnership;
2) a typology of partnerships that recognises value in all;
3) pedagogies or practices that can emerge because of partnerships in primary science education; and
4) how a partnership can lead to growth and change.

The Interpretive Framework was developed through an iterative process using data collected at each phase of the project to develop and refine its various aspects.

Phase 1 of the project involved sharing and documenting current practice. Discussion led to a cross-case analysis that identified common and unique features of the partnership approach undertaken at each university.

Phase 2 consisted of a detailed review of literature to situate the cross-case analysis within the current thinking across the sector on the issues in science education, teacher education and teacher identity development more broadly, and the extent and impact of school-
The STEPS project

university partnerships. This allowed for a deeper analysis of practice, and assisted in identifying key themes (Figure 1) that informed further development of the Interpretive Framework. See Appendix B for a description of the relationships between the elements in Figure 1.

Phase 3 involved data generated from key stakeholders within the individual case studies. Data included questionnaires and interviews with pre-service teachers and interviews with teacher educators, school teachers and principals involved in the 2013 programs. These data ensured that the Interpretive Framework would be informed by the experiences of the students, teacher educators, and school stakeholders.

Phase 4 enabled other examples of partnerships in science education to be captured through interviews with science teacher educators from around Australia.

Stake (2006) claims that at least three sources of confirmation are needed for data to provide “assurances that key meanings are not overlooked” (p. 33). Multiple sources of data collected by the STEPS project have assisted in confirming the key elements of the multiple cases, thereby ensuring the credibility and reliability of the Interpretive Framework. The data included:

- 106 pre- and 105 post-questionnaires from PSTs
- 10 PST interviews
- 15 interviews with university staff
- 80 interviews with teachers and principals
- 20 interviews with other teacher educators

The longitudinal, purposive, and collaborative approach adopted by the project team, and the inherent diversity of contexts and range of data informing the development of the
Interpretive Framework, provided confidence in its validity and potential to be adapted to other contexts in teacher education and education more broadly.

### 3.2 Current and future activities

In 2014-2015, the development of the Interpretive Framework continued. Data from key stakeholders informed the development of illustrative narratives and vignettes describing key aspects of the experiences of each stakeholder group. Along with the case studies, the suite of research-informed descriptions of practice provide context for those interested in exploring partnership arrangements or developing existing partnerships. All the resources are currently being incorporated into the existing materials on the STEPS Project website.

In order to extend awareness of the STEPS project and gauge the attitudes of the sector to implementing similar partnership arrangements, three Round Table discussions are planned for 2015 in Tasmania and Victoria. These will explore the applicability of university-school partnerships to the teacher education context.
Chapter 4. The STEPS resources

This chapter describes the suite of resources developed through the STEPS project, intended to facilitate and support the implementation and/or growth of similar partnership arrangements between universities and schools. These resources represent a major contribution to the establishment and maintenance of university-school partnerships, which also have potential to be employed beyond science teacher education. This chapter describes, firstly, how the analysis informed resource conceptualisation, development and refinement; and secondly, describes the focus and availability of the resources.

4.1 Analysis of practice informing the STEPS resources

According to stakeholder survey and interview data, the school-based approaches to primary science teacher education have had an impact on PST learning and confidence (see Appendix C for publications reporting project findings). A number of our publications and the vignettes and narratives show that PSTs’ confidence increased in relation to their teaching practice, knowledge and view of their capacity to teach science. Also, interviews with school principals and teachers have shown immense interest in sustaining these partnerships, citing benefits for their students, in some cases causing reflection on their own practice, and principals who see this as a valuable opportunity to either boost, support or “be” their science curriculum.

The partnerships under investigation were already ongoing, therefore this project enabled not so much the beginning of new practices, but reflection on existing practices, which has indeed resulted in changes to the way the team undertakes partnerships and teaching. Mostly, though, this project has been successful in constructing a language for partnership practices; emphasised how valuable they are for all involved; clarified the complexity of establishing and maintaining them; and provided an opportunity to converse with others about the possibilities, benefits, and structure.

The STEPS resources represent the nature of school-based units, and are accessible for school teachers, principals, teacher educators, and students. Through teacher educator interviews the team were also able to include the voices of other academics implementing their own versions of university-school partnerships in science education units, as well as teacher educators who are interested in this approach, including those who feel that they are too constrained by their context. Many of the constraints raised by the teacher educators are familiar to some or all of the project team members; therefore the development of resources was targeted to respond to these constraints or concerns. Consequently there is confidence in the applicability of the resources to inform practice across a range of settings and circumstances. Indeed, applicability beyond science education into other curriculum areas and other contexts will be the focus of the next iteration.

The STEPS resources have been developed to respond directly to the first four project outcomes:

- synthesis of teaching and reflective practices and informing theories;
- documentation of exemplars of innovative pedagogies;
- creation of an Interpretive Framework; and
- sustainable methods for establishing and maintaining effective generalisable university-school partnerships.
The resources were constructed through reflection on and analysis of the team’s school-based approaches, and sharing of that practice, which was initially captured through a series of case studies reported in part by Kenny, Hobbs, Jones, Chittleborough, Campbell, Gilbert, Redman & Herbert, (2014) and analysed through a cross case analysis. A shared language, accessible for schools and teachers, was developed to describe: the processes involved in growing partnerships to support a more authentic approach to science teacher preparation; and the purposes and affordances associated with different types of partnerships. Whilst, an annotated bibliography (Speldewinde, 2014) mentioned in Chapter 2 is tailored particularly for researchers, it is accessible for schools and teacher educators for educational purposes. The project website is the repository for all of the resources.

4.2 Website
The project website: (http://www.stepsproject.org.au)

The purpose of the STEPS Project website is to document and communicate information about the project to teacher educators, schools, PSTs, researchers and the general public. The website has six pages:

- The “Home” page describes the purpose and objectives of the cross institutional project;
- The “About” page presents information about the researchers’ institutions and partner schools involved in the project. It also reveals the four phases of the project and the project deliverables;
- The “Case Studies” page provides an overview of the five cases, a sub-page for the case study associated with each institution, and a link to the report “Case studies of current practice” (October, 2013);
- The “Interpretive Framework” page explains the purpose, role and structure of the Interpretive Framework. The STEPS video available on this page shows the Guiding Principles in practice. The latest version of the Interpretive Framework Report is available here to download as a PDF. This area of the website is still under construction due to on-going changes to the Interpretive Framework by the research team, but will be developed by the end of March. It is expected that there will be a high degree of interaction between the various parts of the Interpretive Framework.
- The “Annotated Bibliography” page provides a description of the primary themes of the annotated bibliography which can be downloaded (STEPS: Annotated Bibliography, December 2014)
- The “Reports” page includes reports, presentations, and publications arising from the project, which are all available to download.

The website is being updated as documents become available. The photos for the website showing pre-service teachers working with children at the partner schools were taken in the partner schools by the Deakin University photographer in 2013.

4.3 Case studies and examples of university-school partnerships
The project members are passionate science teacher educators with a commitment to quality science education and pursue the school-based setting because it provides an opportunity for PSTs to teach science and enact pedagogical and learning theories. Data
collection for the project began with case study reports based on each project team member’s current experiences in their school-based programs. These case study reports are available on website. Each case study includes details of the rationale of the program, the theories informing the practice, a description of the structure, the role of reflection, the nature of the partnership with schools, indicators of success, and constraints and affordances of the program.

In all programs, a high degree of negotiation, risk taking, time and resources was required to situate the PST coursework units in schools. The data from the cases highlighted some differences and similarities in implementation of the practices surrounding the partnerships. In four of the five universities (excluding The University of Melbourne) science educators contacted schools directly. The partnerships between the university and the schools is instigated and maintained by the science teacher educator. The coded interview data has been used to illustrate how the structures of these arrangements tend to be organic, somewhat complex, and are constantly being negotiated, and re-negotiated. The case studies describe the site-specific arrangements for how the students are distributed to schools and grouped, how PSTs work with children, and nature of the interactions with teachers in schools. The authentic nature of the school-based experience is core to its impact.

Common to all programs was a commitment by the science teacher educator to promote and enable quality science education. All of the programs promote and use an inquiry approach to teaching science. There is a similarity in the approach across the sites, with each requiring the PSTs to plan, teach and reflect on a science learning sequence. All of the cases follow the 5E instructional approach (originally, Bybee, 1989, and applied in the Primary Connections units by Australian Academy of Science, 2014) often with at least one lesson representing each of the 5Es (Engage, Explore, Explain, Elaborate, and Evaluate); this approach is underpinned by inquiry. Each model promoted reflection differently, however, it is a core aspect of each program, and is recognised as essential for developing professional skills. The teacher educators from the STEPS project, other science teacher educators, and school teachers interviewed, reported an observed increasing level of skill and confidence among the PSTs in teaching science.

4.4 The Interpretive Framework

The Interpretive Framework is a document in which practice is exemplified, contextualised and summarised to allow for maximum transferability. Chapter 6 and 7 of the document are included as Appendix D. The Interpretive Framework (outlined in Figure 2) describes school-university partnership practices in a number of ways:

1. Growing University-School Partnerships (GUSP): Growing partnerships as a process comprised of different stages involving various key stakeholders working together for educational benefits. Narratives are used to illustrate practice.
2. Representing Partnership Practice (RPP): Representing practices in diverse ways depending on the degree of cooperation and collaboration inherent in the partnership. Narratives are used to illustrate practice.
3. Partnership Principles and Growth Model: Capturing the principles underpinning quality partnerships and the growth that can be enabled and fostered through
partnerships. *Vignettes* are used to illustrate principles in practice and aspects of participation for the various stakeholders.

4. **Guiding Pedagogical Principles:** Capturing pedagogical principles underpinning the practices that can be enabled by partnerships. These were the basis of a video describing and promoting the practice, available on the project website.

In deciding on the outputs of the research that would maximise impact in the sector, the team were mindful that:

- using university-school partnerships to improve science teacher education requires specific attention to context; and
- any attempts to describe, inform, disseminate, and advocate for these types of approaches must be aware of the organic, individually determined nature of their development, maintenance and evaluation.

Accompanying the Interpretive Framework document is the STEPS Action Plan, which is a set of tools to support practice. Both documents will be available on the project website. The Interpretive Framework document is in draft mode (currently version 10). An earlier version of the GUSP and RPP was published in the EduLEARN Conference proceedings, and a pre-conference workshop that allowed for feedback (see Appendix C for list of current, forthcoming and submitted publications).
The project team intends the Interpretive Framework to:

- be broad enough to allow for depth of theoretical exploration within the dimensions of partnership theory, identity and self-efficacy theory, authentic experience, and professional growth;
- have practical application within the domains of science teacher education, teacher education, and education generally;
- draw on current practice;
- support the development of new practice; and
- encompass all elements of establishing and implementing practice.

The Interpretive Framework is currently suitable for use by other science teacher educators intending to initiate new practice or enhance or evaluate current practice. However, with further development, its application is intended to extend into other partnerships in education.

In addition to the parts identified in Figure 2, the Interpretive Framework document includes the methodology used in constructing the framework, and the sustainability of...
such approaches by drawing on other teacher educator interviews to describe success, how
success is measured, and what impedes success. Recognition of the difficulties that arise in
other contexts is needed to succeed in facilitating uptake of the approach in other
universities. The different parts of the Interpretive Framework are outlined below.

**The Growing University-School Partnerships (GUSP) and Representing Partnership Practice (RPP)**

The project team laboured over the terminology and typology represented in the GUSP and
RPP tables. It was important to the team that, whilst the framework reflected a typology of
partnership type (aligned with Kruger et al.’s (2009) complementary to collaborative
partnerships), it was not value-laden where one form of partnership is valued over others.
Rather, each type of partnership is valuable, and its importance is defined by the particular
needs or purposes it serves. Thus the typology of partnerships presents a level of
embeddedness rather than a measure of value.

The GUSP and RPP were derived after sharing of practice and construction of the case
studies. The team conceptualised the GUSP and RPP, with assistance from the Reference
Group, in order to capture both the process of “doing” partnerships, as well as capturing the
degree of embeddedness of partnerships. The narratives were written as a way of linking
the data to the GUSP and RPP and justifying the Interpretive Framework according to
practice.

By constructing the narratives, the team was able to consider the intended nature of their
current partnerships versus evidence of the reality of the relationship. For example, if the
goal was to have a transformative partnership but the data suggested that the partnership
was largely generative, then this prompted reflection and impetus to re-negotiate the
partnership.

Further analyses are needed to verify and test the Interpretive Framework in broader
contexts; this will be completed in research planned for 2015 and beyond.

**Tools**

A set of Tools have been developed to support the three stages of partnership growth:

- Partnership Negotiation Tool (PNT), includes a template for recording negotiation as
it progresses;
- Partnership Monitoring Tool (PMT); and
- Partnership Evaluation Tool (PET)

The Tools consist of sets of questions to guide thinking at different stages of enacting the
partnership. They are used in association with the other parts of the Interpretive Framework
included within Figure 2. They will be available on the project website.

**Narratives and Vignettes**

The interview and survey data have been used to construct context-setting representation.
The narratives (referred to in Figure 2, top two quadrants) have been developed to
demonstrate what the GUSP and RPP look like in practice. Each narrative aligns with one or
more cells of the GUSP or RPP, and consists of a description of the cell being represented,
along with excerpts from the case study and interview data as illustration. These narratives provide context for the cells of the GUSP and RPP.

The Vignettes (Figure 2, bottom left quadrant) are written around themes that relate to questions and issues that emerged during dissemination and evaluation of the project outcomes (workshops, presentations, as well as the teacher educator interviews). These themes are important in supporting uptake of school-based practices by other teacher educators. See Appendix D for an example of a vignette (the PST vignette). The themes are written for different audiences. Each vignette contains different themes. The nature of the vignette depends on the audience. The vignette is informed by data but does not necessarily include the data verbatim, although the contributing data is footnoted on the website versions of the vignettes.

Principles and Models
The bottom left quadrant of Figure 2 refers to a set of Guiding Pedagogical Principles (GPPs), which were developed at the beginning of 2013 to capture the pedagogical elements that can be afforded by partnerships. These are:

Guiding Pedagogical Principles

1. Embedded within a partnership between university and schools.
2. A commitment to quality science education.
3. Authentic interaction with children in schools for the purpose of bridging the theory-practice divide.
4. Science teacher educator plays an active role in supporting the pre-service teacher in school settings.
5. Science teacher educator and pre-service teacher practice is informed by pedagogical and learning theories.
6. Interaction between pre-service teachers and children is integral to a science-related unit.
7. Involve planning, implementing and assessment of a learning sequence in science.
8. Reflection on and articulation of practice that focuses on pre-service teacher development and identity, and children’s learning.

The GPPs formed the basis of a video (see Figure 3 for the representation used in the video), which was written and acted by members of the STEPS Project team, filmed at a partner school, and produced with assistance from Deakin University digital learning staff (Deakin Learning Futures). The video is intended as a resource for students and as a tool to facilitate uptake of school-based approaches in the sector. The video is informative of the learning experiences that PSTs will face within a school-based science education unit. The video is structured around the GPPs, and includes interviews with a school principal, STEPS Project leader, and PSTs; and presents footage of the practice in action.

The GPPs and video are available on the STEPS Project website on the Interpretive Framework page. At Deakin the video is included in the “Deakin Airdrop” repository, and has been showcased on the internal Artspark project showcase Wordpress website (https://blogs.deakin.edu.au/artspark/2014/12/17/153/).
A set of Partnership Principles (Figure 2, bottom left quadrant) encapsulates what is core to all partnership practices. The practice of initiating, maintaining and evaluating any type of partnership can be underpinned by a set of principles to guide the partnership practice.

**Partnership Principles**

Effective partnerships require:

- Risk-taking & Trust
- Reciprocity & Mutuality
- Recognition of respective goals
- Respect
- Adaptable & Responsive to changing needs
- Diverse representation

These Partnership Principles are echoed in the other parts of the Interpretive Framework, especially the Growth Model. They both include and extend on, aspects of partnership theory presented by Kruger et al. (2009).

A Growth Model (Figure 2, bottom left quadrant) represents the change processes that are afforded by partnerships. People enter into partnerships because they recognise the value that partnerships can play in enabling growth. Using partnerships to foster and enable growth within teacher education requires being aware of: the potential for partnerships to
enable innovation in pedagogy (GPP); the principles required for making partnerships sustainable and effective (PP); and the fact that partnerships develop, strengthen and evolve over time. The focus on growth is tied to the nature and quality of the learning experience that occurs within the specific partnership. See Figure 4 for a representation of how partnerships enable growth.

The model is empirically based, having been derived as a result of discussions around data informing the vignettes. For the university-school partnerships represented in the STEPS Project, the overarching aim is for growth in the quality and effectiveness of teaching (through the relationship developed within the partnership) and teacher education (through praxis, and confidence and identity changes, both of which are possible because of the partnership). Identity, Confidence, Praxis, and Relationship are four meta-themes that have been found to be recurrent in the data, and are illustrated through the vignettes.

Figure 4. STEPS Growth model for Effective Teacher Education

The Partnership is the enabler of growth through: collaboration within and across partner groups; two-way communication, which is needed for developing and maintaining trust, acknowledging of the risks, and in achieving reciprocity where each partner is willing to contribute to meeting the needs of the other partner/s; and coordination of arrangements by key people who can act as administrators, boundary spanners and gatekeepers.
The intended outcome is achieved as **Personal and Professional Development**, the effectiveness of which is evidenced through changes in *behaviour, expertise* (including knowledge and practice), and *attitudes and values*.

The Growth Model will be available on the STEPS Project website and will be published in academic journals focusing on partnership theory within teacher education.

### 4.5 Applications of the STEPS resources - current and future

The STEPS resources have been designed to be applicable to a variety of institutions and settings, nationally and internationally. At present they focus on primary science teacher education. However, the Interpretive Framework through the GUSP and RPP have applications beyond the STEPS Project as a tool for assisting interested parties to initiate, maintain and/or evaluate projects. In particular, any partnership that is based on an educative process and requires partnership arrangements can benefit. In 2015 the Interpretive Framework will be applied to a project in the Geelong region called “Skilling the Bay” (Deakin University, 2015-2017, managed by The Gordon Institute, funded by the Victorian Government Department of Education and Early Childhood Development [DEECD]) where partnerships between universities, secondary schools and industry partners will work together for curriculum renewal. Collaboration with Deakin’s Faculty of Science, Engineering and Built Environment is required. The STEPS Tools (PNT, PMT and PET) were initially constructed to support the negotiations in this project by way of trialling the STEPS Interpretive Framework.

The teacher educators involved in interviews, and other members of education faculties aware of the project have demonstrated interest in learning more about the project and the Interpretive Framework. There are strong indications of the STEPS resources being applied to other education contexts, with meetings with various key stakeholders already planned in 2015, as well as a series of Roundtable Discussions planned for April/May, 2015.

Other relevant OLT and ALTC projects related to the project’s key areas of Partnerships, the state of science education and teacher identity and readiness will be given a copy of this report:

1. **Leading WIL: distributed leadership approach to enhance work integrated learning outcomes**, LE11-2084 (Lead: Ms Carol-Joy Patrick)
2. **It’s part of my life: engaging university and community to enhance science and mathematics education**, MS13-3167 (Lead: Dr Linda Galligan)
3. **Opening real science: authentic mathematics and science education for Australia**, MS13-3169 (Lead: Prof Joanne Mulligan)
4. **Inspiring mathematics and science in teacher education**, MS13-3174
5. **Reconceptualising mathematics and science teacher education programs through collaborative partnerships between scientists and educators**, MS13-3181
6. **Step up! Transforming mathematics and science pre-service secondary teacher education in Queensland**, MS13-3184 (Lead: Prof Les Dawes)
7. **A framework for building teacher capacity and student achievement in STEM within school-university partnerships**, ID13-3103 (Lead: Prof Terry Lyons)
8. **Pre-service teacher education partnerships: creating an effective practicum model for rural and regional pre-service teachers**, PP9-1285 (Lead: Dr Josephine Ryan)
Chapter 5. Critical success factors and challenges for the project

The outcomes of this project would not have been achieved without the team approach. The incorporation of multiple university and school sites and systems has led to richer outcomes that can be better applied in new contexts. This complexity has resulted in a number of factors that were critical to the success of the project, but also challenges that required particular attention.

5.1 Success factors

There were a number of critical success factors that related to the working of the group: the team worked with purpose, longitudinally, together and alongside one another.

The project team was *purposive* in that the shared philosophy about science education, science teacher education, and the project goals and outcomes were established very early (pre-funding meeting) and provided a clear vision that was maintained throughout the project. A retreat at the beginning of the first year enabled all project members to regroup, realign thinking with the promised project outcomes, and redefine the project direction, in order to convert the proposal into a plan of action. This shared philosophy enabled the team to establish a clear focus with well-defined and obtainable outcomes for the project and its associated research opportunities. Working alongside the project evaluator from application development enhanced this purposive work with project outcomes consistently placed at the center of discussions around data collection and analysis.

The approach was *longitudinal* in that an extended timeline of meetings and events provided time for appropriate analysis and reflection on individual and collective data, and discussions about the analyses and implications of emerging findings. Meetings included both teleconferences and face-to-face meetings at critical moments of the project, for example: pre-funding when the project was conceptualised and roles were defined; yearly two-day retreats to clarify tasks and roles and workshop the developing ideas and resources; and, after Phase 3 data collection, where the parameters for the framework were established (that is, key stakeholders and elements of practices that were to be represented in the framework). In essence, the team worked and re-worked ideas over time, leading to increasing sophistication, complexity, refinement and connectedness in the project outcomes.

The project team adopted a collaborative approach by *working together and alongside one another*. Working together involved team meetings between all team members or smaller working groups to interrogate ideas in light of the individual perspectives of cases, the literature and other research that each member brought to the project. The team also had individual roles and responsibilities within the project, which were completed by working alongside one another. These roles were defined at the application phase, and were designed to be substantive and tailored contributions. Role distribution provided opportunities for individual contributions to the team’s outputs and enhanced the sense of ownership felt by individual team members. A team leader that pulled the individual contributions together was needed to steer the forward progression. A sense of trust, responsibility and ethics was established through this focus on collaboration.
In addition there were critical success factors that related to the tasks themselves:

1. Genuine involvement of key stakeholders as informants leading to richer and more representative outputs, with a giving back of information through a newsletter directing participants and key stakeholders to the STEPS Project website (see Appendix F).
2. Feedback from other teacher educators to inform refinement and targeting of outputs.
3. Confidence in a project manager for administrative tasks, such as scheduling meetings, budget support, assistance with progress and annual reports.
4. Confidence and trust in a reliable research fellow who could maintain the momentum while team members focused on other project tasks. Research fellows are most effective if they maintain regular contact with the team members and especially the leader. Year 1 produced some important data with the first three research fellows, but being Melbourne-based at a distance from the project leader meant that progress was not maximised. Once a research fellow in closer proximity to the project leader was employed, the project progressed more quickly in the direction desired by the team.
5. A publication plan from the beginning, and decisions about authoring alleviated an otherwise complex and potentially threatening process for a large project team. A balance is needed between publications for academic purposes and project outputs and other documents for the project website.
6. Flexibility in the timeline was needed to enable modification to processes in response to constraints and unexpected time delays, for example, ethics approval processes and research fellow changes.
7. The Project Evaluator was effective at reinforcing the need to use data specifically to address project outcomes and research questions, rather than to generate data for the sake of generating data.
8. Use of the web for document repository (Dropbox) and the purchase of additional space for the project leader and research fellow were absolutely essential to enable timely and practical storage of data and documents that were accessible to all.

5.2 Challenges
The team were not faced with any major impediments as such, but challenges were encountered. Challenges that related to the collaboration included most keenly the loss of a team member when sadly, Doctor Jeff King from RMIT University passed away in October 2013. His contributions were greatly influential on the progress of the project. Jeff’s passing had a significant impact on the group, and although the role was filled, it required considerable adjustment due to his expected contribution to group dynamic and the work of the project. Jeff’s roles were taken on by Dr Andy Gilbert from RMIT in 2014, a fantastic addition to our team. Other team challenges related to:

1. Changeover of research fellow: when the research fellow left in the middle of data collection and analysis, there was delay in the tasks assigned to that role.
2. Staff on leave: The team member responsible for the website was on leave for most of first trimester in 2013 at Deakin, meaning that the website could not progress as quickly as would have been expected. Being a large team, however, meant that generally an absent team member did not slow progress extensively.
Other task- and process-related challenges changed the project timeline and impacted on methodology. It was difficult to recruit pre-service teachers for the survey and interviews, resulting in less data than expected. The team learnt that gaining university student participation in research involves a multi-dimensional approach to recruitment, including hardcopy surveys. The difficulties in recruiting PSTs for the interviews meant that less transcription and data analysis was required.

Gaining ethics approval from the Victorian Department of Education and Early Childhood Development delayed the data collection process at schools. Ethics clearance took two weeks longer than expected. This resulted in less time to generate data at the schools; in particular video recording of practice was not possible. Also, it meant that the methodology for the interviews needed to be changed, as teachers could not take the photos of the children that were to be discussed during the interviews. Late ethics approval has therefore resulted in a different quality of interview, with less emphasis on the children’s experience as a result of the partnership.
Chapter 6. Dissemination, Impact, Evaluation

The fifth intended outcome for this project was “the facilitation of the uptake of innovative school-based practices within the sector for the purpose of improving the educational outcomes of science teacher education programs, and teacher education programs generally”. This facilitation has been supported by a comprehensive dissemination strategy, a rigorous and ongoing evaluation, and attention to maximising impact as much as possible within the project timeframe.

6.1 Planning for dissemination and evaluation

In keeping with the advice offered by the ALTC funded project D-Cubed (Hinton, Gannawat, Berry, & Moore, 2011), the dissemination strategy was fully integrated, on-going and multi-dimensional, achieving a number of aims and reaching a range of audiences. The project was designed so that teacher educators, partnership schools and the PSTs were integral to the project in terms of its process and evaluation. Hence they were informed and consulted throughout the project. The comprehensive dissemination strategy is described in Appendix G.

A key strategy employed to validate the Interpretive Framework was to share it with the broader education community at key points of its development. Along with the developing Interpretive Framework, the results of the interview and survey data, case studies, Guiding Pedagogical Principles (GPP), and PST confidence and learning, have thus far been reported. This has been done in a number of ways in order to impact on different audiences:

- A project website, which is continuously updated as the project progresses;
- A media interview on ABC local Radio, Date: December 10 2013;
- Presentations at local, national and international conferences: Pre-conference workshop, prior to ASERA (2013, Wellington; Melbourne, 2014); EduLearn (Barcelona, 2014), ATEA (Sydney, 2014), STEM Education Conference (Melbourne, 2014), the annual Contemporary Approaches to Research symposium (CAR) Symposium (Melbourne, 2013, 2014), and submissions have been made to present at ATEE (Glasgow, 2015), ESERA (Helsinki, 2015) and ATEA (Darwin, 2015);
- The project was mentioned in the NTEU submission to Teacher Education Ministerial Advisory Group (TEMAG);
- Several papers have been and will be submitted to journals on various aspects of the project. A book proposal is also in preparation.

Reporting of the project has focused strongly on encouraging uptake of these partnerships in the teacher education sector. Facilitation has been most directed through the interviews conducted with other science teacher educators, of whom twelve of the fifteen people contacted showed interest in the approach, as well as the project outcomes.

6.2 The Webpage as a key dissemination tool

Chapter 5 describes the structure of the website. The website has been operational since 1st March 2013. The analytical data from 1st March to 21st December 2014 reveal a steady use of viewers from a variety of countries. The data indicates 736 sessions, by 442 users (60 percent are new visitors, 40 percent returning visitors) and 2,030 page views. This result is
encouraging and as publications and content increase it is anticipated that the access to the webpage will increase. The analytic data indicate the percentage page views of the total 2030 page views for the site from 1/3/14 to 21/12/14:

- “front” page = 38.8%
- “about” page = 15.2%
- “case studies” page = 12.3%
- “Interpretive Framework” page = 11.2%
- “annotated bibliography” page = 8.2%
- “reports” page = 7.8%

The analytics reveal that the front page is the primary first point of interaction, the about page is the second primary point of interaction and the Interpretive Framework is the third primary point of interaction. The data suggest that the website is easy to navigate and access.

The visitors to the website originate from 51 countries. There were 66 percent of visitors from Australia, 13.7 percent from Brazil, 2.2 percent from USA and 2 percent from Italy. Less than two percent of visitors were from each of Mexico, India, Russia, Spain, Argentina and the UK, and less than one percent from a number of other countries. The international interest in the website indicates the global interest in science pre-service teacher education, partnerships and authentic school-based practices. The way viewers accessed the site varied, with 43.1 percent through direct link, 29.2 percent by referral, 27.6 percent by organic search and remaining 0.14 percent social. The website will continue to be available after the end of the project. The website is a significant site that provides easy communication with international researchers. As such it appears to be an effective dissemination tool, and will be more so as professional and academic journal articles are published.

6.3 Evaluation

Evaluation played an important role in maintaining momentum, project direction and relevance and cogency of the project outputs. Below is an outline of the evaluation process adopted in the project, along with a description and examples of the team’s use of the evaluation data. Ways in which evaluation data and project findings were used to guide decision-making and the manner in which they influenced the nature of the project’s processes, outputs and outcomes is also documented.

Evaluation processes

Evaluation involved two linked processes: an ongoing evaluation by the team and a formally commissioned, external evaluation.

Internal evaluation was ongoing. The internal evaluation processes began in the proposal planning stage, as described in the project proposal. This involved a review of needs and approaches by the project team in relation to the coordination of theory and practice in primary science teacher education programs in Australia. This process identified key issues to be addressed and helped to inform decisions on the focus, aims and structure of the project in order to respond to issues in teacher education generally, and science teacher education more specifically.
The team constantly documented and sought feedback on processes and outputs from a range of sources as a basis for ongoing review, planning and decision-making. Regular team meetings, including regular teleconferences and annual extended retreats, along with the team’s willingness to reflect on and amend procedures as necessary, facilitated this internal evaluation. In addition, a reference group played an important role at key points of the project to assist in planning, evaluating and shaping outputs. The types of feedback collected included: advice and guidance from the reference group; audience responses from conference presentations; participant input at the pre-conference workshop where an early version of the Interpretive Framework (GUSP, RPP and narratives) were presented and interrogated by participants (See Appendix H for the workshop evaluation); and notes provided by focus group participants at the Roundtables.

An external evaluator was appointed at the beginning of the project and was invited to participate in the team’s initial planning retreat. During the retreat, an evaluation plan for the project was discussed and accepted. A key element of the plan was interactive evaluation of the project’s implementation, enabling the evaluator to observe and document project processes and emerging outcomes, and in turn provide formative feedback to the team as input for its ongoing decision-making. In carrying out this role, the evaluator acted as both an evaluator and a critical friend, having access to project team deliberations via telephone contact during meetings and access to meeting minutes, monitoring progress, raising questions and providing feedback. Team meeting agendas were also structured to facilitate the team’s formative evaluation approach, with key components of the project being itemised for review in terms of current progress, influencing factors and options for ongoing action. See Appendix I for the Evaluator’s Report.

**Evaluation informing project outcomes**

Evaluation data and feedback in some cases confirmed the appropriateness of planning decisions, and in other cases led to decisions being amended in order to promote more effective or appropriate processes and outputs. In particular, the pre-conference workshop and a subsequent round of conference presentations in July/August 2014 was a major turning point in planning the Interpretive Framework, dissemination and promotion of uptake in the sector (see Appendix H for a summary of the feedback and our subsequent decisions). For example, evaluation and feedback initiated the development of the vignettes, and facilitated the prompt construction of the Growth model, Partnership principles and Tools. Generally, feedback through evaluation strategies helped to inform and shape views about the uniqueness of the project team’s approach and stance on the value of all partnerships.

**6.4 Evidence of impact**

It is still too early to be able to measure the lasting impact of this project. The on-going effects of the project and potential links to new ventures will emerge over the next few years. However, there is some evidence of early impact and some indicators of further likely impact. The ongoing dissemination process is designed to develop awareness of the findings and resources and to promote uptake. Already the “Skilling the Bay” project has used the Interpretive Framework to guide the establishment of partnerships between industries and schools, and a number of people attending conferences and other dissemination events have expressed a desire to investigate the Framework for negotiating partnerships in pending projects.
A program of research and promotion of the Interpretive Framework is enabling the development of a multi-dimensional approach to impacting the sector. The ongoing refinement of the resources in response to feedback from key audiences is a critical factor in facilitating and promoting future uptake. Concurrently, the recent TEMAG (2015) report has positioned partnerships as a key direction in teacher education reform, making our partnership model, through the Interpretive Framework, a critical addition to the impending discussions. Both these movements in the sector, as well as the actions undertaken thus far, are creating the conditions likely to maximise uptake and impact.

Other impacts have been on the team’s partnerships with schools and current and future teaching practice. School discussions have been leading to better understandings between the university and schools, and therefore, stronger partnerships. In particular, finding out how the university programs have impacted the schools has enabled an appreciation of the important role teacher educators have in supporting the teaching of science to children. It has also helped to identify the needs of all key stakeholders and prompted changes to be made to programs in order to better attend to these needs and possibilities.

The most immediate evidence of impact has been on the team member’s own teaching. Through collaboration with the other universities the team has shared how to approach partnership development and maintenance, promote student reflection, improve the student experience, and use theory to inform practice. These reflections have impacted on individual approaches to teaching and planning.
Chapter 7. Conclusions and Implications

There are two major conclusions emerging from this project: the first relates to the use of partnerships in teacher education; the second relates to science education, which is the context for the STEPS partnership model.

7.1 The valuable role of partnerships in teacher education

This project responded to significant and growing critique of the quality of teacher education, which has recently intimated a shift from predominantly university-based teacher education programs toward one more reliant on schools (TEMAG, 2014, 2015). The premise of the university-school partnerships represented in this document is twofold: 1) school-based teaching experiences are essential for the development of PSTs’ professional identity and practice, and for science in particular, not just in the traditional formal practicum arrangements; and 2) the teacher educator’s role of directing the learning associated with of PSTs’ school-based experiences is crucial. While schools play an essential role in initial teacher education, the expertise provided by university teacher educators is indispensable in fostering PSTs’ learning and development. This has been recognised in other studies (e.g. Brandenburg, 2004; Jones, 2010; Loughran, 2002) where the role of the teacher educator has also been viewed as critical in helping PSTs notice important elements of teaching and learning and subsequently, their learning to articulate aspects of their own and others’ praxis; what Loughran (2002) phrased as “making the tacit, explicit, meaningful and useful” (p. 38). Partnerships that maintain professional integrity and recognise the essential roles of both universities and schools are needed to enhance learning and raise PSTs’ awareness of the value and importance of teaching marginalised subjects in primary schools, such as science.

The final project outcomes articulate the mutual benefits in using university-school partnerships and specific aspects of the roles played by school and university staff. For teacher educators and PSTs, one of the primary motivations for involvement in a partnership is the opportunity for the PSTs to gain authentic experience of teaching a unit of science to children. PSTs need a successful and authentic experience of teaching science to not only enhance their knowledge and capability in teaching science but also to build their self-efficacy beliefs in their ability to do so. University-school partnerships in teacher education provide PSTs with an opportunity to apply and practice the theory they are learning in the university setting in a timely and often concurrent manner. Data from PSTs consistently highlighted the benefits of this concurrent theory and practice experience. Direct involvement with children learning science also gives PSTs the much needed opportunity to witness the engagement and enjoyment children have in learning science, which is often unexpected due to their own poor experiences and/or attitudes towards science. The partnership also serves an important function of helping teacher educators remain connected with schools. Teacher educators need to observe what is happening in schools not only to assess the success of their own science education programs, but also to understand the ways in which classrooms and schools are evolving over time.

Project data showed that PSTs valued the teacher identity-building experience of the school-based approach because it provided an opportunity to work in supportive, school-based teams for planning week by week, and following up on previous teaching whilst remaining flexible in response to students’ learning needs. PSTs valued the team teaching for its
capacity to enable them to work with a range of others including peers, mentor teachers and university staff. They reported that the regular contact with schools, and the regular classroom experience, contributed to their confidence to teach in general, and science in particular. These changes in PST confidence was a major factor noted by classroom teachers, and in the subsequent interviews for this project, confidence was often stated, and tied to a successfully supported placement teaching science. The PSTs experienced the positive impact of science teaching in classrooms, and the high level of engagement and enthusiastic participation of children, which they themselves found motivating.

Project data also illustrated ways in which school-university partnerships provided benefits for schools. Schools need strong science programs, but they often struggle to address science adequately for a range of reasons. Teachers need to cover a lot of content from a range of curriculum areas and they often feel the pressure of a crowded curriculum. Teachers also need to have confidence in their background knowledge of science and in their ability to teach it effectively. The lack of this confidence and/or knowledge can limit their ability and incentive to each science. The project demonstrated that a partnership with a university science teacher education program can help to address these needs by providing access to expert science educators to ensure there is adequate support in the development and delivery of science units. Schools also need to have appropriate resources – both staffing and material – to provide a rich science curriculum. Access to such resources can be difficult for schools and the partnership approach helped to address this through the use of equipment borrowed from the university involved. Schools also valued the engagement and excitement that the science program brought out in the children. The nature of the school-university partnership allowed children to see that science is accessible to them and not something that is only for the "smart kids".

Many principals and teachers viewed the partnership as an opportunity for science professional learning where they were exposed to a range of new activities and ideas and were able to keep up-to-date with contemporary pedagogical approaches. Many schools also highlighted the benefit of the partnership for future recruitment as they got to know the pre-service teachers and their capabilities through the program. The partnerships with universities were viewed as an attractive selling point for some schools and they advertised it through their newsletters and school council meetings as a way of demonstrating the school’s success.

Partnerships are only valuable if they have impact. The intended impact depends on the need and rationale, and what each partner is willing to contribute. The need for mutual benefit, or reciprocity, cannot be underestimated for partnerships to be sustainable. Developing successful university-school partnerships involves appreciating that it is a process requiring ongoing attention to the changing needs and institutional requirements, where the relationships involve a degree of risk taking and trust, reciprocity and mutuality, respect, adaptability and responsiveness. There are a diversity of approaches and types of partnerships, depending on the degree of embeddedness desired; they can be Connective, Generative, or Transformative. Each serves a purpose, and may be short term or long term. Amongst these variables, however, there is one constant, and that is that partnerships have significant potential for enhancing the learning of all involved.
7.2 Using partnerships in science education
The school-based experiences in the five participating universities involved teacher educators providing opportunities and support for primary science PSTs to plan and reflect on their science teaching experiences in light of theory and in order to foster a developed sense of praxis. The case studies and interview data have demonstrated that the school-based science programs raised PSTs’ awareness of the benefit and importance of engaging children through science, and provided them with a range of ideas and strategies for its teaching. Such experiences have been shown to enhance the quality of science teaching and learning at universities.

School-based partnerships specific to science teacher education are critical in providing these opportunities due to the variable quality and low amounts of time spent on science in primary schools, which was noted earlier. These impediments limit PSTs’ ability to observe the teaching of science and to practice it themselves during the traditional practicum. A science-dedicated school-based experience helps to overcome this issue, especially where the teacher educator plays an active role in supporting PST learning and professional development.

The project team’s common philosophy about science education and science teacher education provided the foundation of the project outcomes. A clear vision, common purpose, and a collaborative plan of action was maintained throughout the project by regular face-to-face and teleconferenced events that enabled focused planning, workshopping of outputs, and maintained common focus.

7.3 Implications
Four major implications from the findings of the STEPS project are:

- The knowledge and experiences of educators organising the science school-based programs is transferable and can be shared with other partnership situations:

The case studies report on the knowledge and experiences of a variety of science school based programs that have been operating for up to 25 years. This knowledge capital is applicable and transferable to other community and contextual learning situations. This was evident at workshop conferences where other teacher educators were compelled to share their stories, but also very interested in hearing more about the team’s experiences.

- The language and framing used to describe the partnerships in the Interpretive Framework is relevant and applicable to other partnership situations:

Partnerships that incorporate the community, school, and university are becoming increasingly significant in teacher education programs (White, 2014). Teacher quality is recognised as critical for a quality education and there is a growing concern about the effectiveness of initial teacher training1. In Victoria, the School Centres for Teaching Excellence (DEECD, 2014) is operating from 2015 for two years. The program aims to actively build partnerships between universities and schools with the aim of improving teacher quality with a site-based training model for pre-service teacher training2. The

findings of the STEPS Project with regard to the language and framing of the nature of partnerships between universities and schools has implications for future teacher education programs. The current discussions that disrupt the traditional role of universities in teacher education and positions schools as being more active partners has implications for the emerging roles and responsibilities of teacher educators, PSTs, teacher supervisors, mentors and principals. The Interpretive Framework, as a partnership model, can help shape the way new partnership ventures are grown, the relationships that are developed, the practices that might arise as a result of the partnership, and how the partnership can enable growth and change. While the Interpretive Framework is currently explicitly written for partnerships in science education (especially the Guiding Pedagogical Principles), the four-part framework is adaptable to other educative partnership contexts, as illustrated by its application to university-school-industry partnerships of the “Skilling the Bay” project in Geelong.

The authentic learning experiences of the school-based approach inspire and foster growth:

The project reported that the authenticity of the school-based program provided contextual practical learning opportunities in which the PSTs had to plan, teach, assess and critically reflect on a complete unit of science. It is not inconsequential that reflection is core to all of the school-based programs. Reflection is an essential generic skill that is a mechanism for professional growth. The Growth Model, while not including reflection explicitly; posits growth in identity, confidence, praxis and relationships as being essential for more effective teaching and teacher education; critical reflection is required for this growth to occur. An authentic learning experience that disrupts previously held perceptions, and prompts new ways of perceiving the world and themselves, provides the fuel for this reflection.

School-based approaches in teacher education build confidence and knowledge in teaching science:

The data showed an increase in PST confidence to teach science as a result of their experiences in the school-based programs. This has implications for the teaching of science in primary schools and will help to tackle the extensively reported issues around primary teachers’ lack of science knowledge and confidence to teach science. The teacher educator interviews identified a number of barriers to using partnership approaches in teacher education; many of these same barriers had been encountered by the project team in their own contexts. However, as the findings of this project show, despite the challenges, the effect of using these types of partnership approaches are immense and worth pursuing.

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3 TEMAG, 2015; School centres for teaching excellence
References


Appendix A. Certification

Certification by Deputy Vice-Chancellor (or equivalent)

I certify that all parts of the final report for this OLT grant/fellowship (remove as appropriate) provide an accurate representation of the implementation, impact and findings of the project, and that the report is of publishable quality.

Name:  Professor Beverley Oliver
        Deputy Vice-Chancellor (Education)

Date:  20 March 2015
Appendix B. Initial conceptualisation of the STEPS project

Initial discussions identified varied elements of the project. These helped to guide the literature search and annotated bibliography, and to conceptualise the data collection associated with evaluation of the project. These elements related to theory underpinning the approach, the potential impact of the school-based practice, and the specifics associated with the different models of practice of the project team.

The theoretical elements refer to areas of the literature that are informing the study. The current state of “science teaching in primary schools”, as well as the tendency for pre-service teachers to have limited positive experiences with science and opportunities to see science taught or to teach science on placement. This element is related to the conceptualisation of a “theory-practice divide” between authentic classroom practice and educational theory. There appear to be changes in the teacher education sector moving towards situated learning experiences that require “partnerships” with schools as a way of linking theory with practice. “Partnerships” are fundamental to the school-based practice. The research is conceptualising value for the schools, also the distinctiveness of the science context in terms of this approach. “Reflective practice” and “teacher efficacy and identity” are fundamental to the practices; teacher identity can be a mechanism for developing a teacher efficacy and professional identity and teacher reflection is a mechanism through which identity development can occur. Reflective practice, identity and efficacy focus strongly on the experience of the pre-service teacher. This focus on teachers thinking their way into a space is a move away from the previous model of primary science teachers, which was principally focused on competence and confidence (a deficit model). Timing of the school-based practice is important so that PSTs are “ready” to begin constructing an identity in relation to science.

The potential impact of the project is on “Teacher Education” through providing practical and theoretical models of effective science practice through real science teaching experiences that pre-service teachers often do not have during placement or as an in-service teacher. The project also has a potential impact on “school practice” through preparing willing and able teachers, but also modelling for the school, teachers involved in contemporary and effective science teaching pedagogy.

The project examines the specifics of the models used by each university involved. They are all different in terms of “site difference and contexts”, that is the schools used; and the “nature of the school-based approach” and “specifics of each model” vary depending on the unit aims and goals and nature of the partnerships involved. In addition, the variety of models included has meant that the project has been able to generate “critical success factors and barriers” that may be inherent in different contexts.
Appendix C. STEPS Publications


Appendix D. The Interpretive Framework: GUSP and RPP
(Excerpt from the STEPS Interpretive Framework document)

Chapter 6. Growing University-School Partnerships
Table 1 describes the Growing University-School Partnerships (GUSP). This part of the Interpretive Framework describes the phases of initiating, implementing and evaluating school-based teacher education. The descriptions have been derived through analysis of the practices of 5 existing or past examples of this practice.

Five Components are used in the GUSP to describe the likely processes and thinking required at each phase of development. While the development from initiation to evaluation appears to be linear for each component, these types of processes are iterative and must remain responsive to the needs of all key stakeholders, which might mean starting again at another school if a previous school is no longer available, for example.

Descriptions of the processes involved in developing these types of partnerships help others who might be considering adopting such partnerships to be aware of what thinking and planning is needed over time. It also can help those within existing partnerships by providing a language to talk about often undocumented and amorphous practices.

The GUSP is intended for use by school and university stakeholder groups. The cells of the GUSP can, therefore, be interpreted by each group. Most cells have the same content, however the final two components (Curriculum Development and Elements of Practice) are mostly differentiated for each group because of the different roles and activities undertaken by each. Elaboration of the five components is described below.

GUSP Components

A. Aims and Rationale
Whether initiating, implementing or evaluating a university-school partnership, the needs of each partner and their respective rationale for being involved in the partnership need to be considered. Identifying needs and rationale ensures that each partner’s core requirements are accounted for in the establishment of a partnership arrangement. In effective partnerships, partners regularly check with one another in the implementation phase to ensure that each others’ needs are being met, and where possible, are flexible in arrangements to meet emergent needs that may not have been apparent in the initiation phase. In the evaluation phase each partner should review ways in which arrangements did and did not meet their respective needs and adjust the partnership arrangement accordingly for future iterations.

B. Institutional Requirements
Both universities and schools have a range of requirements that may shape the way in which a partnership can be organised. Aspects such as timetabling, curriculum and resources, to name a few, may determine the extent of the partnership arrangement. Each organisation should try to identify as many requirements, constraints and enablers as possible to ensure the success of a partnership. Partners should also be prepared to respond, if possible, to changing requirements if and when they become apparent during the partnership implementation periods. The evaluation phase also allows for changing or emergent constraints.
to be better planned for in further partnership iterations.

C. Relationships
An essential aspect of initiating a partnership arrangement is to define the type of relationship that is desired/possible. Defining the nature of the relationship means considering the role each person is wanting and able to commit to. Partnerships can be connective, generative or transformative. Each of these types of partnership is valuable in its own right, but provides different opportunities for the level of partners’ involvement before, during and after the partnership period. Table 2 (Representations of Partnership Practices) explores the nature and extent of partner roles in more detail. In evaluating the nature of the partnership, each partner can reconsider their level of involvement and maintain similar or negotiate different levels of involvement for future iterations.

D. Nature and quality of learning
The nature and the quality of the learning arising from pre-service teachers’ interaction with children is the core purpose of the partnership. Here, the learning experiences of the children are of fundamental concern. Thus careful planning of the types of learning experiences—ways in which subject and general content and pedagogy is implemented—is essential. The other stakeholders also stand to learn from their involvement in the partnership; the degree to which this learning is planned for will depend on the type of partnership. Learning is informed by educational research, particularly related to science education and effective teacher practice. Involvement of the different stakeholders in planning and implementation of the learning experience can depend on the nature of the partnership that has been negotiated. In evaluating these interactions, both partners consider the experience of the children, the pre-service teachers, classroom teachers, and teacher educators, and how educational research can inform the most effective experience possible.

E. Commitment to action
Commitment to action emphasises that the various partners generate common understanding of what they are committing to. When a lead partner initiates contact there is careful consideration of how to make contact and the process for entering into a partnership. Negotiation requires discussion about the aims and rationale for involvement, requirements, constraints, enablers, type of relationship desired, and learning outcomes to be achieved.

During implementation, all partners monitor and reflect on current levels of commitment and involvement. This ensures that aims and rationale, institutional requirements, and learning needs are consistent with the practices occurring within the partnership. There is scope to shift practice as the partnership progresses.

Evaluation occurs at a time when it is possible to respond with change as necessary, such as at the end of a year or after completion of an iteration of the partnership practice. Evaluation is informed by data. Sustainability of the practice depends on continued common understanding of what they are committing to.

A set of Tools have been developed to support the three stages of partnership growth:

- Partnership Negotiation Tool (PNT), includes a template for recording the negotiation as it progresses;
- Partnership Monitoring Tool (PMT); and
- Partnership Evaluation Tool (PET)

The Tools consist of sets of questions to guide thinking. They can be used in association with the other parts of the Interpretive Framework.
### Table 1. Growing University-School Partnerships (GUSP)

<table>
<thead>
<tr>
<th>Phase</th>
<th>A. Aims and Rationale</th>
<th>B. Institutional Requirements</th>
<th>C. Relationships</th>
<th>D. Nature and Quality of Learning</th>
<th>E. Commitment to Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Initiation Phase</td>
<td>Identify mutual and differing needs and provide rationale</td>
<td>Identify requirements, constraints and enablers governing the approach to partnership development</td>
<td>Negotiate roles and responsibilities and define value and parameters defining the nature of the partnership</td>
<td>Conceptualise an approach to PST interactions with children</td>
<td>Initiate contact</td>
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<tr>
<td></td>
<td>(See Partnership Negotiation Tool)</td>
<td></td>
<td></td>
<td></td>
<td>Negotiate actions</td>
</tr>
<tr>
<td></td>
<td>2. Implementation Phase</td>
<td></td>
<td></td>
<td></td>
<td>Monitor and reflect on current levels of commitment and involvement</td>
</tr>
<tr>
<td></td>
<td>Be mindful of the needs and rationale and be responsive to emerging needs</td>
<td>Manage, compromise, justify and respond to requirements (limitations and possibilities)</td>
<td>Maintain and work with partners to meet individual and differing needs of partners</td>
<td>Enable interactions with children that reflect subject-related and general content and pedagogy</td>
<td></td>
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<tr>
<td></td>
<td>(See Partnership Monitoring Tool)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Evaluation Phase</td>
<td>Evaluate the needs and rationales for their continued relevance and future possibilities.</td>
<td>Evaluate against institutional requirements, and consider different possibilities &amp; approaches.</td>
<td>Evaluate the nature of the partnership to respond to current and future needs and possibilities.</td>
<td>Evaluate the nature of interactions drawing on a range of evidence, including key stakeholders’ reflections and educational research.</td>
<td>Evaluate commitment and respond with change as necessary</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(See Partnership Evaluation Tool)</td>
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</table>
Chapter 7. Representations of Partnership Practices

This part of the Interpretive Framework (Table 2) depicts a typology of practices. These types—described as Connective, Generative and Transformative—are based on the nature of the purposes, embeddedness within the partner institutional structures, nature of the partnership as collaborative or cooperative, and extent to which links between theory and practice results in reflection on practice and professional identity development for the various partnership stakeholders. The table is not described to be value-laden, but represents differing types of practices, each with its own value and arising out of the desired purposes and educational outcomes, rather than as a trajectory that a partnership must move through in order to reach maturity. Again, the descriptions in each cell have been derived through analysis of the practices of five existing or past examples of this practice.

Descriptions of the types of partnerships assist those who might be considering entering into partnerships to consider the desired outcomes, structures, and level of responsibility taken by each partner. It also can help those within existing partnerships by providing a language to talk about often undocumented and amorphous practices.

The Table is intended for use by school and university stakeholder groups. All cells have the same content, therefore, they should be interpreted by each group.

RPP components

A. Purposes
The rationale for partners, and in particular, schools, for participating in the school-based partnership.

B. Institutional Practices
The structures that exist within each institution and how they are managed and/or adapted to facilitate the school-university partnership.

C. Nature of Partnership
The level of co-operation or collaboration between partners to service a need or engage in joint effort and commitment to partnership outcomes.

D. Linking theory and practice
The level of involvement of each partner in reflection on theory and practice and opportunities for professional identity development.

Typology

1. Connective
Connective partnerships are co-operative in nature. They are typified by a “win-win” outcome where each partner recognises a key benefit/value from working together. They arise when one or other of the partners may have a particular need and the other is able to provide a space or service to accommodate that need. These partnerships sit within existing structures and tend to be “one-off” or short-term in nature. They are provided because both partners recognise schools as important sites for PSTs to link theory and practice. These partnerships meet important short-term needs and provide seeding opportunities for other partnerships and/or more long-term generative or transformative partnerships.
2. Generative
Generative partnerships, whilst still mainly co-operative in nature, see a greater level of commitment and participation from both partners. These partnerships generate new or different practices and outlooks in the school and university programs by committing to longer-term involvement in the partnership arrangement due to the recognised mutual benefits. Partners respond to one another’s needs to develop programs that may involve small modifications to existing structures in order to accommodate one another’s needs. PSTs are engaged in reflection on their practice where they make links to underpinning theoretical ideas. Teachers are cognisant of what PSTs are doing in the classroom and this provides opportunities for them to also reflect on practice that may be linked to theory. These partnerships meet important long-term needs and are well-established in both the school and university planning.

3. Transformative
Transformative partnerships are collaborative and focused on active involvement in planning and delivery of curriculum for the purpose of professional learning. They are ongoing and embedded in the programs of the collaborating institutions. Partners have an invested interest in working collaboratively to develop key practices and outcomes that are aligned with and fundamental to their teaching and professional learning. Partners engage in critical reflective practice that is guided by theory-practice nexus and over time develops a sense of professional identity forged through their collaborative experience.
Table 2. Representations of Partnership Practices (RPP)

<table>
<thead>
<tr>
<th>Connective</th>
<th>A. Purposes</th>
<th>B. Institutional structures</th>
<th>C. Nature of partnership</th>
<th>D. Linking theory with practice</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Engagement based on provision of curriculum or other service need.</td>
<td>Partnership activities are short-term and opportunistic and sit within existing structure.</td>
<td>Both partners provide short-term services with a focus on one partner’s needs but with mutual benefits and value for all.</td>
<td>Both partners recognise schools as important sites for PSTs to link theory and practice.</td>
</tr>
<tr>
<td>Generative</td>
<td>Partners recognise opportunities for mutual professional learning</td>
<td>Partnership activities are considered long-term and are planned and catered for in the teacher education and school programs.</td>
<td>Partners jointly plan the structure of the school-based practices to the benefit of both.</td>
<td>Opportunities exist for both partners to reflect on practice that may be linked to theory.</td>
</tr>
<tr>
<td>Transformative</td>
<td>Partner involvement based on active professional learning</td>
<td>Partnerships are embedded in the ongoing structures and practices of the institutions.</td>
<td>Partners take joint responsibility for mutually agreed practices and outcomes that are embedded in their respective core outcomes.</td>
<td>Both partners engage explicitly in reflective inquiry guided by theories of professional identity development.</td>
</tr>
</tbody>
</table>
Appendix E. Vignette 4. The Pre-service teacher experience: Shifting, learning, valuing

This vignette reflects the reported outcomes of growth that pre-service teachers experience as a result of a science teaching focus that arises from the school-university partnership. It relates to changes in confidence and identity aligned with school-university based science education experienced in the partnership.

Working in school based teams for planning
A significant and notable growth reported in the data is in the changes to students’ identity and their teaching practices. This arose from the experiences of working with a range of others, peers, mentor teachers and university staff. The students experience team planning and team teaching. This can be experienced when working with each other, or with school based teachers, or with university academics. Some PSTs initially expressed concern, even anxiety, just around the thought of planning with others (I wasn't really quite sure how I was going to go with team planning, but I actually really enjoyed it, ... Everyone was very supportive; I had to plan with other people ... We had to get together with somebody else ... and work out a compromise, so that was really good I guess.). The 'others' includes their peers, predominately, they seem to be satisfied and comfortable with planning discussions with academics and school based staff (I actually worked collaboratively with my PLT. There were three other grade five teachers so I worked with them for the brainstorming; if it didn't work you can take it back to uni the next day or the next week and share and having that resource of people). There are a variety of successes reported, and some failures as well, as students managed planning times (so I thought we should have sat down at the beginning and gone 'well where do we want the kids to be at the end of the unit').

Experiences of planning over time
There are examples of enthusiastic reporting of successful teams planning together (I had two people who I was working with were really good partners so we shared a lot of information and we were able to build upon each other), researching science concepts and resourcing lessons with materials, and discussing students learning needs. The planning week by week, and following up on previous teaching, for some had not been a successful, or team experience, and for some had an infrequent experience (Planning I think because I'd never really done any planning week to week). In addition some were able to experience the need to plan, and then be flexible in response to students learning needs (you can see that it's still going to work even if things don't go exactly to plan).

Confidence from working and planning with others
The students who reported on successful teamwork, in their placement, shared collegiate experiences of knowing the children and making more informed decisions together. (I really liked that we got the chance to meet the kids and decide on what they were interested in and go on from there; we actually get to see it for ourselves). The regular contact with schools, and the regular classrooms experience, contributed to the confidence and enjoyment levels, because PSTs felt more confident. Their increased positive identities were aligned with the idea that they felt they knew what was needed to be taught (we got a feeling of what they wanted to know which
was really good felt that was really engaging for them).

**Confidence in teaching science**
Confidence is a key element evident in the discussions and repeated with frequency by the PSTs. This is associated with team planning and teaching, as reported above, but it is also associated with the teaching of science in classrooms (So I think it's opened my eyes to the wonderful things that you can do through science and it's made me feel more confident approaching it in a school setting; and honestly much more excited about teaching science. I'm certainly not hesitant anymore I'm ready to do it and I've already got lots of ideas yes it was a very ... really positive experience of science teaching and learning; I think without the amount of experience that I had I wouldn't be able to meet the needs of the students like I’m able to now).

**Valuing teaching science**
The teaching of science is valued for both the classroom practice (I was a little bit, not hesitant, but a bit unsure when it came to teaching science) and as a valued experience that they could refer to in a statement on their CV (I go into teaching I'll know how to do it ... I've delivered a science unit and when I go for a job interview I think confidentially I'd land a successful science (inaudible - assuming 'job') because of this, this and this.)

**Successful class experiences teaching science**
This change in confidence is a major factor noted by classroom teachers, and in the subsequent interviews for this project, confidence is often stated, and tied to a successfully supported placement teaching science. The PSTs have experienced the positive impact of science teaching in classrooms, and how level engagement and enthusiastic participation. Students explain how nervous they were before, but as a result of high levels of classroom engagement, now declare growth in confidence levels (I guess I was so nervous and didn't get much sleep the night before my first lesson ... The kids were really engaged ... it was quite good content ... So I guess probably the confidence was the biggest thing ... I've been much more relaxed; yes absolutely I feel a lot more confident).
Appendix F. Newsletter
PST Educators:

They emphasized the importance of teachers being knowledgeable about science and how to teach it, as well as having a strong connection to their students. They believed that teachers should be able to connect their students to real-world applications of science concepts. They also highlighted the importance of building strong relationships with students, allowing them to see the relevance of science in their daily lives.

STEPS Guiding Principles for Practice:

1. Science teacher education plays an active role in preparing pre-service teachers for school settings.
2. Science teacher education and pre-service teacher practice is informed by pedagogical and learning theories.
3. Interaction between pre-service teachers and children is integral to science education.
5. Embedding science education in the curriculum is crucial for pre-service teachers to develop a deep understanding of science teaching and learning.
## Appendix G. Dissemination strategy

<table>
<thead>
<tr>
<th>Type of dissemination</th>
<th>STEPS Project examples</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Branding</strong></td>
<td><strong>Templates</strong></td>
</tr>
<tr>
<td><strong>Conferences</strong></td>
<td>ASERA, ATEA, EduLearn, 2015 abstracts submitted</td>
</tr>
</tbody>
</table>
| **Email lists, discussion forums, social networking tools**| Google +  
Twitter feed  
(Not very active!)                                                                                                                                                                                    |
| **Funding sub-projects at other institutions, mentoring, participatory dissemination** | Science Teacher Educator email list for interviews, newsletter(s), sharing findings  
Intention to submit ARC Discovery in next 2 years                                                                                                                                                    |
| **Guides and teaching materials**                          | Case study report, Interpretive Framework etc, available on website                                                                                                          |
| **Influencing Policy**                                     | STEPS pedagogies included in submission to teacher education inquiry from the University of Tasmania                                                                                                           |
2 published conference proceedings  
1 paper in Asia-Pacific Journal of Teacher Education  
2 papers submitted                                                                                                                                  |
| **Media releases**                                         | Releases from Deakin University Warrnambool, Australian Catholic University, University of Tasmania                                                                                                           |
| **Meetings, roundtables, invited presentations**            | Various talks that have referred to the project  
Roundtables planned for Jan/Feb 2015                                                                                                                      |
| **Newsletters, networks**                                  | Newsletters                                                                                                                                              |
| **Project workshops, showcases**                           | Workshop prior to ASERA 2014                                                                                                                               |
| **Webpages, online repository**                            | Project website  
Promotional and instructional video  
All project documents, currently being updated                                                                                                        |
Appendix H. Evaluation of STEPS workshop and July conferences 2014

The presentations at the Australasian Science Education Research Association (ASERA) conference in 2013 and 2014 illustrated that the teacher education sector is keen to hear more about our approach. Further discussions have shown that there is value in talking to educators who undertake similar practices, or are interested in trying it but are under prohibiting constraints. Understanding this now will mean that we can focus on those institutional (university) and systemic (education sector more generally) elements that might enable such practices to be implemented.

Workshop:
Ten participants.

Evaluation and feedback, and impact on project planning and decisions

<table>
<thead>
<tr>
<th>Evaluation data and feedback (prepared August 2014)</th>
<th>How informed planning and decisions (prepared February 2015)</th>
</tr>
</thead>
<tbody>
<tr>
<td>The value of this collaboration of five universities to share, explore and theorise practice.</td>
<td>Greater promotion of the team approach during subsequent presentations</td>
</tr>
<tr>
<td>Trust and reciprocity were elements that participants of the workshop tended to struggle with in developing their own partnerships. This idea of trust can be linked to the RPP, sometimes difficult to go in immediately is Transformative intentions as this requires trust and matched needs and rationale etc.</td>
<td>Lead to conceptualisation of the Partnership Principles and vignettes</td>
</tr>
<tr>
<td>Communication was raised as a possible absence. Perhaps this is assumed throughout as the mechanism for ensuring the shared understanding.</td>
<td>Communication is now part of a vignette and the Growth model</td>
</tr>
<tr>
<td>There was discussion about whether the RPP are hierarchical, both at the workshop and conferences. The darkening blue indicates levels of embeddedness, as do the numbers, 1,2,3. Suggestion was made to remove numbers and use letters to remove the initial impression of hierarchy and that Transformative is “better” than Connective. We needed to argue that Connective were as valuable as Transformative. The question was asked:</td>
<td>Framed our decision to impress the value of ALL partnership types in the RPP</td>
</tr>
<tr>
<td>When is it NOT a partnership?</td>
<td>Further narratives have been used. Journal articles are under construction that show how the narratives emerged from the data and are complimentary to the GUSP and RPP</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Narratives were considered good but need additional information to contextualise. This idea of contextualising is important. The vignettes, case studies and narratives are all going to be important. They liked the idea of the rollovers for the online IF. In the printed version, the context needs to be spelled out, and more embedded in some way, perhaps more apparent?</td>
<td>Contributed to schedule of interview questions for the teacher educators, and decision to link the case studies to the RPP which has been planned for a project book proposal. Contributed to the decision to prepare the Tools (PNT, PMT, PET) to support implementation of the Interpretive Framework Future research has been planned</td>
</tr>
<tr>
<td>What is the evidence of effectiveness? What might evidence look like? How can we collect evidence to show what it looks like? We need to consider this and it needs to be clear in the document and website. Case studies need to be written to use the language of the GUSP and RPP. Suggests a program of research to establish value, eg longitudinal study showing ongoing impact for in-service teachers (see John’s data, Mellita planning on some future research, I have a Masters student exploring this through research).</td>
<td>Contributed to schedule of interview questions for the teacher educators, and decision to link the case studies to the RPP which has been planned for a project book proposal. Contributed to the decision to prepare the Tools (PNT, PMT, PET) to support implementation of the Interpretive Framework Future research has been planned</td>
</tr>
<tr>
<td>We need to consider sustainability: what is needed for sustainability? The longevity of the arrangements at Deakin University suggest it is possible, also the increased buy-in at RMIT University, The University of Melbourne and Australian Catholic University. The focus on contemporary science pedagogies is valued by schools. Perhaps the value associated with the partnerships need to be spelled out further – this involves using our data, which as yet we have not done apart from an inconclusive paper on confidence gains. Vignette showing evidence of success with critical success factors may be important</td>
<td>Contributed to schedule of interview questions for the teacher educators Five conference and journal papers have been written since August 2014, utilising the data to promote the value of the partnership models Value and sustainability are themes that have been subsequently captured in the vignettes A chapter of the Interpretive Framework relates to sustainability</td>
</tr>
<tr>
<td>Feedback at Presentation on confidence gains at ATEA recommended use of efficacy theory to inform the paper</td>
<td>We have done this in the IF document, so will be acted on in the published paper.</td>
</tr>
</tbody>
</table>
Appendix I. Evaluator’s report
Science Teacher Education Partnerships with Schools Project

ID12-2412

External evaluation report

Paul Chesterton

February 2015
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Acknowledgements

Appreciation is expressed to the project team leader and team members for their support of the evaluation and for their willingness to share their understandings, insights, expertise and time.
1.0 Introduction

This report outlines details and findings of an external evaluation of the project entitled *Science Teacher Education Partnerships with Schools*, undertaken by a team of teacher educators from Deakin University, RMIT University, Australian Catholic University, University of Melbourne, and University of Tasmania, led by Dr Linda Hobbs. The project was funded by the Office for Learning and Teaching (OLT) under its Innovation and Development Program and the external evaluation was conducted by Dr Paul Chesterton, an independent evaluation consultant.

The following sections outline the intentions of the project, the functions, approach and procedures of the evaluation, key evaluation findings and overall conclusions.

2.0 Intentions and procedures of the project

The overall intention of the project, as outlined in the project proposal, was to ‘review and build on established, innovative and successful practices at five universities, to develop and promote a framework supporting school-based approaches to pre-service teacher education’. In turn, the intended outcomes for the project were identified as -

- A synthesis of the variety of teaching and reflective practices and informing theories used in school-based science teacher education programs.

- Documentation of exemplars of innovative pedagogies that represent the range of contexts, constraints and affordances that lead to quality student outcomes.

- Creation of an interpretive framework informed by contemporary practice that can guide improvement of science teacher education programs.

- Determination of sustainable methods for establishing and maintaining effective school-university partnerships generalisable across a range of contexts.

- Facilitate uptake of innovative school-based practices within the sector for the purpose of improving the educational outcomes of science teacher education programs, and teacher education programs generally.

The project began with an examination of the school-based science teacher education programs and practices of the project team members’ universities, leading ultimately to publication of five case studies and a cross-case analysis on the project website. Further analysis of practice was undertaken using data from pre-service student surveys and interviews of pre-service students, teacher education staff and school personnel. This in turn enabled identification of the nature and role of contextual factors in shaping, enabling and constraining innovative practices and quality student outcomes, along with a set of themes common across the various practice contexts. A review of the research literature on frameworks, theories and pedagogies associated with school-based delivery of curriculum content provided a broader basis for validating and extending the findings from the case
study analysis. The literature review led to the production of an annotated bibliography, accessible on the project website.

In the light of the above processes, a series of draft interpretative frameworks and guiding principles was progressively developed during the course of the project. Presentation of early drafts at the Australasian Science Education Research Association (ASERA) Conference and the Deakin Methodology Symposium in 2013 enabled feedback and advice on their ongoing development to be gained from the wider higher education sector. This continued in the second year of the project, with team members conducting workshops and making presentations at conferences run by ASERA, EDULEARN and the Australian Teacher Education Association (ATEA). The framework was further augmented with the incorporation of vignettes to demonstrate key points and narratives to contextualize main ideas.

The intent of the framework’s development was ‘to guide and inform the partnerships between universities and schools that support science teacher education programs .. and .. to help support judgments about current practice, and provide a framework for initiating practice’ (http://www.stepsproject.org.au/interpretive-framework). The workshops and presentations were used by the project team as a means of dissemination and promotion of the framework to potential university and school users, as well as the previously mentioned function of gaining feedback. Additional means of dissemination included submission of articles to professional journals, production of a newsletter and promotional video, development of the project website and planning for a Showcase Day in early 2015.

3.0 Functions of the evaluation

The evaluation was designed to –

i. provide formative feedback to the project team on the implementation, outputs and outcomes of the project; and

ii. provide a summative evaluation of the extent to which the intended outcomes were achieved and the processes underlying such achievement.

4.0 Evaluation approach and procedures

4.1 Approach

Two forms of evaluation were adopted for the external evaluation - interactive and impact. Interactive evaluation involved a responsive approach in which project processes were observed and documented, taking into account the values and perspectives of different stakeholders and their varying contexts. This enabled formative feedback to be provided to the project team on its approaches, as well as on the framework, principles and resources as they were progressively developed. Impact evaluation assessed the effectiveness of the project in terms of the extent to which it was meeting its intended outcomes. It also checked for unintended outcomes and sought to explain project outcomes in terms of project processes and practice contexts.
The evaluator operated in a critical friend role, having access to project team deliberations (via meeting minutes and participation in team retreats), monitoring progress, raising questions and providing feedback.

The evaluation was guided by the following questions:

i. What are the intended processes and outcomes for the project?

ii. How is the project being implemented?

iii. To what extent are the intended outcomes being achieved?

iv. What factors are helping and hindering achievement of the intended outcomes?

v. To what extent are the project outcomes meeting the needs of the audiences for whom they are intended?

4.2 Procedures

The external evaluation plan included a range of information sources and information gathering techniques that were designed to address the evaluation questions, as outlined in the table below.
<table>
<thead>
<tr>
<th>Evaluation question</th>
<th>Sources of information</th>
<th>Information gathering techniques</th>
</tr>
</thead>
<tbody>
<tr>
<td>i. What are the intended processes and outcomes for the project?</td>
<td>a. Project proposal</td>
<td>a. Review of project proposal</td>
</tr>
<tr>
<td></td>
<td>b. Project team</td>
<td>b. Discussions with project team</td>
</tr>
<tr>
<td>ii. How is the project being implemented?</td>
<td>a. Minutes of project team and reference group meetings/project reports</td>
<td>a. Review of minutes and reports</td>
</tr>
<tr>
<td></td>
<td>b. Material on project website</td>
<td>b. Review of website material</td>
</tr>
<tr>
<td></td>
<td>c. Project team members</td>
<td>c. Discussions with /interviews of team members</td>
</tr>
<tr>
<td>iii. To what extent are the intended outcomes being achieved?</td>
<td>a. Project documents, e.g. case studies, principles, interpretative framework drafts,</td>
<td>Review of documents, reports, newsletters, presentations and articles</td>
</tr>
<tr>
<td></td>
<td>database</td>
<td></td>
</tr>
<tr>
<td></td>
<td>b. Project reports and newsletters</td>
<td></td>
</tr>
<tr>
<td></td>
<td>c. Conference presentations, articles</td>
<td></td>
</tr>
<tr>
<td>iv. What factors are helping and hindering achievement of the intended outcomes?</td>
<td>a. Minutes of project team and reference group meetings</td>
<td>a. Review of minutes</td>
</tr>
<tr>
<td></td>
<td>b. Project team members</td>
<td>b. Discussions with /interviews of team members</td>
</tr>
<tr>
<td>v. To what extent are the project outcomes meeting the needs of the audiences for whom they are intended?</td>
<td>a. Roundtable discussions with teacher educators</td>
<td>a. Review of feedback from Roundtable discussions</td>
</tr>
<tr>
<td></td>
<td>b. Project Seminar and Showcase Day</td>
<td>b. Observation and review of feedback</td>
</tr>
<tr>
<td></td>
<td>c. Pre-conference workshops</td>
<td>c. Review of feedback from pre-conference workshops</td>
</tr>
<tr>
<td></td>
<td>d. Minutes of reference group meetings</td>
<td>d. Review of minutes</td>
</tr>
</tbody>
</table>
5.0 Evaluation results and findings

The external function of the evaluation, as noted in section 3.0, was to provide a summative evaluation of the extent to which the intended outcomes were achieved and the processes underlying such achievement. The following results and findings are accordingly presented in order to -

i. ascertain progress towards achievement of the project’s intended outcomes; and

ii. outline the nature and effects of the processes adopted for the project.

5.1 Achievement of intended outcomes

5.1.1 A synthesis of the variety of teaching and reflective practices and informing theories used in school-based science teacher education programs

The starting point for the project lay in the five different models of school-based delivery of science education in the universities from which the team members were drawn. Each of the models involved partnerships with schools and each came with a record of well-established and successful implementation. The nature of the partnerships varied, as did the learning and teaching, student assessment and staff professional development practices, and the underlying theoretical foundations. The first intended outcome of the project was aimed at synthesising these diverse models to identify common themes and the theories underlying their structures and practices.

To provide the synthesis, team members prepared case studies of the practices involved in each of the five models, covering aspects such as rationale, theories informing practice, structure, nature of partnership, student learning outcomes and indicators, plans for future directions, and constraints and affordances. The case studies were then subjected to a draft cross case analysis. A number of commonalities emerged from this analysis, including -

- Program rationales based on providing an authentic experience in teaching science during pre-service teacher training;
- A growing significance of partnership between university and schools;
- Overall aim to build skills and confidence in teaching science;
- Prevalence of constructivist theory and inquiry approaches;
- Adoption of strategies to promote self-efficacy; and
- Existence of logistics and staffing constraints.

The synthesis and analysis of the five models conducted in the early stages of the project may be seen to have provided a sound and useful basis for more detailed investigation of these models in their operating contexts and of other models in the wider higher education
sector. Accordingly the first specified outcome of the project is viewed as having been achieved as intended.

5.1.2 **Documentation of exemplars of innovative pedagogies that represent the range of contexts, constraints and affordances that lead to quality student outcomes**

This outcome covers two aspects – first, it ‘relates to building detailed accounts of each model or practice, which requires the perspectives of the various stakeholders involved. .. (It) also relates to other uses of these practices beyond the project members’ (Grants Program Year 1 Report, 21 January 2014).

For the first aspect, the team gathered and analysed data from pre and post student surveys, student interviews, course assignments, tutor interviews, and school Principal and teacher interviews. This enabled the team to identify changes in student attitudes and beliefs, noting in particular increased confidence in teaching Science. It also enabled more detailed attention to be given to the contextual factors associated with each of the models. These were subsequently spelt out in a series of narratives to demonstrate the nature of the interpretative framework in practice across the five models.

For the second aspect, 20 science pre-service teacher educators from 17 Australian universities were interviewed by telephone. The interview questions addressed five themes – ‘prevalence of the school-based partnership model being employed by Australian universities; the theories that underpin the practice of a teacher educator using the school-based partnership model; the characteristics of the partnership; how the teacher -educator sustains the partnership or what would be needed to commence a partnership; and what the blockers and challenges are to sustaining or commencing a partnership.’ (Teacher Educator Interviews paper, p.1). The same questions were responded to in written form by the project team members, providing additional data in this case for the detailed accounts of the initial five models.

The interview data were collated and analysed according to the five themes noted in the preceding paragraph. They were then used, along with the case study data, to generate detailed vignettes for four different audiences - schools and/or teachers, teacher educators and schools, teacher educators and pre-service students. The introductory text for the vignettes indicates that each was written around themes relating to questions and issues that emerged during the project’s dissemination and evaluation processes, with the themes being seen as important in supporting uptake of school-based practices.

Additional investigation of school-based delivery of curriculum content within the wider higher education sector was undertaken by a literature review, focusing largely on science teacher education. This led to the production of an annotated bibliography that is publicly available on the project website. This, along with the publication of the narratives and vignettes, provides a detailed explication of innovative pedagogies in school-based science education.
teacher education programs within the case study programs and the wider higher education sector, which in turn points to the achievement of the second intended outcome.

5.1.3 An interpretive framework informed by contemporary practice that can guide improvement of science teacher education programs

Achievement of the preceding two outcomes provided the basis for the generation of an interpretative framework. As noted in the earlier outline of procedures (section 2.0), a series of draft interpretative frameworks and guiding principles was progressively developed during the course of the project. By the end of the first year, the framework was in its fourth draft including early versions of the Growing University-School Partnerships (GUSP) and Representations of Partnership Practices (RPP) grids, and had received feedback from the ASERA Conference and the Deakin Symposium. Review of the feedback at a team retreat in early 2014 led to version 5 of the framework, followed by a further version, including the narratives, that was presented to audiences at three conferences during that year. Feedback on the framework and its application was gathered at these events by means of workshop materials and activities, presentation comments and questions, and a workshop evaluation form. The feedback included a number of issues and questions for the team to consider, enabling further fine tuning. In general the feedback was positive, affirming the overall structure and content of the framework and associated materials. Some minor adjustments and additions, including the vignettes, led eventually to the publication of version 8.2 on the project website by the end of 2014.

The processes that were adopted to develop the framework attest to its validity and potential usefulness. The framework is grounded in the literature and informed by current practice of the case study sites and of the wider higher education sector. It has been subjected to continuing appraisal by a variety of audiences, with feedback being used to guide its ongoing development. Its acceptance and applicability across a diversity of audience contexts provide a clear indicator of its perceived worth and potential. The extent to which this potential can be translated into measured improvement of science teacher education programs has yet to be tested, through application of the recently published final version in a range of contexts. The soundness of its development and trialling processes would suggest a strong likelihood of its potential being realized in future applications. At this stage, the potential is clearly demonstrated and accordingly the project’s third intended outcome is seen as having been met.

5.1.4 Determination of sustainable methods for establishing and maintaining effective school-university partnerships generalisable across a range of contexts

The generation of methods for establishing and maintaining effective school-university partnerships is evidenced in the interpretative framework, and in particular, in the Growing University-School Partnerships (GUSP) grid. As its introductory notes indicate, the grid describes the likely processes and thinking required in the initiation, implementation and evaluation phases of school-university partnerships, in terms of five components – need and
rationale; institutional and unit demands; relationships; pre-service teacher interactions with children; and elements of practice. The material draws on the project team’s analysis of current practice of the case study sites and of the wider higher education sector and related professional literature. Accordingly, it is not tied to any particular model or program. Its focus on fundamental concepts and directions add weight to its generalizability across contexts - essentially it places the onus on potential audiences to tailor and apply the processes and thinking to their own specific contexts, needs and priorities. Feedback gained during the project from diverse contexts has in turn been used to assess and promote its generalizability.

The extent to which the methods are sustainable cannot be fully known at this stage. There is some evidence of elements of the grid having been successfully used to establish and maintain effective partnerships over a period of time in the case study settings. The grid in its entirety has yet to be applied however across diverse contexts to determine its impact and sustainability. The project team has produced the methods - their sustainability is an issue that can only be resolved in the longer term beyond the funded life of the project.

5.1.5 Facilitate uptake of innovative school-based practices within the sector for the purpose of improving the educational outcomes of science teacher education programs, and teacher education programs generally

The preceding four outcomes provide a potentially strong base for facilitating uptake of innovative practices through the insights and materials generated in the project. As previously noted, the project’s outputs are grounded in both successful practice and the research literature, providing clear guidance as to the nature of innovative partnership practices and the key principles, issues and methods underlying their establishment and maintenance.

The generation of insights and materials has been accompanied by a comprehensive set of dissemination processes. This has involved continuing contact with the sector with the intent of developing interest and awareness as well as engaging potential adopters by seeking critical appraisal and feedback. Dissemination strategies have included distribution of draft documents such as the case studies and interpretative framework, uploading materials to the publicly accessible project website, production of a newsletter and promotional video, pre-interview contact with science pre-service teacher educators across the sector, conference presentations, pre-conference workshops and submission of journal articles. The generally positive response and feedback from these contacts, and the ongoing refinement of the resources in response to such feedback, have assisted in creating favourable conditions for sector uptake.

The interest shown by the sector is not surprising, given concerns that have been expressed about the quality of science teaching and the lack of coordination of theory and practice in teacher education courses, and calls for more school-based experiences and innovative
pedagogies. The rationale for the project drew on these issues, and its insights and materials can be seen as providing concrete ways addressing the sector’s needs and concerns.

The factors outlined above indicate planning and activity by the project team to create the conditions that are likely to maximize uptake and impact - comprehensive and well grounded materials, plus extensive dissemination that engages key audiences and provides ways forward to address key needs. It is too early however to identify the extent and nature of actual uptake. This also means that the extent to which the project has facilitated such uptake, the fifth intended outcome, cannot be determined at this stage. Positive conditions have been established but their effects are yet to be seen. As with the preceding intended outcome, this is a longer term issue.

The extent to which the outcome may be achieved will also depend on dissemination processes in place after the funded period of the project ends. To what extent and in what ways will the dissemination processes continue? The project proposal indicated that a report of findings will be made to the Australian Council of Deans of Education and through this to the Faculties and Schools of Education, to the Australian and Victorian science education associations and to the public through general media releases. Presentations to conferences in 2015 and 2016 have been signaled in project planning documents, along with journal articles and a book publication. A series of roundtables is also envisaged in Victoria and Tasmania in 2015 to promote broader discussion around use of school-based university teaching and school-university partnerships.

The project website is an important means of informing and engaging the sector. Attention will need to be given to its ongoing resourcing, updating, monitoring and maintenance for it to retain its contribution to facilitating uptake of the innovative practices beyond the funded project period.

At this stage it appears, in relation to the fifth outcome, that the project’s activities and its dissemination processes have focused largely on science teacher education programs and not ‘teacher education programs generally’. This is understandable, given the additional complexities of the broader program context and the finite period of the project. The insights and materials generated by the project may be seen as providing a useful beginning to any such broader exploration and application.

5.2  Nature and effects of processes

The second function of the evaluation was to identify the nature and effects of the processes adopted for the project. The project processes have been outlined in the accounts of procedures and progress towards achievement of the project’s intended outcomes in Sections 2.0 and 5.1 above. Their effects may be seen through an analysis of associated factors that helped and challenged the project’s operation and progress. Findings from this analysis are outlined below.
Factors identified as helping the project’s operation and progress included the following.

- Joint preparation of the proposal by team members, enabling early shared ownership of the project. This was reinforced by an initial residential team retreat in February 2013 that helped in establishing rapport, common understanding and agreement on procedural details and directions.

- Having regular meetings, with face-to-face being particularly helpful. A second residential team retreat in February 2014 provided a well-organised and focused opportunity for the team to review progress and to engage in detailed planning for the second year of the project.

- Direct access to the five programs of team members from which the case studies were derived. This was aided by members’ openness about their programs and their non-competitive approach in working as a team.

- Proactive and effective leadership by the project team leader, based on detailed planning, comprehensive recording of proceedings and decisions, regular communication, monitoring of progress and encouragement to challenge and interrogate ideas.

- A skilled and committed team, with members willing to share ideas and take on responsibilities.

- Allocation of defined tasks to team members, accompanied by a mix of small group meetings to handle tasks and to report and review progress. Setting milestones for tasks was also noted as helping to keep things on track.

- Drawing in skilled specialist personnel for data collection and project administration.

- Advice and feedback from the Reference Group.

- A well planned and comprehensive set of dissemination processes with a willingness to seek and listen to feedback from the sector.

Factors identified as hindering the project’s operation and progress included -

- Issues in establishing a multi-institutional agreement and trying to identify each university’s procedures for handling funds from multi-institutional projects in the early stages.

- Team members’ difficulty in finding time for project tasks in the midst of increasingly busy agendas and workloads.
6.0 Conclusions

The overall intention of the project, noted earlier in section 2.0, was to ‘review and build on established, innovative and successful practices at five universities, to develop and promote a framework supporting school-based approaches to pre-service teacher education’. The project team has produced the intended framework, with a strong grounding in current practices of both the five case study universities and the wider sector and in the research literature. The framework and its related materials have in turn been authenticated through a comprehensive set of dissemination procedures across the sector that have sought critical review and appraisal, with subsequent feedback being used to guide ongoing development and refinement. The acceptance and applicability of the framework and related materials across diverse audience contexts provides a clear indicator of their perceived worth and potential in guiding improvement of science teacher education programs.

The extent to which the framework’s methods for establishing and maintaining effective school-university partnerships across a range of contexts are sustainable (outcome 4) is more of a longer term issue, as is the extent to which the project is able to facilitate uptake of innovative school-based practices within the sector to improve science teacher education program outcomes (outcome 5). A sound basis has been laid for the achievement of these outcomes in the form of credible and authenticated materials and comprehensive and well focused dissemination. Promoting longer term impact is an ongoing challenge. A continuation of dissemination activities beyond the project funding period, as currently envisaged by the project team, and establishing arrangements for ongoing resourcing, updating, monitoring and maintenance of the project website will be needed in order to maximize the extent to which the longer term impacts are realised.

In summary, the project team has made a valuable contribution to promoting and supporting school-based approaches to pre-service science teacher education. The sector has been provided with a clear and comprehensive framework to establish and maintain effective school-university partnerships and guide program improvement, with its key audiences having been critically engaged in the framework’s development and validation. The project’s achievements have in no small part been due to the skills, commitment and group dynamics of the project team, its highly effective and proactive leadership, the use of specialist personnel, and the adoption of well planned and comprehensive dissemination and feedback processes. The immediate outcomes, in the form of the framework and associated materials, have been well received, providing positive and feasible means of addressing currently expressed needs in science teacher education. This in turn provides a sound and positive basis for longer term impact, stimulated and supported by ongoing dissemination activities.