UTS UNIVERSITY OF TECHNOLOGY SYDNEY

Exploring Primary Teachers' Professional Learning Network (PLN) Activities for Value as Professional Development in Science Education

by Ruth Fentie

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Associate Professor Matthew Kearney [Supervisor]
and Dr. Kimberley-Pressick-Kilborn [Alternate Supervisor]

University of Technology Sydney Faculty of Arts and Social Sciences

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Certificate of Authorship

I, Ruth Fentie declare that this thesis, is submitted in fulfilment of the requirements for the award of Doctor of Philosophy, in the Faculty of Arts and Social Sciences at the University of Technology Sydney.

This thesis is wholly my own work unless otherwise reference or acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

This document has not been submitted for qualifications at any other academic institution.

This research is supported by the Australian Government Research Training Program.

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Abstract

Effective, scalable teacher professional development is requisite to international governments' objectives of improved student learning outcomes and career uptake in science and STEM fields. In seeking an optimal balance between personally relevant and professionally potent development, primary teachers are among those using Professional Learning Networks (PLNs). This multi-mixed methods study, includes quantitative and qualitative data collection, focused on investigating international primary teachers' PLN activities, for contributing value as professional development in science education. Data analysed and integrated came from an online survey, interviews, participant artefacts, including a brief review of professional documents. Participants' perceptions, analysed through a socio-cultural theoretical lens, revealed key themes. Themes indicated participants' informal activities in multiple online contexts of their PLN contribute considerable value for developing professionally, although not exclusively in science education. Value ascertained from teachers' perceptions, used criteria for effective teacher professional development and a model for teacher professional knowledge. Primary teacher participants, regardless of science background, perceived that their PLN activities inspire, promote, support and affirm implementation of newer science and technology practices. Participants' selective online PLN construction, contingent interactions and reflective activities provide evidence of developing science pedagogical content knowledge (PCK). Participants shared ideas, resources, tools and ways to implement these, to science-topic and K-6 suitable specificity. In sharing professional knowledge such as science PCK, participants influenced their own and others' professional identity. Participants adapted general pedagogical knowledge for science; and participants refined their science content knowledge (SCK) (to a lesser extent); both with implications for student learning. While acknowledging study limitations, primary teachers' PLN use, has individual and collective value for professional development in science education. An implication for pre-service teachers and in- service teachers is that using a PLN inspires and supports opportunities to develop their science pedagogical knowledge and teaching skills through a career.

Table of Contents

Certificate of Authorship....ii

Acknowledgment....iii

List of Papers and Presentations....iv

Abstract....v

List of Tables....ix

List of Figures....x

Abbreviations and Definitions....xii

Chapter 1 Introduction....1

1.1 Background....3

1.2 Research Problem....4

1.3 Purpose Statement....7

1.4 Significance of the Study....7

1.5 Research Questions....9

1.6 Overview of Chapters....10

Chapter 2 Literature Review....12

2.1 Theoretical Background....13

2.2 Related literature....33

2.3 Summary....50

Chapter 3 Methodology....52

3.1 Methodological Decisions....52

3.2 Rigor in Mixed Methods....62

3.3 Ethical Considerations....66

3.4 The Participants and Sampling Methods....70

3.5 Data collection methods....76

3.6 Data Analysis Methods....86

3.7 Limitations 90

3.8 Summary 92

Chapter 4 Integrated Findings 93

4.1 Primary Teachers' Purposes in Initiating PLN Construction 95

Summary of Section 4.1 120

4.2 Key Features of Using a PLN for Developing K-6 Science Teacher Knowledge and Skills 121

Summary of Section 4.2 148

4.3 Considerations in using PLNs to inform K-6 science teacher development 149

Summary of section 4.3 160

4.4 Summary of chapter 4 160

Chapter 5 Discussion 162

5.1 Primary teachers' selective PLN construction 165

5.2 Detailed nature of primary teachers' PLN interactions 178

5.3 Primary teachers' perceptions of value of PLN activities 187

5.4 Value of primary teachers' PLN activities for professional development in science education 202

5.5 Limitations 207

5.6 Summary of chapter 5 208

Chapter 6 Chapter 6: Implications, Future Directions for Research and Conclusion 211

6.1 Implications for Primary Teachers 211

6.2 Implications for Professional Development Providers 213

6. 3 Implications For Pre-service and In-service Teachers' Professional Development 215

6.4 Implications for Employers of Primary School Science Teachers 216

6.5 Suggested Future Directions of Research 217

6.6 Conclusion 219

References 222

Appendix A: Approvals, Participant Information and Consent Forms. I

Appendix B: Phase 1 Survey Instrument Development XVI

Appendix C: Communications with participants XXIX

Appendix D: Interview Schedules for Phases 2 & 3 XXXIII

Appendix E: Phase 3 Data Collection Tool – an evaluation template XXXVI

Appendix F: Samples of Coding Themes XXXVII

Appendix G: Extracts from Reviewed Teacher Professional Standards Documents XLII

Appendix H: Quantitative Data from Survey Items Using SPSS Tables XLIV

List of Tables

Table 3.1 *Participant demographics for Phase 1 of this study* 73

Table 3.2 *List of Phase 2 & 3 Participants* 74

Table 4.1 *Reasons Why Primary Teacher Respondents Initiated Building a PLN (Phase 1 survey responses, n=49)* 96

Table 4.2 *What Primary Teachers Were Seeking from Their PLNs (Combining Categories of Important and Very Important Phase 1 survey responses, n=49)* 98

Table 4.3 *Correlations of Survey Items Baseline Confidence in Science Content Knowledge, and Using PLN to Build Primary Science Content Knowledge* 107

Table 4.4 *Extent of Primary Teachers' Agreement to Learning How to Implement New Learning Tools (e.g. Apps) in Science Lessons Through Their PLN Activities (Phase 1, Survey Item, n=49)* 114

Table 4.5 *The Five Most Popular Platforms in Primary Teachers' PLNs (Phase 1 Survey Data, n=49)* 121

Table 4.6 *Primary Teachers' Perceptions of Using PLN for Science Professional Development as Useful as Face To Face PD (From Phase 1 Survey, n=49)* 140

Table 4.7 *Primary Teachers' Most Frequent Reasons for Adding to Their PLN (Phase 1 Survey Data, n=49)* 152

Table 5.1 *Summary of Research Sub-Question Major Themes: Primary Teachers' Perceptions of Value of Their PLN Activities for Professional Development in Science Education* 164

List of Figures

Figure 2.1 *Model of teacher professional knowledge and skill including PCK and influences on classroom practice and student outcomes (Gess-Newsome, 2015, p.31)* 30

Figure 2.2 *PLNs From A Teacher's Perspective. (From Kearney, Pressick-Kilborn & Hunter, 2016, p. 31). Used with permission*. 36

Figure 2.3 *Proposed Framework for Ascertaining Value of Primary Teachers' PLN Activities for Their Science Education Focused Professional Development* 49

Figure 3.1 *Exploring Primary Teachers' PLN Use: A MMMR Structure Overview of This Study*..... 58

Figure 3.2 *Nested sequential sample of participants over 3 phases* 71

Figure 3.3 *Samples of online advertisements for survey recruitment* 81

Figure 4.1 *Reasons Primary Teacher Respondents Initially Constructed a PLN (Phase 1 survey, n=49)*..... 96

Figure 4.2 *Word Cloud of 20 Most Frequent Words, Generated in NVivo in Phase 1 Survey Open-ended Professional Development Item (n=30) Responses.* 99

Figure 4.3 *Integrated Results from Text Search 'Word Query' of "New" in NVivo for Phases 1 and 2 Data*..... 100

Figure 4.4 *Participants' Rating of Frequency for Using Their PLN to Access Latest Science Educational Research Findings (Phase 1 Survey Responses, n=49)* 105

Figure 4.5 *Scatterplot Indicating Very Weak (Non-Significant) Relationship Between Confidence in Primary Science Content Knowledge and Using PLN to Build Primary Science Content Knowledge*..... 106

Figure 4.6 *Contrast of Using PLN to Seek Content Knowledge and Expert Advice with Using PLNs to Improve Science Concept Knowledge by Asking Experts (Phase 1 Survey Data, n=49)* ... 109

Figure 4.7 *Teacher Respondents Surveyed (n=49), Agreement of Using their PLNs to Improve Understanding of Primary Student Misconceptions*..... 113

Figure 4.8 *Comparison of Single Classroom Primary Teachers' of Science and Primary Teachers' of Science Across One Or More Grades Agreement About Using Their PLNs to Learn Ways to Promote Student Interest in Science (Phase 1 Survey Data, n=49)* 119

Figure 4.9 *Primary Teacher Participants' Use of Multiple Platforms from Phase 1 Survey (n=49)*. 123

Figure 4.10 *Primary Teachers' Agreement in Using PLN for Primary Specific Curriculum Knowledge (n=49)* 125

Figure 4.11 *Primary Teachers' Level of Agreement on Quality Satisfaction With Science-Based PLN Interactions (Phase 1 survey, n=49)*..... 144

Figure 4.12 *Survey item, n=49, When I need to learn something new for my science teaching I take the initiative to learn it using my PLN*..... **Error! Bookmark not defined.**

Figure 4.13 *Participants' Level of Agreement that their PLN Activities Promoted Changes in their Science Teaching Practice (Phase 1 survey, n=49)*..... 148

Figure 4.14 *Survey Participants' (n=49) Rating of Decision Basis for Adding New Connections to Their PLN (e.g. People/groups to follow)*..... 153

Figure 4.15 *Participants' comments from Phase 2 and 3 interviews about effective PLN management considerations and strategies* 156

Figure 4.16 *Comparison of Teacher Perceptions of Employer Recognition of PLN Activities as Teacher Professional Development With Perceived Importance of Self- Directed PLN Activities For Professional Development (Phase 1 survey, n=49)*..... 158

Figure 5.1 *Primary Teachers' PLN Activities Value for Development of Science Professional Knowledge Mediated by Their PLN Activities. (Adapted from Gess- Newsome (2015) Consensus Model, p. 31)*..... 203

Abbreviations and Definitions

AR **Augmented Reality**

Augmented reality describes a composite or enhanced representation of reality by using technology to augment the real world with sound and/or image and/or text or other digital content.

CoP **Communities of Practice**

Communities of practice are groups of people with shared interests learning more efficiently through their interactions together (Wenger, 1999). The shared domain of interest creates an identity and membership in being part of joint activities where practice involves shared, co-developed resources.

CoRL **Co-Regulated Learning**

Co-regulated Learning describes computer-supported collaborative learning, based on self-regulated learning theory. Co-regulated learning is where individual self-regulatory processes are supported temporarily within a group by its members, the technologies used or by aspects of the environmental context (Jarvela et al, 2016)

Generalist science primary teacher

A generalist science primary teacher teaches across all key learning areas within the K-6 school curriculum with no specialised science discipline knowledge qualifications (does not exclude primary teachers with more specialised work experience, qualifications and specialisms in other domains). Generalist science primary teachers tend to teach in a single classroom across a school year, except where classes are composite (for example, K/1 or 5/6).

Abbreviations and Definitions continued.

NIC Networked Improvement Communities

NICs are sharing networks, designed to execute solutions to complex, difficult problems requiring multi-step solutions. NICs allow for deeper group understanding between members allowing them to work smoothly as a system to solve complex or "wicked problems" (Gomez et al., 2016, p.11).

PCK Pedagogical Content Knowledge

PCK refers to teachers' professional knowledge and skill focused on knowledge of the subject content, their beliefs about teaching and learning, and knowledge of ways to implement content learning activities using their knowledge of their students (Shulman, 1986). This transformative knowledge practice distinguishes teachers from subject matter content experts (Loughran, 2013). PCK is a crucial part of teachers' background knowledge. Where background knowledge involves teachers' curriculum knowledge, including assessment and general pedagogical knowledge of teaching approaches. Managing learning opportunities and environments conducive to learning, teacher's identity and motivations are also part of this background (Gess-Newsome, 2015). PCK is distinctive from general pedagogical knowledge as it is content, even topic specific; actively emergent with practice; and is complex in detail.

PCK & S Pedagogical Content Knowledge and Skill

Pedagogical Content Knowledge and Skill or PCK & S is a term used to describe teachers' practice at the classroom level of implementation of skill in PCK, suited to a specific group of students, and which develops with teaching (Gess-Newsome, 2015).

PCK-ing

PCK-ing is a similar concept to PCK&S which focuses on the active process of teachers transforming their content knowledge. PCK-ing or PCKg is inclusive of the learning context, and researchers propose that it comprises four aspects including content knowledge of subject matter, student needs, the learning environment and pedagogical understanding (Cochran, De Ruiter and King, 1993; Van Driel et al, 1998).

Abbreviations and Definitions continued.

PDP **Professional Development Program**

Professional development programs are developed (duration and mode of delivery varies) as a means of improving quality teaching classroom practices which can affect student learning, often for purposes of accreditation and continued teacher professional development.

PLC **Professional Learning Community**

Professional Learning Communities in education are noticeable for their common features. The community's shared aim of focusing on the collaborative, as well as individual responsibility to increase reflective practice is a feature, as are the professional goals of inquiry and promoting student learning (Jones et al., 2013).

PLN **Professional Learning Network**

Professional Learning Networks (PLNs) are complex interactional systems in online spaces where people access and use the available collective technology-mediated tools, resources and other people to support professional learning and ongoing development for their own and others' benefit (Trust et al, 2016).

PST **Pre-Service Teachers**

Pre-service teachers are undergraduate teacher education students, pre-employment.

Primary science teacher

A primary science teacher is a teacher of science at the primary or elementary school K-6 level, who may be generalist or specialist educated.

Abbreviations and definitions continued

RCM Refined Consensus Model

The Refined Consensus Model refers to a newer version of the Consensus model of teachers' PCK and skills. This newer model resulted from a second PCK summit, feedback sessions at science teacher conferences and electronic discussion, collated by Carlson & Daehler (2019).

SCK, SMK, CK Subject Content Knowledge or Subject Matter Knowledge

Content Knowledge or CK is used by Shulman (1986) to describe teachers' professional knowledge involving subject matter or discipline knowledge, curricular knowledge and pedagogical content knowledge. SCK refers to the content (facts, accepted theories, terminologies) knowledge particular to a subject and can be topic specific within a subject. Furthermore CK can be epistemic or syntactic, for example describing the ways that science knowledge develops, and substantive (SMK) knowledge of science (historic, accepted), (Anderson & Clark, 2012).

SDL Self-Directed Learning

Self-directed learning is a term used in an adult learning theory by Knowles (1975) where learners self-direct a process to identify their own ongoing learning needs; actively plan and pursue those goals, using relevant strategies and sourcing materials. Self-directed learners then evaluate whether their goals are met and formulate next steps. The self-directed learner may or may not enlist the help of others.

SNA Social Network Analysis

Social Network Analysis means conceptualising and analyzing social network relationships in structural-relational terms, emanating from social psychology and anthropology, and is facilitated in recent years by computer software. Patterns of dynamic relations are explored with global (big picture) and local measures (units at more individual level) using statistical methods to identify interaction characteristics like distribution, connections as ties and nodes, direction, and visualizing these flows of relationships such as reciprocity on maps or graphs (Carrington & Scott, 2014; Knoke & Yang, 2008).

Abbreviations and definitions continued

Science specialist primary teacher

A science specialist primary teacher is one who may have an other than primary education qualification, such as high school teacher with specialised domain knowledge in science, and also teaches primary or elementary K-6 school students; or teaches science exclusively; or a primary teacher with extra qualifications in the specialised knowledge domain of science (Appleton, 2007).

SRL **Self-Regulated Learning**

Self-regulated learning or SRL refers to the self-management of the learning process: identifying goals, employing self-control and self-monitoring towards goals and a self-reflective phase (Pintrich, 2000). This self-regulation involves motivational factors of affect, personal agency, self-belief and self-efficacy.

SSRL **Socially-Shared Regulation of Learning**

Socially-shared regulation of learning (SSRL) involves the collective efforts of group members to have productive group work processes. Through their group learning activities, they motivate and regulate group cognitive and affective experiences and behaviour (Jarvela et al., 2016).

STEM **Science, Technology, Engineering & Mathematics**

The acronym STEM was coined to lift the profile of each of these subject areas in educational contexts. STEM also refers to integration of these subject areas with their specific content knowledge as well as interdisciplinary activities (English, 2016).

TPD **Teacher Professional Development**

Teacher professional development to be considered effective needs to be based on professional learning that has structure and is associated with teachers changing their practice and improved learning outcomes for students, according to Darling-Hammond et al. (2017). TPD is usually associated with formally provided programs.

Abbreviations and definitions continued

TPKB Teacher Professional Knowledge Base

Teacher professional knowledge base is a general professional knowledge with several components. It is based on research and a shared understanding of effective teaching practice. TPKB also consists of topic specific professional knowledge (Gess-Newsome, 2015).

TSPK Topic Specific Professional Knowledge

Topic specific professional knowledge refers to content knowledge specific to science topics such as forces, living things etc., includes pedagogy and is specific to a student development level (Gess-Newsome, 2015).