DIGITAL EDUCATION AND LEARNING

DIGITAL TECHNOLOGY, SCHOOLS AND TEACHERS' WORKPLACE LEARNING

POLICY, PRACTICE AND IDENTITY

MICHAEL PHILLIPS

Digital Education and Learning

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Much has been written during the first decade of the new millennium about the potential of digital technologies to produce a transformation of education. Digital technologies are portrayed as tools that will enhance learner collaboration and motivation and develop new multimodal literacy skills. Accompanying this has been the move from understanding literacy on the cognitive level to an appreciation of the sociocultural forces shaping learner development. Responding to these claims, the Digital Education and Learning Series explores the pedagogical potential and realities of digital technologies in a wide range of disciplinary contexts across the educational spectrum both in and outside of class. Focusing on local and global perspectives, the series responds to the shifting landscape of education and the way digital technologies are being used in different educational and cultural contexts, and examines the differences that lie behind the generalizations of the digital age. Incorporating cutting-edge volumes with theoretical perspectives and case studies (single-authored and edited collections), the series provides an accessible and valuable resource for academic researchers, teacher trainers, administrators and students interested in interdisciplinary studies of education and new and emerging technologies.

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Digital Technology, Schools and Teachers' Workplace Learning

Policy, Practice and Identity

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To Cush, Riley and Bobby.

Series Preface

Much has been written during the start of this millennium about the potential of digital technologies to radically transform education and learning. Typically, such calls for change spring from the argument that traditional education no longer engages learners or teaches them the skills required for the twenty-first century. Digital technologies are often described as tools that will enhance collaboration and motivate learners to re-engage with education and enable them to develop the new multimodal literacy skills required for today's knowledge economy. Using digital technologies is a creative experience in which learners actively engage with solving problems in authentic environments that underline their productive skills rather than merely passively consuming knowledge. Accompanying this argument has been the move from understanding literacy on the cognitive level to an appreciation of the sociocultural forces shaping learner development and the role communities play in supporting the acquisition of knowledge.

Emerging from this context the Digital Education and Learning series was founded to explore the pedagogical potential and realities of digital technologies in a wide range of disciplinary contexts across the educational spectrum around the world. Focusing on local and global perspectives, this series responds to the shifting demands and expectations of educational stakeholders, explores the ways new technologies are actually being used in different educational and cultural contexts, and examines the oppor-

tunities and challenges that lie behind the myths and rhetoric of digital age education. This series encourages the development of evidence-based research that is rooted in an understanding of the history of technology, as well as open to the potential for new innovation, and adopts critical perspectives on technological determinism as well as techno-scepticism.

While the potential for changing the way we learn in the digital age is significant, and new sources of information and forms of interaction have developed, many educational institutions and learning environments have changed little from those that existed over one hundred years ago. Whether in the form of smartphones, laptops or tablets, digital technologies may be increasingly ubiquitous in a person's social life but marginal in their daily educational experience once they enter a classroom. Although many people increasingly invest more and more time on their favourite social media site, integrating these technologies into curricula or formal learning environments remains a significant challenge, if indeed it is a worthwhile aim in the first place. History tells us that change in educational contexts, if it happens at all in ways that were intended, is typically more 'incremental' and rarely 'revolutionary'. Understanding the development of learning technologies in the context of a historically informed approach therefore is one of the core aspects of this series, as is the need to understand the increasing internationalisation of education and the way learning technologies are culturally mediated. While the digital world appears to be increasingly 'flat', significant challenges continue to exist, and this series will problematize terms that have sought to erase cultural, pedagogical and theoretical differences rather than to understand them. 'Digital natives', 'digital literacy', 'digital divide', 'digital media'—these and such mantras as 'twenty-first century learning'—are phrases that are being used in ways that require further clarification and critical engagement rather than unquestioning and uncritical acceptance.

This series aims to examine the complex discourse of digital technologies and to understand the implications for teaching, learning and professional development. By mixing volumes with theoretical perspectives with case studies detailing actual teaching approaches, whether on or off campus, in face-to-face, fully online or blended learning contexts, the series will examine the emergence of digital technologies from a range of new international and interdisciplinary perspectives. Incorporating original and innovative volumes with theoretical perspectives and case studies (single

authored and edited collections), the series aims to provide an accessible and valuable resource for academic researchers, teacher trainers, administrators, policymakers and learners interested in cutting-edge research on new and emerging technologies in education.

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Further afield, I would like to thank the community of TPACK (Technological Pedagogical Content Knowledge) researchers that I have been fortunate enough to engage with. In particular I would like to thank Peter Albion and Neil Anderson for their thoughtful contributions to earlier versions of this work; Joshua Rosenberg for his help in extending my thinking about the importance of contexts; Aaron Kessler and Aroutis Foster for their engaging conversations about future research directions; Punya Mishra for his humor, wit and capacity to work with so many different people in such meaningful collaborations; Judi Harris for her amazing insights and scholarship which continues to push so many people interested in teachers and digital technology; Matthew Koehler for his supportive, inclusive and encouraging collegiality.

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CHAPTER 1

Contextualising the Use of Digital Technologies

The Growing Influence of 'The Digital'

Developments in digital technology have formed the basis of many advances in society over the past 30 years. Since the 1980s, many commentators have detailed the growth in the power and diversity of numerous digital developments including computers, mobile devices and the Internet. More recently, discussion about the ways in which social media, cloud computing and other 'Web 2.0' tools have influenced society have become commonplace (e.g., Castells 2013).

Neil Selwyn's (2010) critique of this 'digital age' summarises the tenor of both popular and academic perceptions of digital technology which 'tend to be informed by a notion that the development of digital technology represents a distinctively new and improved set of social arrangements in relation to preceding "pre-digital" times' (p. 7). Selwyn's comments reflect earlier accounts of the perceived importance and influence of digital technologies such as Steve Woolgar's (2002, p. 3) suggestion that the introduction of digital technologies implies 'that something new, different, and (usually) better is happening' or Murdock's (2004, p. 20) 'pervasive sense of leaving the past behind'. Indeed, the digital remediation (Chadwick 2013) of everyday life has reportedly influenced a wide variety of social processes and practices including education where the ubiquitous presence of technology in our society 'not only changes teaching and learning but also the curriculum' (Voogt et al. 2012, p. 119).

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It only requires a cursory glance of popular and academic reports to find examples of the influence of social media on a wide variety of shared interactions including the use of Twitter and Facebook to organise student demonstrations against the construction of power plants in Patagonia (Scherman et al. 2015), the impact of Facebook, YouTube, Flickr and Twitter in the collaborative rewriting of the Icelandic Constitution (Valtysson 2014) or changes in the way we conceptualise intimacy and friendship in technologically mediated personal relationships (Chambers 2013). While there is little doubt that social media platforms have made valuable contributions to social processes and practices that can enhance individual meaning making and action (W.L. Bennett and Segerberg 2011), research has also illustrated the complex, 'messy' and sometimes subversive ways in which digital technologies have been integrated into contemporary society.

As Nick Couldry (2012, p. 10) reflects:

> in Iraq in the early 1990s, the requirement that *typewriters* be registered with the authorities was still plausible means of state censorship, and television channels were few and heavily influenced by the state; by 2009, 470 Arabic language satellite TV channels were available in the Arab world and the recent spread of web enabled mobile phones has made state censorship still more difficult.

In contrast to the 'pre-digital' political environment in which censorship and political control were comparatively easy to maintain, the impact of social media in the 'Arab Spring', which began in December 2010, was quite dazzling. More than three million tweets and thousands of blog posts reportedly shaped political debate and social activism (Hussain and Howard 2013), providing a clear example of the ways in which digital technologies can and do change social processes and practices.

In contrast to the extreme examples of the impact of digitally based social media shaping political outcomes, some commentators have highlighted the everyday affordances of digital technologies, digital communication and interaction in seemingly pedestrian or routine aspects of contemporary life. For example, advertising materials for Christine Hine's guide for Internet ethnographers claimed:

> The internet has become embedded into our daily lives, no longer as an esoteric phenomenon, but instead an unremarkable way of carrying out our

> interactions with one another. Online and offline are interwoven in everyday experience. Using the internet has become accepted as a way of being present in the world, rather than a means of accessing some discrete virtual domain. (Bloomsbury Publishing 2015)

The everyday interconnections between online and offline are not only evident in the ways in which we are entertained, communicate and shop but the everyday use of digital technologies is also evident in the ways in which emerging technologies have been used to build on a history of initiatives intended to exploit available technologies to expand the reach of higher education (Universities UK 2013).

Recently, content from many university courses has been made accessible through the introduction of massive open online courses (MOOCs) which provide access to free tertiary education for anyone with internet access. On the surface, MOOCs appear to have had a dramatic impact on the provision of tertiary education with three MOOC providers (Udacity, Coursera and edX) offering nearly 700 MOOCs to more than eight million users worldwide (Cusakck 2014). Indeed, some MOOC enthusiasts such as Anant Agarwal reportedly have been so bold as to suggest that MOOCs will 'reinvent education … to transform universities. It's going to democratise education on a global scale. It's the biggest innovation to happen in education for 200 years' (reported in Cadwalladr 2012). Despite Agarwal's claim that MOOCs may be the greatest innovation since the invention of the pencil, others have suggested otherwise.

Research has found that completion rates in MOOCs are very low—generally between 5% and 12% (Cusakck 2014; Koller et al. 2013). These kinds of statistics and other critiques of MOOCs such as that offered by Jenny Mackness and colleagues (2013) that have seen the President's Council of Advisors on Science and Technology (2013) advise Barack Obama that the possibilities offered by MOOCs 'have yet to be realized' (p. 1) and 'many questions and challenges remain' (p. 3). Phillip Dawson (2013) has raised similar concerns suggesting that providing higher education to all is more complicated than enrolling people in a course. Dawson supports his argument with data that show more than 90% of MOOC students dropping out, while Australian universities maintain a 90% retention rate, with universities, colleges and technical training institutions in the UK, Norway and France all retaining more than 80% of students (Grove 2014).

There appear, therefore, to be tensions between the rhetoric and reality surrounding MOOCs; that the opportunity for changes similar to those

seen through the use of social media have materialized and the use of this form of digital technology is somewhat 'messier' if one digs below the surface (e.g., see Selwyn et al. 2015). Looking deeper into academic reports on the use of social media and other forms of Web 2.0 technology, similar cautionary or critical accounts can also be found (e.g., see De Zwart et al. 2011; Taddei and Contena 2013), suggesting that, to borrow a phrase from danah boyd (2014), it's complicated.

The pace of development of a new, digitally mediated social order and educational landscape has challenged academics to analyse changes and developments in a reasoned or coherent manner. This rapid rate of change coupled with the pervasiveness of digital technology in our contemporary lives suggests 'the Internet's consequences for social theory are therefore radical' (Couldry 2012, p. 2); this is true not only for the examples already outlined in this chapter, but it is also clearly evident as an issue in school contexts which are the focus of this book.

Schools and Digital Technology: Policies and Practices

School campuses are now awash with digital hardware, and growing amounts of schoolwork are now carried out on a 'virtual' basis. Teachers, often from developed Western nations, have been seduced to take up digital technologies through advertising campaigns sponsored by hardware and software companies, influenced by aspirational statements made by political parties and compelled to achieve digital technology standards set by teacher registration organisations and extensive financial investment by schools in digital infrastructure coupled with a raft of professional learning opportunities. These occasions have reinforced the assumption that digital technologies have the capacity to enhance society generally and teaching and learning more specifically. As Conole et al. (2008, p. 511) and her associates indicated:

> [digital technologies] seem to offer the potential for 'pedagogical innovative' (Sharples 2002) or are suggested as acting as 'catalysts for change'. These assumptions are reflected in the rhetoric associated with e-learning policy directives internationally but arguably are not reflected in actual changes to practice.

While this book is concerned with what is widely referred to as digital technology, information and communication technology (ICT), educa-

tional technology or a variety of other terms that have become adopted and accepted variations on the 'information technology' label, the focus of this book is not on technological devices or the artefacts that can be produced through their use. In contrast, this book focuses on a range of social, cultural and political issues associated with the rapid rise and use of digital technologies in educational settings.

Discussion earlier in this chapter has illustrated the pervasive impact of digital technologies on our daily lives. Educational settings have not been immune to the influence of digital technologies, yet unlike the adoption of digital technologies in business, research or populist pursuits, the use of digital technologies in educational contexts has been driven by macro-, meso- and micro-educational policies.

On an international or macro scale, the potential for digital technologies to influence educational outcomes has been recognised for more than a decade. This potential has been reflected in a range of policy documents including those drawn up by the G8 heads of state (2000), the World Bank (2003) and the United Nations (2005). As Kozma (2008) indicates, 'much has been promised by multinational organizations' (p. 1084) in terms of the benefits of digital technologies including such lofty aims as to enhance public welfare, to promote sustainable economic development and to foster international peace and stability. While much may have been promised by multinational policies, it is left to individual nation states to operationalise these macro-level policies.

An example from Australia typifies recent political responses in this field. The Federal Labor Government's $AUD 2.4 billion *Digital Education Revolution* promised to 'help bring our classrooms into the 21st Century' and 'revolutionise the nature of education and training and provide students with more access to technology than ever before' (Gillard and Firth 2009, p. 4). This 'revolution', it was suggested, will also 'contribute a sustainable and meaningful change to teaching' (Department of Education Employment and Workplace Relations 2011) leaving little doubt about an implied connection between increased access to, and use of, digital technologies and the resultant improvement in the educational landscape.

The Australian political landscape is not unique in this respect. For some time governments from a number of countries representing diverse political perspectives have been developing policies to shape increasingly common examples of digital technology use in schools. For example, Michael Thomas (2011) provided an account of an active policy to encourage the embedding of virtual learning environments (VLEs) in UK schools; a

policy outlined in the UK government's 2005 strategy paper 'Harnessing technology—transforming learning and children's services'.

Similarly, Marshall and Anderson (2008) outlined the development of educational policy in the Republic of Ireland and Northern Ireland between 1996 and 2006, and provided a detailed outline of three major policy developments during this time: 'Schools IT2000: A policy framework for the new millennium' (Republic of Ireland 1997), 'A blueprint for the future of ICT in Irish education' (Republic of Ireland 2001) and 'National Development Plan and Classroom 2000 (C2K)' in Northern Ireland.

In a broad, future-focused study, 14 academics from a range of international jurisdictions including Hong Kong, Taiwan, Germany, Singapore, China, Canada, Sweden, Chile, the UK, the USA and Australia examined the meso-policy implications of e-learning in school education until 2024 and recommended:

> the relevant stakeholders across different countries/regions consider policies on the goal-setting of curriculum addressing 21st century skills development and bridging gap between school and society; on the availability of digital technology for school education; on the privacy/legal issues of learning data in e-learning process; and on the teacher development for pre-service and in-service teachers. (Siu Cheung et al. 2014, p. 70)

In addition to the benefits of digital technologies highlighted in broad societal discussions and meso-level government policy, a large body of research literature also points to the potential benefits associated with teachers' adoption of digital technologies. On a micro level, school leaders are invested in areas such as 'technology-enhanced learning' (e.g., see Carneiro et al. 2011; Cerratto-Pargman et al. 2012; Dror 2011; Kim and Hannafin 2011; Vittorini et al. 2012) and 'computer-assisted learning' (e.g., see Karaksha et al. 2011; McDowall and Jackling 2012; Ross et al. 2011) to enhance the educational outcomes of students in their schools. While these aspirations are admirable, the use of terms such as 'technology-enabled learning' reinforces the connection between technology and the improvement of learning and teaching in state-of-the-art instances.

Investigations into such exemplar instances of digital technologies in education have prompted educational technology researchers such as Connell (2007) to claim that 'we are on the verge of profound change' (p. 7) or, as Laurillard (2008) more wryly observed, 'education is on the

brink of being transformed through learning technologies; however, it has been on that brink for some decades now' (p. 1). Laurillard's observation highlights that state-of-the-art case studies, which are the basis of many investigations, remain somewhat distinct from the 'state of the actual' (Selwyn 2008). In other words, there is a disjuncture between the rhetoric and the reality or a division between the policy and the practice when it comes to the educational uses of digital technologies in teaching and learning. A number of researchers examining teachers' pedagogical adoption of ICTs in schools claim that technology integration is not happening, happening too slowly or happening with little or no effect on student learning (e.g., see Becker 2001; Cuban 2001; Donald 2002; Ertmer 1999; Hattie 2009; Mumtaz 2000; Parisot 1995). More recently, these claims have been reinforced by an OECD report in which data from 64 countries and economies illustrated that digital technologies have had, at best, a mixed impact on student learning outcomes, with widespread classroom adoption not yet evident (OECD 2015) and data from national assessments designed to measure the digital literacy of Australian secondary school students indicating almost 50% of participants failing to meet national minimum standards (Australian Curriculum and Reporting Authority 2015).

Somekh (2008) conducted a substantive review of factors affecting teachers' pedagogical adoption of ICT and concurs with other studies stating that 'much of the research on teachers' use of ICT in their teaching describes low levels of usage and minimal pedagogical change' (p. 449). More recent criticisms of the Australian Federal Government's 'Digital Education Revolution' suggest that little may have changed with a range of issues impeding on teachers' ongoing use of technology (e.g., see Facchinetti 2010); however, findings such as these are not particular to Australia. The Innovative Teaching and Learning (ITL) research project examined teachers' integration of digital technologies as part of their classroom practice in seven countries including Finland, Indonesia, Russia, Senegal, England, Mexico as well as Australia, indicating that:

> while researchers saw many examples of specific practices that were innovative within a given national context (such as students working in teams or developing presentations based on current social issues they had researched on the Internet), descriptions of learning activities that incorporated a coherent set of innovative practices were quite rare, and the 21st century skill-building opportunities offered by the typical learning activity remains low. (Shear et al. 2011, p. 26)

The ITL and OECD findings closely resemble earlier findings of Becker (2001), Cox et al. (1999), Cuban (2001), Dupange and Krendl (1992) and others, suggesting that there has been little meaningful change in teachers' 'state of the actual' use of technology in more than two decades despite increasingly sophisticated technological advances.

While the potential for digital technologies to revolutionise education has been palpable for a number of decades, teachers' adoption of such technologies has not materialised in a way predicted by early proponents such as Papert (1984) who described the digital 'blowing up' of the conventional school. Many researchers have investigated this phenomenon and yet we are still finding teachers hesitant and, in some cases, resistant to the use of digital technologies as part of the classroom practice. What has become clear is the fact that there is no simple explanation for teachers' (non)use of digital technologies and that many investigations failed to account for the complex, compromised and often 'messy' realities of classroom technology use by school teachers.

Teachers' (Non)Use of Digital Technologies

The factors affecting teachers' use of digital technologies as a component of their practice is potentially a more complex phenomenon than information system adoption and may be described as a 'wicked problem' that has, in part, its genesis in social policy and theory (Rittel and Webber 1973). Wicked problems, as opposed to tame problems, are difficult to describe, and the answers provided by scientific, quantifiable models such as the 'technology acceptance model' (Davis et al. 1989), the 'theory of planned behaviour' (Ajzen 1991) and Hall's (1979) 'concerns-based adoption model' focus on elements such as efficiency and idealised outcomes but do not deeply consider the social settings confronting individual teachers and schools, which 'rely upon elusive political judgement for resolution (Not "solution". Social problems are never solved. At best they are only re-solved over and over again)' (Rittel and Webber 1973, p. 160). Rittel and Webber make the distinction between wicked and tame problems, in that wicked problems are characterised by:

- Requirements that are incomplete, contradictory and changing
- Uniqueness, in that no two wicked problems are alike
- Occurring in complex and unique social contexts

- Solutions that are difficult to realise and recognise because of complex interdependencies and contexts
- Solutions that are not right or wrong, simply 'better', 'worse', 'good enough' or 'not good enough'
- Solutions that have no stopping rule, the best we can hope for is 'satisficing' (Simon 1969)—achieving a satisfactory solution, an outcome that, given the circumstances, is good enough.

The inconsistent findings from research based on technology adoption models, particularly when applied to educational research, suggest that these 'tame' approaches do not provide a framework through which the 'wicked' problem of teachers' pedagogical technology integration can be effectively understood as 'each issue raised by technology integration presents an ever-evolving set of interlocking issues and constraints' (Graham 2011, p. 3). These interlocking issues and constraints have previously been considered from an information systems or technology adoption perspective with research using models and frameworks such as Rogers' (1962) Diffusion of Innovations and Venkatesh et al.'s (2003) 'unified theory of acceptance and use of technology'; however, 'recent studies on technology have shifted from the emphasis on technology skills alone to integrating pedagogy and content with technology' (Tee and Lee 2011, p. 89). The shift in focus to considerations of teachers' knowledge and the ways in which teachers use this knowledge to integrate pedagogy, content and technology is reflected in the increasing number of research studies using Mishra and Koehler's (2006) technological pedagogical content knowledge (TPACK) framework; however, as will be revealed in the following section, the knowledge required by effective teachers and the ways in which we might categorise these forms of knowledge are often contested.

Considering Teachers' Knowledge

Academic research into the features separating teachers' knowledge from the knowledge used in other professions has been reported in research literature for almost a century. Notable contributions to research in this field have been made by Dewey (1904), Scheffler (1965), Green (1971), Fenstermacher (1986), Kayser (1916), Smith (1980) and Schwab (1983). Many of these investigations, along with work undertaken by other researchers (e.g., see Blömeke and Delaney 2014; Welker 1992), have contributed to our current understanding of teachers' knowledge including ideas such as

personal practical knowledge proposed by Clandinin and Connelly (1986). Clandinin's work in particular was valuable as it proposed that teachers' classroom knowledge is not objectivist or a pre-existing body of knowledge that is simply acquired by teachers and then applied to practice. In contrast, the personal practical knowledge required by expert teachers is 'experiential, value-laden and oriented to practice' (Clandinin 1985, p. 19).

Of those researchers who have examined teachers' knowledge, Shulman's (1986, 1987) work is of particular note. Shulman's ideas developed in response to challenges associated with the professionalisation of teaching, in particular in an attempt to articulate the 'knowledge base for teaching' (Shulman 1987, p. 87). Shulman's categorisation of the knowledge required by teachers has been described in several publications 'though, admittedly not with great cross-article consistency' (Shulman 1987, p. 109). This inconsistency is revealed in publications including Shulman (1986), Shulman and Sykes (1986) and Wilson et al. (1987); despite the lack of consistency with which these categories have been classified, Shulman argues that:

> at a minimum, they would include:
>
> - Content knowledge;
> - General pedagogical knowledge, with special reference to those broad principles and strategies of classroom management and organisation that appear to transcend subject matter;
> - Curriculum knowledge, with particular grasp of the materials and programmes that serve as 'tools of the trade' for teachers;
> - Pedagogical content knowledge, that special amalgam of content and pedagogy that is uniquely the province of teachers, their own special form of professional understanding;
> - Knowledge of learners and their characteristics;
> - A knowledge of educational contexts, ranging from the workings of the group or classroom, the governance and financing of school districts, to the character of communities and cultures; and
> - Knowledge of educational ends, purposes, and values, and their philosophical and historical grounds. (Shulman 1987, pp. 92–93)

Among these classifications, Shulman's (1987) delineation of teachers' professional knowledge as pedagogical content knowledge (PCK) has been particularly powerful. The PCK framework differentiates expert teachers from content experts as expert teachers have a blend of pedagogical

knowledge (PK) and content knowledge (CK) collectively labelled PCK in contrast to content experts' deference to CK alone. Unpacking the complex notion of PCK is outside the scope of this chapter and has been the focus of many research agendas for the past three decades. Suffice to say that the PCK framework differentiates teaching experts, such as a physics teacher, from content experts, such as a physicist. Shulman and Sykes (1986, p. 9) argued that expert teachers have PCK that enables teachers to answer questions including:

> What are the aspects of this topic that are most difficult to understand for students? … What analogies, metaphors, examples, similes, demonstrations, simulations, manipulations, or the like, are most effective in communicating the appropriate understandings or attitudes of this topic to students of particular backgrounds and prerequisites? What student preconceptions are likely to get in the way of learning?

This conception of PCK has been utilised in different educational contexts (e.g., see C.D. Bennett and Dewar 2012; Benson and Brack 2009; Berliner 1988), particularly in the education of science teachers (e.g., see Loughran et al. 2004).

The Importance of Technological Knowledge for Teachers

The increasing influence of digital technologies on teachers' work has been reflected in the way technological knowledge (TK) has become incorporated into earlier considerations of teachers' knowledge. For example, Pierson (2001) indicated that a 'teacher who effectively integrates technology would be able to draw on extensive content knowledge and pedagogical knowledge, in combination with technological knowledge' (p. 427). Foreshadowing future research findings, Pierson (2001) concluded that 'the intersection of the three knowledge areas, or technological-pedagogical-content knowledge, would define effective technology integration' (p. 427).

Subsequent research examining the knowledge required by effective teachers considered ICT-related PCK (Angeli and Valanides 2005) or technology-enhanced PCK (Niess 2005) and produced findings similar to those of Pierson (2001) and reflected the growing importance of TK as a component of the knowledge base required by effective teachers. While

each of these papers added to the growing corpus of work considering teachers' knowledge, particularly the role of TK, this issue did not become part of broader educational discussions until Koehler and Mishra (2005) added to Shulman's PCK framework.

In an attempt to understand how the increasing use of digital technologies in schools might influence the development of teachers' professional knowledge, Koehler and Mishra (2005) proposed two questions:

1. What do teachers need to know about technology?
2. How can teachers acquire this knowledge?

To explore their first question, Mishra and Koehler (2006) expanded the PCK framework through the addition of TK. In doing so, Mishra and Koehler (2006) proposed that good teaching with technology involves a combination of TK, PK and CK or TPACK. Mishra and Koehler (2006) represented their TPACK framework as three overlapping circles, with each circle representing a component of teachers' professional knowledge. This framework resulted in seven potential forms of teachers' professional knowledge with the aspirational TPACK positioned at the nexus of these circles. Bounding these different forms of knowledge are the contexts in which teachers acquire and exhibit their knowledge as shown in Fig. 1.1.

The impact of the TPACK model has been profound and widely used in hundreds of studies examining teachers' professional knowledge (Graham 2011), with a great deal of effort refining definitions and explanations of the differing forms of knowledge represented in each part of the framework (e.g., see S. Cox 2008). The majority of these investigations use the TPACK framework to measure the extent and sophistication of teachers' knowledge (Jordan and Dinh 2012) and often draw on validated surveys (Archambault and Crippen 2009; Schmidt et al. 2009), open-ended questionnaires (Niess et al. 2006; So and Kim 2009), interviews (Niess et al. 2006, 2009) and performance assessments (Graham et al. 2012).

With such a proliferation of TPACK-based research, it comes as little surprise that there is marked variation in the contexts in which investigations have examined TPACK and include examinations of the TPACK development of pre-service teachers (e.g., see Albion et al. 2010), distance educators (e.g., see Archambault and Crippen 2009) and primary teachers (e.g., see Chai et al. 2011). While these investigations have made valuable contributions to our understanding of the interplay between forms of pro-

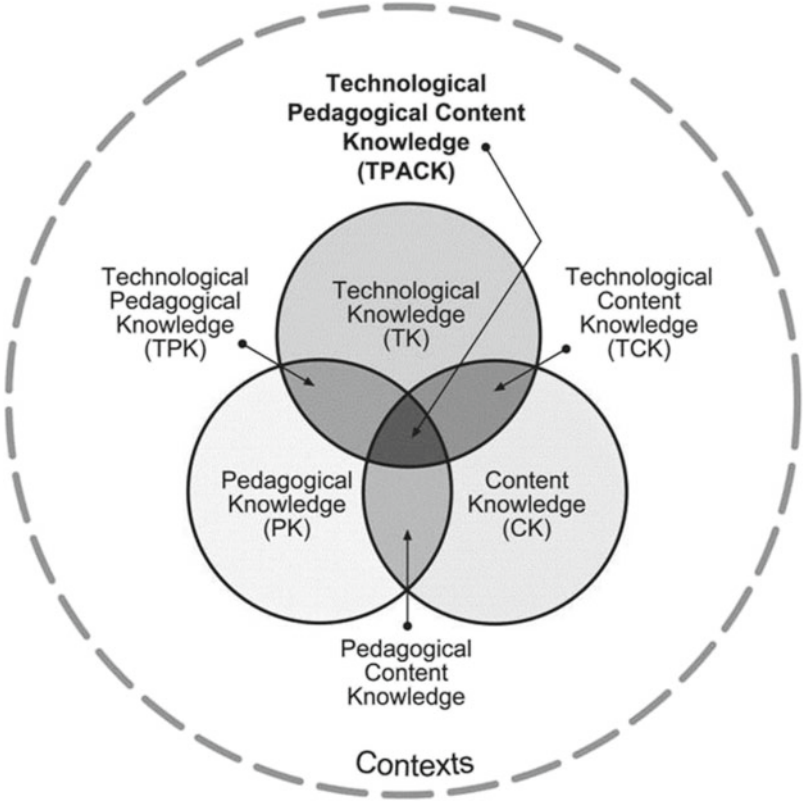

Fig. 1.1 The TPACK framework (Reproduced by permission of the publisher, © 2012 by tpack.org)

fessional knowledge in a variety of settings, the use of TPACK as a theoretical framework has raised a number of concerns.

Parr et al. (2013) provide a series of insightful critiques of the TPACK framework, particularly in the way it can be interpreted and utilised for pre- and in-service English teachers. Examining Mishra and Koehler's (2006) framework, Parr et al. (2013) claim that their 'initial concern with this framework was the way it seemed to compartmentalise professional knowledge of English teaching and ICT knowledge into separate

"packages"' (p. 13). The separation or compartmentalisation of teachers' knowledge has also been questioned by other TPACK commentators including Graham (2011) and Archambault and Barnett (2010, p. 1658) who suggest that 'that the highly accepted seven mutually exclusive domains of the TPACK theory may not exist in practice', further indicating 'that it is difficult to separate out each of the domains' (p. 1659). Parr et al. (2013, pp. 13–14) go further and, citing McEwan and Bull (1991) and Segall (2004) in support, state 'we found the theorising of pedagogy as distinct from "content knowledge" to be limiting to say the very least'.

In addition to the challenges associated with the separation of different knowledge domains, the TPACK framework has also received critique in relation to the assumptions underpinning the development of CK. Building on Shulman's (1986) development of PCK, CK in the TPACK framework presumes that the expertise for CK and PK is derived from different communities (Parr et al. 2013). Furthermore, Parr et al. (2013, p. 15) argue that the notion of a discrete set of CK 'drawn from outside the [teaching] profession [which] is neatly bounded, unchanging and widely agreed upon by a homogenous academy for whom knowledge in their field is not open to serious or ongoing challenge or change' is a 'fundamental flaw' in the TPACK logic.

While there are some who might argue that the TPACK framework, and indeed the PCK framework before it, does not represent CK as stable or unchallenged, the depiction of CK as one, largely disconnected part of a Venn diagram can reinforce this perception. To avoid this misrepresentation, it is important for those considering teachers' knowledge to regularly return to Shulman's (1987) text and to consider PK and CK (together with TK in the case of TPACK) not as separate, codifiable domains but as elements that, when seen collectively, can be understood as PCK or 'that special *amalgam* [emphasis added] of content and pedagogy that is uniquely the province of teachers, their own special form of professional understanding' (p. 92).

Further critiques of the TPACK framework suggest that the work undertaken thus far 'fails to appreciate that in the richest processes of teaching and learning knowledge is engaged with, interpreted and reinterpreted, challenged and built upon' (Parr et al. 2013, p. 15). Moreover, the role played by language in the interpretation and negotiation of knowledge can indeed produce new knowledge which 'is often generated dialogically *through* [emphasis in original text] teaching and learning (cf. Mercer 1995; Wells 1999)' (Parr et al. 2013, p. 15). The important role of

language not only in the development of TPACK but also in understanding the ways in which TPACK enactment is shaped is under-represented in TPACK research (Phillips 2014).

The effectiveness of TPACK is further problematised by the increasing occurrences of teaching teams in schools. In particular, I would like to highlight additional epistemological challenges to the TPACK premise, which are brought into focus when considering the balance of the different forms of knowledge required for effective team teaching with technology.

In changing the focus from individual teachers to teams of teachers, the TPACK framework appears to be ill-equipped to examine the complex, situated and socially mediated negotiations that shape the collective knowledge and practice within teaching teams. While recognising the interplay among TK, PK and CK does not produce a single solution for all teachers (Mishra and Koehler 2006), the TPACK framework does portray teachers' knowledge as an individually acquired attribute (Phillips 2013). This individual acquisition of TPACK is challenged by the introduction of team teaching in schools where an individual's understanding of 'the complex relationships between technology, content, and pedagogy' (Mishra and Koehler 2006, p. 1029) can no longer be considered in 'pedagogical solitude' but instead as 'communal property' (Shulman 1993, p. 6). In this sense, TPACK may be considered as knowledge that grows and develops through participation, knowledge sharing and negotiation as a productive member of a team and therefore as knowledge 'as something outside of the individual's head, or even body' (Hager 2005, p. 833). Reframing TPACK as communal property requires reconsideration of the contexts in which teachers develop and enact their TPACK. As Voogt et al. (2012) suggest, 'teaching with technology does not take place in isolation but is situated' (p. 112) echoing earlier thoughts espoused by Koehler and Mishra (2008).

Examining the TPACK literature reveals two particular contextual issues that remain underexplored: first, in-service teachers' TPACK development in their workplaces remains an area in which little work has been conducted and reported (e.g., see Jordan and Dinh 2012); second, the definition of context used in TPACK investigations is limited and can restrict considerations of expert teachers' knowledge as individually acquired and possessed. Recently, the broader considerations of TPACK and context have appeared in academic literature (Di Blas et al. 2014; Phillips 2015; Phillips et al. 2016; Porras-Hernández and Salinas-Amescua 2013; Rosenberg and

Koehler 2014, 2015) and offer different ways in which we can consider the influence of context on teachers' TPACK development and their (non) use of digital technologies.

Context: Exploring a Contested Term

Drawing on a long history of contextual references, Burke (2002) highlighted that context is a term that has become more common in research 'in the last thirty or forty years' (p. 152). The increasing frequency of 'contextualised studies' can be found in a range of disciplines including, but certainly not limited to, research of 'legal context[s] that helps to determine which rules should be applied in a particular situation' (Banakar 2015, p. 78), changes in social dynamics in a global context (Martin et al. 2014), architecture in context (Bogoni and Lucchini 2011) and educational research which is increasingly focused on 'studying individuals and groups in context' (Tabak 2004, p. 225).

Described by some as a 'contextual turn' (Lawson 2008, p. 584), a focus on the conditions and circumstances of events has resulted in refined understandings of many phenomena; however, the increased contextual focus has also led to a number of problems. For example, Burke (2002) suggested 'there is a price to be paid … the inflation or dilution of the central concept, which is sometimes used—ironically enough, out of context—as an intellectual slogan or shibboleth' (p. 152). More particularly, Turner and Meyer (2000) indicate that educational researchers 'have developed a folk definition of context that we think we all understand but truly do not use coherently or cohesively' (p. 83). In response to this issue, they suggest:

> we do not need a larger research base that presents as a basic principle that 'everything depends on context'. Instead we need to explore what it means to create a learning context and how or whether processes become context specific. (Turner and Meyer 2000, p. 83)

While the challenges associated with the development of a general understanding and application of the term 'context' have been outlined for a number of years, the 'messiness' of the term, in particular understandings of how or whether processes become context specific, continues to plague more recent theoretical developments including TPACK. Burke (2002) discouraged researchers trying to find a new term (or set of terms)

to replace context as this, he argues, would likely create new problems in turn. Alternatively, he suggests 'it is more realistic to employ the word in the plural, to place it mentally in inverted commas, and then to do our best to contextualize it, in all the many senses of that term' (p. 117).

TPACK and 'Contexts'

One reason why TPACK acquisition and development (and PCK before it) have proven so difficult to measure is that knowledge must be acquired and exhibited in specific contexts. Mishra and Koehler (2006) acknowledged the influence of context on teachers' TPACK enactment, stating:

> the core of our argument is that there is no single technological solution that applies for every teacher, every course, or every view of teaching. Quality teaching requires developing a nuanced understanding of the complex relationships between technology, content, and pedagogy, and using this understanding to develop appropriate, context-specific strategies and representations. (p. 1029)

The importance of context was also discussed by Cox (2008) who concluded that 'the effect of context is that TP[A]CK is unique, temporary, situated, idiosyncratic, adaptive, and specific and will be different for each teacher in each situation' (p. 47); therefore suggesting that 'any true example of TP[A]CK must necessarily include the context of that example' (p. 48). Despite Cox's (2008) recognition of the importance of context, her extensive literature review revealed that much of the published research examining TPACK focused on measuring or defining forms of knowledge that are part of the TPACK framework and paid less attention to the context in which the TPACK is developed or enacted.

Cox's findings (2008) were substantiated by Kelly's (2010) content analysis of TPACK research, which reported erratic inclusions of context in TPACK research conducted between 2006 and 2009. Subsequently, Rosenberg and Koehler (2014) conducted a comprehensive content analysis of peer-reviewed journal articles between 2005 and 2013, and concluded that 'there is a non-systematic inclusion of context as regards a significant proportion of the corpus of prior work about TPACK' (p. 2619) reflected in their finding that only 36% of published TPACK papers considered context. One may argue, therefore, that the 'contextual turn' described by Burke (2002) which is evident in other areas of academic research is not consistently apparent in investigations of teachers' TPACK.

In addition to this inconsistent consideration of context in TPACK research, Porras-Hernández and Salinas-Amescua (2013) argued that 'the original TPACK framework is limited in that it defines the contexts in which teachers work too narrowly. In fact, the majority of published work refers to the context element in a rather general manner' (p. 224). In contrast, drawing from the conceptual framework of Porras-Hernández and Salinas-Amescua (2013), Rosenberg and Koehler (2015) provided a revised, particular definition of context in relation to TPACK and indicated that context can be considered as 'the conditions around the knowledge and activities of teachers' (p. 2619).

While this clarification of 'context' provides some sense of direction for researchers, I believe the broad notion of the 'conditions around the knowledge and activities' may be enhanced by further consideration and refinement. Previous research has considered the notion of 'conditions' from a variety of perspectives including the factors inside the four walls of a classroom such as 'the school environment, the physical features of the classroom, the availability of technology, the demographic characteristics of students and teachers including prior experience with technology' (Kelly 2008, as cited in Cox 2008, p. 47), the broader sociopolitical conditions that exist within school workplaces (Phillips 2013, 2014) as well as systemic conditions associated with pre-service teacher preparation (Albion et al. 2010). The variety in these different contexts is reflected in Rosenberg and Koehler's (2015) coding frame that categorises micro-, meso- or macro-contextual levels; however, this characterisation of context amplifies additional challenges for TPACK researchers.

One of these significant challenges centres on the ways in which researchers might consider how knowledge and activities of teachers are dialogically linked to the contextual conditions that surround them. While context arguably shapes teachers TPACK development, there is also a strong argument to suggest that context shapes the enactment of this knowledge (e.g., see the discussion regarding pedagogical reasoning and action outlined by Shulman 1987). Prior research has also shown that the relationship between knowledge and practice is not unidirectional, but researchers also need to consider the ways in which teachers also shape their context (Banister and Reinhart 2011). Thus, context may be better thought of as both influencing and being influenced by teachers and their activities. For this reason, scholars have argued for some time that context cannot be fully separated from individuals (Tabak 2004).

The distinction between teachers' TPACK and the factors that shape the enactment of their TPACK (their practice) is unclear. By practice, I refer not only to the things that teachers do to facilitate learning, but also to a broader definition that encompasses the teacher, their identity and their community, aligning with sociocultural views of participation in practice (Grossman et al. 2009; Wenger 1998). Knowledge development and the enactment of that knowledge in sociocultural contexts remain an under-theorised aspect of TPACK research. For example, few researchers have published empirical studies that examine the intricacies involved in teachers' TPACK enactment in situated workplaces such as schools. In such contexts, teachers' knowledge may not arguably change from one hour to the next on any given day, yet the way teachers enact their knowledge at different time points in different classes over the course of that day may look entirely different.

While some of these variations may be explained by micro-contextual factors such as the age of the students in any given class, there are a significant number of other meso- and macro-level factors that also shape teachers' TPACK development and enactment. Taken together, the challenge is to consider teachers' knowledge, practice, identity and context as intertwined factors, which can be important for understanding and supporting teachers' efforts to integrate technology into their teaching. A further challenge is to consider how these factors are woven together to explain what teachers think and do.

Digital technology use, particularly in educational contexts, is often presented in uncritical terms. This chapter has examined the complex and often messy reality of teachers' use of digital technologies. In particular, it has been illustrated that teachers' technology use can be influenced by both their knowledge and the contexts in which that knowledge is exhibited. Despite the influence of knowledge and context on teachers' digital technology use, both these concepts are contested and will be explored in greater detail in the following chapters.

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CHAPTER 2

Workplace Learning, Policy and Practice: Connecting Community, Practice and Teachers' Identities

This chapter examines the sociocultural and sociopolitical influences that shape in-service teachers' TPACK development and enactment in their school workplaces. It is pertinent, therefore, to develop a more nuanced understanding of the influence of workplace learning literature and policy on teachers' knowledge development, their practice and their identity through an examination of different theories which attempt to unpack the process of learning in a workplace.

Historical Perspective on Contending Theories

Hager's (2005) extensive critical assessment of workplace learning literature is particularly beneficial for this investigation as it maintains a focus on workplace learning in educational settings. Providing a sense of the development of the history of academic investigations into workplace learning, Hager (2005) highlights the growing body of workplace learning literature from the 1970s which he positions in two categories. Early accounts of workplace learning, he argues, 'were strongly influenced by the learning as a product' (Hager 2005, p. 829), whereas more recent accounts focus 'on learners developing by actively engaging in the processes of workplaces' (Hager 2005, p. 829). These two categories mirror many aspects of the learning metaphors of acquisition and participation that Sfard (1998) has argued underpinning much educational thought. As Hager (2005) highlights, 'learning as a product dovetails neatly with the

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acquisition metaphor, while learning as a process accords with the participation metaphor' (p. 829).

Many of the early theories of workplace learning focussed on the notion of knowledge as a product that can be acquired by individuals. Such ideas stemmed from the fields of organisational psychology, action learning, experiential learning and management theory, including those of Argyris and Schön (1974, 1978); Schön (1983, 1987) and Marsick and Watkins (1990). Hager (2005) contends that one of the most influential developments from this early theorising was Argyris and Schön's distinction between single-loop learning (in which the learner demonstrates reactive behaviour to adapt to changing circumstances in the workplace) and double-loop learning (in which the learner reflectively amends or adds to previous learning in selecting a suitable course of action to deal with a challenging workplace situation).

Olwyn McNamara and her colleagues provided a contemporary example of single-loop learning in which they highlight the intention of the UK's Secretary of State Education to move pre-service teacher education out of universities and back into schools because of Gove's belief that 'teaching is a craft and it is best learnt as an apprentice observing a master craftsman or woman' (Gove 2010, as cited in McNamara et al. 2014, p. 32).

Schön's subsequent work (1983, 1987) on the 'reflective practitioner' has been widely discussed in literature examining workplace learning (Hager 2005). In particular, many authors have highlighted the 'eureka moment' (eg, see Kinsella 2007, p. 103) when first reading Schön's rejection of the notion of technical rationality which 'locates practitioners as instrumental problem solvers who select technical means best suited to particular purposes' (Schön 1987, p. 4). In contrast, Schön's (1987) alternative epistemology posits the notion of a 'reflective practitioner' who engages in 'knowing-in-action' and 'reflection-in-action' underpinned by unprompted moments in which workers 'notice', 'see' or 'feel' features of their actions and then consciously or unconsciously change their workplace practices for the better. He differentiates the expert from the novice as one who has greater tendency to reflect. While this is a different perspective to technical rationality, Schön's theorising maintains his focus on 'the rational, cognitive aspects of performance' (Hager 2005, p. 832).

Marsick and Watkins' (1990) contribution to workplace learning theory utilised experience and reflection as major concepts in their widely recognised analysis of 'informal learning' and 'incidental learning'. In building on these concepts, Watkins and Marsick's (1992) conception of workplace

learning included such diverse notions as 'learning from experience, learning by doing, continuous learning for continuous improvement, accidental learning, self-managed learning or the learning organization' (Watkins and Marsick 1992, p. 287). The expansion of Marsick and Watkins' (1990) framework to also include an increasing variety of 'characteristics' and 'conditions', and the changing interrelationships between 'characteristics' and 'conditions' provides an indication of the complexity and diversity of the range of factors involved in workplace learning.

Despite the variations in early workplace learning theories, Hager (2005, pp. 832–833) claims that they have a range of common features:

1. They centre [on] individual learners
2. They focus mainly on the rational, cognitive aspects of work performance
3. Work performance tends to be conceived as thinking or reflection followed by application—this is especially evident in Schön's work
4. Learning itself is taken for granted and not theorised or problematized. This means in practice that, as Elkjaer (2003) points out, it tends to assume that workplace learning is formal learning, thereby traditionally associated with the acquisition metaphor
5. The social, organisational and cultural factors in workplace learning and performance are downplayed.

In contrast to these theories of workplace learning focussed on the notion of acquisition, another conception focussed on a participatory account of workplace learning theories is evident in a variety of international practices. These include, but are certainly not limited to, the Ontario College of Teachers' self-reflective professional learning tool, Switzerland's use of reflective practice groups combining new teachers with experienced mentors, Japan's research lessons or 'kenkyuu jugyou' and Singapore's Teacher Network in which 'master teachers who have received training from the Institute of Education are appointed to lead the coaching and development of new and veteran teachers in each school' (Darling-Hammond et al. 2010, p. 3).

Participatory theories broadly recognise that workplace learning and performance are embodied phenomena that are shaped by social, organisational and cultural factors that extend beyond individuals and are evident in the examples illustrated above. Key theorists whose work supports these programmes include Lave and Wenger (1991); Engestrom (2001, 1999); Billett (2001) and Eraut (2000).

Lave and Wenger (1991) and Wenger (1998) have made important contributions to the second conception of workplace learning through their development of notions such as communities of practice (CoP)[i] and legitimate peripheral participation. These concepts provide a stark contrast to the view of learning as acquisition and emphasise learning through relationship:

> whether propositions or skills, their specifically relational account views the novice as learning how to function appropriately in a particular social, cultural and physical environment. This means that the learning ('situated learning') is something outside of the individual's head, or even body. (Hager 2005, p. 833)

As an alternative to Lave and Wenger's (1991) conception of workplace learning within a CoP, Engestrom (1999, 2001) views workplaces as activity systems. These systems are composed of a range of components including items such as workplace rules, the division of labour and mediating artefacts (Engestrom 1999). Engestrom suggests that learning occurs as work proceeds within such activity systems because the activity systems continually throw up contradictions and tensions that need to be resolved by workers. While it might be questioned whether all learning at work occurs from the contradictions and tensions within an activity system, this account of workplace learning finds places for social, organisational and cultural factors within a system that the acquisition and process metaphors of learning and individualistic frames of learning do not address.

In this sense, Engestrom's (1999, 2001) activity systems approach has certain dimensions that are similar to Lave and Wenger's (1991) situated learning perspective, and together these two frameworks stimulated 'a surge of … research and conceptual innovation on learning at work' (Hager 2005, p. 834). Included in these conceptual innovations is the expansive–restrictive continuum (Fuller and Unwin 2003, 2004) for analysing the incidence and quality of workplace learning. This framework was intended to specifically remedy the deficiencies that Fuller and Unwin (2003) identified in Lave and Wenger's (1991) account of workplace learning, namely that it does not include place for formal qualifications from educational institutions for novice workers. As such, Fuller and Unwin's (2003) expansive–restrictive continuum centres on two sets of features: those relating to organisational context and culture, and those to learning opportunities arising from various forms of participation in workplaces.

Billett's (2001) attention to participation through the social and the individual provides an account of expertise located in the dynamic activities of social practices:

> It proposes how individuals come to know and act by drawing on cognitive, sociocultural and anthropological conceptions, and through an appraisal of the ontological premises of domains of knowledge. The inter-psychological processes for developing expertise are held to be constituted reciprocally between the affordance of the social practice and how individuals act and come to know in the social practice. (p. 432)

In developing his account of workplace learning, Billett (2001) problematises the notion that expertise is a capacity of an individual and locates it instead in particular domains of knowledge and social practice. Additionally, Eraut (2000) argues for the retention of individual cognitive and tacit forms of knowledge whilst accepting that they are always deployed in a situated way. Thus, as Hager (2005) reminds us, 'Eraut can be seen as warning that accounts of workplace learning in the second category should not jettison all of the resources of the first category' (p. 835). Beckett and Hager (2002) suggest that some aspects of workplace learning can be understood at the level of the individual, but some of it is inherently at the level of the group or community of practitioners, and they argue that both should be kept in sight in attempts to examine workplace learning.

The above discussion has located workplace learning in traditions which construct learning either as acquisitional in nature (learning as product) or as socially mediated as a process. While the differences between traditions have been highlighted, it has also been pointed out that a third group of researchers including Eraut (2000); Hager (2005); Beckett and Hager (2002) and Winch (1998) suggest that future investigations into workplace learning should take both theoretical traditions into account.

Workplace Learning in Communities: Implications for Research

This chapter examines the ways in which a CoP framework can help to understand in-service teachers' TPACK enactment. In Chap. 1, I proposed that TPACK provides a useful framework to develop an understanding of the ways in which different forms of knowledge impact on teachers'

pedagogical technology use. However, I argued that a limitation of the framework is that researchers are yet to effectively establish an understanding of the processes that mediate the ways in-service teachers enact these forms of knowledge. Mishra and Koehler (2008) suggested that one way to examine these processes is by taking the context or the environment in which teachers work into account with other researchers (eg, see S. Cox 2008; S. Cox and Graham 2009; Porras-Hernández and Salinas-Amescua 2013), indicating that context is an important yet underdeveloped consideration when exploring teachers' TPACK.

Despite highlighting the importance of context as a potential avenue for researchers to explore, Mishra and Koehler (2008); S. Cox (2008); S. Cox and Graham (2009) or Porras-Hernández and Salinas-Amescua (2013) do not go as far as to indicate an appropriate theoretical lens through which context can be considered in teachers' knowledge development. The discussion in this chapter has proposed that Wenger's (1998) CoP framework may be suitable for such an investigation as it links teachers' participation and identity within their workplace contexts to their learning. Moreover, an examination of Wenger's (1998) CoP framework from a workplace learning perspective illustrated that the effectiveness of Wenger's work lies in the participatory perspective underpinning the CoP framework that takes account of the social, cultural and political dimensions. Despite these strengths, the critique of Wenger's (1998) CoP framework from a workplace learning perspective has stressed that it may be short-sighted for one perspective to jettison the other (Eraut 2000).

Schoenfield's (1999) perspective contributes to the calls for a balanced view in workplace learning research, claiming that 'the very definition of learning is contested, and that assumptions that people make regarding its nature and where it takes place are also widely contested' (Schoenfield 1999, p. 6). Contestation of the definition, nature and location of learning brings into question whether the concept of a general theory of learning is possible or indeed feasible. Winch (1998) argues in his exploration of education, work and social capital that 'the possibility of giving a 'scientific' or even a 'systematic' account of human learning is … mistaken' (p. 2).

The challenge, Winch (1998) claims, is that as there are many, diverse cases of learning with each case each subject to 'constraints in a variety of contexts and cultures' (p. 85), which prohibits them from being considered in a general way. It is valuable to note for this investigation examining TPACK enactment from a CoP perspective that Winch's (1998) concep-

tualisation of 'contexts and cultures' is at a micro level. While it may be the case that the majority of workplaces share a common macro context, or as Wenger (1998) describes as a global CoP, they each have unique and particular contextual and cultural factors at the micro or local level. Hager (2005) suggests that it might not only be a mistake to think about workplace learning in terms that are too closely linked to learning in formal classrooms, but that 'it may also be inappropriate to think that all workplace learning is of one kind' (p. 836). This suggestion echoes Eraut's (2000) argument, highlighted earlier in this section, which contends that individual cognitive and tacit forms of knowledge are always deployed in a situated way, thereby highlighting the need for researchers to consider not only the macro–micro context in which research is conducted but also the balance between examinations of individually acquired knowledge and that knowledge developed through participation in workplaces.

A particular challenge facing those examining workplace learning is not simply in understanding differences between acquisition and participation perspectives, nor even the influence of macro or micro contexts. Researchers wishing to examine the elements of workplace learning, as in this investigation, also need to problematise these concepts further (Hager 2005).

In addition to the dimensions discussed, examination of the impact of these dimensions on policies associated with workplace learning is also potentially important as it is policy that so often drives the architecture of the professional learning that exists in many workplaces. Despite this close connection, researchers such as Bereiter (2002) suggest that policies that impact on learning at work too often carry with them unreflective assumptions about what such learning is like, instead of relying on the common-sense or folk theory (Bereiter 2002) perspective of learning dominated by the acquisition perspective. This contention is supported by Hager (2005) who suggests, despite the development of participation as well as acquisition theories of workplace learning, 'policies and practices that directly impact on the emerging interest in learning at work are clearly rooted in the learning as product view' (Hager 2005, p. 836). In contrast to the option of considering policy from a participation viewpoint, Hager (2005) argues for the development of a third metaphor building on Sfard's (1998) earlier work and proposes a (re)construction metaphor.

Hager (2005) argues that a (re)construction metaphor provides a better accordance with the learning process than other metaphors as it includes 'the construction of the learning, of the self and of the environ-

ment (world) which includes the self' (p. 842). This notion, argues Hager (2005), has built into it the idea that change may be unceasing; however, Hager (2005) also highlights that 'it is quite possible to have successful participation while resisting all change' (p. 842). In this sense, Hager (2005) argues 'the (re)construction metaphor has an extra dimension … that others, such as the participation metaphor, lack' (p. 842). Thus, the inclusion of the (re)construction metaphor along with Sfard's (1998) acquisition and participation metaphors provides researchers investigating workplace learning with a triumvirate of perspectives from which knowledge development can be considered.

This discussion about knowledge development in the workplace has provided a range of perspectives that appear as recurring themes in the workplace learning literature and from which a number of conclusions can be drawn. Of particular interest for this investigation are Hager's (2005) four major criteria for evaluating workplace learning theories. Hager's (2005) four criteria examine the effectiveness of workplace learning theories by determining how well they

1. view such learning as a process
2. take account of the social, cultural and political dimensions
3. reflect (re)construction metaphors
4. avoid single-factor or universally applicable explanations

When using these four criteria to assess Wenger's (1998) CoP framework, the theoretical strength of Wenger's work arguably lies in the first two standards. For example, this chapter has provided an explanation and the critique of the CoP framework that illustrates Wenger's (1998) conceptualisation of the process of transition from legitimately peripheral newcomer to centripetal old-timer that takes into account social, cultural and political dimensions through notions of participation (eg, joint enterprise, shared repertoire and mutual engagement) and identity development (eg, imagination, alignment and trajectory).

Despite these theoretical developments, it is open to interpretation how well the CoP notion and the concept of legitimate peripheral participation that preceded it are in accord with the (re)construction metaphor. While the transition of legitimately peripheral newcomers to old-timers who more fully participate in the CoP might well be seen as a form of communal reconstruction, Lave and Wenger's (1991) account of this phenomenon 'has little to say about the learning by the individual learner that

underlies the reconstitution of their personal identity from that of novice to full participant' (Hager 2005, p. 843). Hager's (2005) critique of this component of the CoP framework has been identified by other workplace learning theorists, including Elkjaer (2003) who argues that the participation metaphor in Lave and Wenger's work 'deals with learning at the organisational level, but … at the expense of a description of the actual learning process—*how* does learning come about through participation?' (p. 488). The investigation of the actual learning process is a key aim for this research, which is examining 'how' are teachers' TPACK enactments influenced in a CoP? How do in-service teachers learn what is valued, appreciated and deemed necessary to be identified as competent in the context in which they work?

This chapter focusses on situated learning theories, specifically a critique of Wenger's (1998) notion of CoP. The review of literature associated with CoP highlights the complexity of this framework but concludes, through a review of other workplace learning literature, that CoP is a suitable lens through which the context of in-service teachers' TPACK can be explored.

From Situated Learning to CoP

Situated cognition or situated learning has made an impact on educational thinking (Billett 1996; Herrington and Oliver 1995) as it 'place[s] learning in the context of our lived experience of the world' (Wenger 1998, p. 3) in contrast to acquisitional perspectives that abstract knowledge from a learner's context. Grounded in Resnick's (1987) notion of bridging apprenticeships to span the gap between the theoretical learning associated with formal, classroom-based instruction and the real-life application of knowledge in the work environment, the term situated learning was first expounded by Brown et al. (1989).

Brown et al. (1989) provided a general introduction to the concept of situated learning with their contention that 'given the chance to observe and practice *in situ* the behaviour of members of a culture, people pick up relevant jargon, imitate behaviour, and gradually start to act in accordance with its norms' (p. 34). While recognising that 'these cultural practices are often recondite and extremely complex … given the opportunity to observe and practice them, people adopt them with great success' (Brown et al. 1989, p. 34). These assertions arose from their observations of successful learning situations in a variety of contexts and cultures. The subse-

quent analysis of the key features of these learning situations highlighted the common connection between practice and knowledge construction.

Similarly, Lave and Wenger's ethnographic research from the 1980s highlighted the connection among observation, practice and learning with the social and physical contexts in which the knowledge construction takes place. Their subsequent book *Situated Learning: Legitimate Peripheral Participation* introduced the notion of 'legitimate peripheral participation'. They argue that learning should be viewed holistically where a person, firmly situated in a social and cultural environment, increasingly participates in practices common to a group of people.

Substantiating their notion of situated learning, Lave and Wenger (1991) provide several diverse examples of apprenticeship such as Yucatec midwives, US Navy quartermasters and tailors from Vai and Goa. These investigations of apprentices and apprenticeship focussed on 'the structure of social practice rather than privileging the structure of pedagogy as the source of learning' (Lave and Wenger 1991, p. 113) and provided insights into the ways in which peripheral skills and practices are learned within the cultural and social context in which work is undertaken. Additionally, Lave and Wenger (1991) highlight that the development of peripheral skills and practices is accomplished over time and results in apprentices, or newcomers to a CoP, being given increasing access to more central practices of the community. It is important to note that the concept of legitimate peripheral participation did not promote the idea of a set of central practices nor illegitimate peripheral participation, but Lave and Wenger (1991) simply coined the phrase 'legitimate peripheral participation' to refer to the way in which 'newcomers' gain access to the knowledge, skills, artefacts and meaning making of the 'old-timers'. In the foreword to Lave and Wenger's (1991) examination of situated learning, Hanks (1991) claims that from Lave and Wenger's perspective,

> learning is a process that takes place in a participation framework, not in an individual mind. This means, among other things, that it is mediated by the differences of perspective among the co-participants. It is the community, or at least those participating in the learning context, who 'learn' under this definition. Learning is, as it were, distributed among co-participants, not a one person act. (p. 15)

In addition to the role of social practice in individuals' knowledge development, Lave and Wenger's (1991) notion of situated learning

and legitimate peripheral participation also considers the ways in which participation within a group of people leads to changes in identity. This consideration of both practice and identity highlights another important component that distinguishes this framework from the diffusion and adoption theories in which identity provides 'a way of talking about how learning changes who we are and creates personal histories of becoming in the context of our communities' (Wenger 1998, p. 5).

Lave and Wenger (1991) theorise that learning is an aspect of social practice that involves the whole person which 'implies becoming a full participant, a member, a kind of person' (Lave and Wenger 1991, p. 53). The activities, tasks, functions and understandings undertaken by participants do not exist in isolation,

> they are part of broader systems of relations in which they have meaning. These systems of relations arise out of and are reproduced and developed within social communities, which are in part systems of relations among persons. The person is defined by as well as defines these relations. Learning thus implies becoming a different person with respect to the possibilities enabled by these systems of relations. To ignore this aspect of learning is to overlook the fact that learning involves the construction of identities. (Lave and Wenger 1991, p. 53)

Lave and Wenger's situated learning framework therefore offers an alternate perspective through which teachers' TPACK enactment may be examined and understood. In contrast to other knowledge acquisition concepts, such as theories of adoption and diffusion, in which knowledge can be considered to 'consist of coherent islands whose boundaries and internal structure exist, putatively, independently of individuals' (Lave 1988, p. 43), legitimate peripheral participation and CoP explicitly move the focus from the individual and his or her immediate social environment by theorising about broader forces such as shared cultural systems, political–economic structures and most particularly the relationship between practice and identity. Lave and Wenger (1991) place particular 'emphasis on connecting issues of sociocultural transformation with the changing relations between newcomers and old-timers in the context of a changing shared practice' (p. 49).

In this way, legitimate peripheral participation refers to learning through participation in social practice which 'emphasises the relational interdependency of agent and world, activity, meaning cognition, learning, and

knowing' (Lave and Wenger 1991, p. 50). Subsequently, Wenger (1998) claims that 'in pursuit of our enterprises and attendant social relations, these practices … are the property of a kind of community created over time by the sustained pursuit of a shared enterprise. It makes sense, therefore, to call these kinds of communities *communities of practice*' (p. 45).

From this perspective, being a member of a CoP necessitates learning through participation in social practice which, in itself, is not immutable but rather an evolving form of membership and is inextricably linked to individual and communal identity. It therefore becomes necessary to understand shared practices which underpin the formation of a CoP and their relationship to identity.

Practice as Meaning and Identity

Situated learning portrays learning as a matter of enculturation (Brown et al. 1989) or legitimate participation (Lave and Wenger 1991) within a CoP; however, such a concept is not easily accessible. Wenger (1998) tackled the task of operationalising the theory of situated learning by exploring the mechanisms of a CoP and extrapolating a set of design principles that recognise the importance of 'learning by doing' and 'learning by becoming' (p. 5). Wenger (1998) calls this design framework a 'learning architecture' (p. 230), which 'encourages us to consider educational designs not just in terms of techniques for supporting the construction of knowledge (let alone in terms of delivery of curriculum), but more generally in terms of their effects on the formation of identities' (Fowler and Mayes 1999, p. 11).

Wenger's earlier argument developed with Lave (1991) provided readers with the concept that practice and identity are inseparable components of all CoP. Practice is more than what we do. It is how we perceive our environment and how we interact with what goes on around us. At the same time, our identity that frames how we perceive ourselves and what is important to us shapes and is shaped by our practices. A disruptive student may be perceived by a teacher as trying to avoid cognitive effort, whereas a social worker could perceive the student as rebelling against the lack of control afforded to students in a formal learning environment. In this situation, the teacher understands the classroom environment and learning activity in a different way to the social worker. Furthermore, the teacher's identity, as a member of a teaching CoP with a personally

distinct history, would flavour that understanding in a way that is essentially individual. Both practice and identity play a role in how the teacher perceives and responds to a situation, but also in how the teacher learns. For instance, when teachers sympathetically swap 'war' stories, they are sharing practice and demonstrating that they are members of a professional community.

Henderson's (2007) investigation of the impact of CoP on teachers' participation in sustained, blended professional development highlights that CoP are equally defined by the practices and identities of members. In addition, Wenger (1998) carefully uses the term identity which he believes allows us to look at the individual within the community from a social theory perspective. He claims that our identity is a negotiated experience through participation and reification, in much the same way as practices are negotiated. Furthermore, membership of a CoP entails a certain level of competence in the dimensions of engagement, enterprise and repertoire (1998). Henderson (2007) reflected Wenger's (1998) equal consideration of the importance of both identity and practice in defining a CoP in Fig. 2.1.

The interconnection between practice and identity highlighted regularly in Wenger's (1998) development of the CoP framework is important for this study as it develops links between knowledge, practice and identity, and provides a different perspective on in-service teachers' knowledge enactment compared to adoption–diffusion models or acquisitional perspectives of knowledge development. As such, the remainder of this chapter closely examines dimensions of Wenger's (1998) CoP framework amplifying the identity and practice concepts in an attempt to provide a perspective from which the wicked problem of teachers' knowledge development and subsequent pedagogical technology integration and TPACK enactment can be better understood.

Fig. 2.1 Identity and practice defining CoP (Henderson 2007, p. 58)

Defining Community

The term community is used extensively in studies examining technology adoption and use. In educational contexts, the term community has been similarly incorporated with much favour and can be seen in expressions such as 'communities of learners', 'discourse communities', 'learning communities', 'school communities' and 'teacher communities' (Branch et al. 2010). Confusion resulting from the profligate use of the word community has resulted in some authors arguing that there is no clear definition of community (Cuban 2004) and others, such as Grossman and Wineburg (2010), questioning the value of the term claiming 'it is clear that *community* has become an obligatory appendage to every educational innovation' (p. 6).

While one could suggest that researchers examining a 'school community' or a 'community of teachers' would be able to investigate the situated social and cultural factors inherent in these notional constructs, it becomes apparent that such extensive use of the term community warrants specific definition. Westheimer (1999) summarised the concerns of scholars considering this issue stating that 'researchers could benefit from a stronger conceptualization of communities based in empirical research' (p. 148). Consequently, this research must be critical of the nature of community on which a framework such as CoP is based.

Wenger's (1998) detailed examination of CoP and the dimensions that influence learning and practice within a situated community provide greater insight into the factors that underpin this complex socially mediated practice. It is in this work that the distinction is made between a CoP and other forms of community. Wenger's (1998) specific conceptualisation of the term community is different from that of other researchers such as those investigating gaming communities (Resnick 1987), discourse communities (Barton and Tusting 2005) or learning communities (Fowler and Mayes 1999). Wenger (1998) specifically states that 'a community of practice is not merely a community of interest.… Members of a community of practice develop a shared repertoire of resources: experiences, stories, tools, ways of addressing recurring problems—in short a shared practice' (pp. 2–3).

Wenger's (1998) postmodern conceptualisation of community sits in contrast to modernist perspectives of community. Cox (2005) highlights the disparity between many of the modernist perceptions of communities and Wenger's (1998) interpretation of the term which are listed in Table 2.1. Despite these different ways of seeing community, the term

Table 2.1 Wenger's use of the term community (Cox 2005, p. 532)

Expected usage	*Wenger's (1998) usage*
Tightly knit network	Tightly knit
Large scale	Uncertain scale, probably smaller
Neighbourhood-based (geographically situated)	Co-located in the workplace
Self-conscious/externally recognised	Not recognised, not clearly bounded
All-encompassing	Specific to the enterprise
Friendly, supportive	Conflictual as well as harmonious
Unpurposive	Purposive
Static	Ephemeral, creative
Born into	Voluntary

often lures the reader 'into the trap of seeing it is a rather large unhelpful and friendly bounded group' (Cox 2005, p. 532), which is a view that Wenger himself warns against.

The distinction between Wenger's notion of a CoP and other conceptions of community has been highlighted by other researchers using CoP as a theoretical lens including Barton and Tusting (2005) who claim that

> the starting point for the idea of a community of practice is that people typically come together in groupings to carry out activities in everyday life, in the workplace and in education. Such groupings can be seen as distinct from the formal structures of these domains. (pp. 2–3)

CoP differ, therefore, from other definitions of community in many respects, not least of which relate to notions of belonging or membership of a CoP, which is not necessarily based on formal, structured and reified categories of membership but rather a sense of belonging to a particular community (Wenger 1998).

This informal notion of belonging and related sense of unqualified acceptance has attracted some criticism, exemplified by Cox's (2005) reproach levelled at Wenger's (1998) choice of the term 'community', stating 'it [community] has strongly and unqualified positive overtones' (p. 532) and postulates on Brown and Duguid's (2001) suggestion, that the labels 'cadre' or 'commune of practice' may have been viable alternatives to community. Others such as Contu and Willmott (1988) have also highlighted the consensual connotation implicit in much of Wenger's language (eg, 'joint' enterprise) and the expressed concern about challenges that result when trying to analyse unfriendly or unsociable relationships

within the confines of positive expressions. Baumann (2000) portrays a more vivid image of community, suggesting that there is a

> tendency to shape the image of community after the pattern of the ideally protected body: to visualise it as an entity homogenous and harmonious on the inside, thoroughly cleansed of all foreign, ingestion-resistant substances, all points of entry closely watched, controlled and guarded, but heavily armed on the outside and encased in impenetrable armour. The boundaries of the postulated community, like the outer limits of the body, are to divide the realm of trust and loving care from the wilderness of risk, suspicion and perpetual vigilance. The body and the postulated community alike are velvety on the inside and prickly and thorny on the outside. (p. 184)

Critiques such as these remind us of a need to problematize assumptions around the term 'community', and particularly those assumptions about CoP. This becomes particularly important as the CoP framework has been adopted by a number of research studies, and many elements of the framework have been widely debated in the literature; however, not all of the studies examining CoP refer to Wenger's (1998) notion of a CoP, which, as previously noted, originated from the concept of situated learning (Lave and Wenger 1991).

In a later work, Wenger with McDermott and Snyder (2002) published a book *Cultivating Communities of Practice*, which some researchers claim is a refinement and extension of Wenger's (1998) original work (eg, see Andrew et al. 2008; Cremers and Valkenburg 2008; Klein and Connell 2008; Kopcha 2010). However, it has been argued by Henderson (2007, 2015) and Fernando (2008) that these two works should be viewed as different theories because of their different foci. Echoing this claim, Cox (2005) asserts that Wenger et al.'s 2002 theory 'is genuinely a different concept from that proposed in [Wenger 1998], not just a change of tone or position; it is simply a different idea' (p. 534) in which the focus is on managing knowledge in organisations in contrast to the earlier (1998) focus on learning through participation and mutual engagement in a situated learning environment to pursue the joint enterprise.

Cox provides a useful comparative summary of the major differences between Lave and Wenger's (1991); Wenger's (1998) and Wenger et al. (2002) concept of community, view of learning, power and conflict, change, (in)formality, diversity and level as shown in Table 2.2.

Despite all three works highlighted in Table 2.2 using the notion of situated learning and a CoP as their focus, it is evident that they differ. It is not surprising therefore to find a varied array of research papers and books that claim to use CoP as a focus but which use the concept in different ways. Barton and Tusting (2005), in their work thematically grouping elements of Wenger's (1998) framework, highlight the different ways CoP has been used, stating that their 'examination of current journal publications and simple web searches shows the range of fields where notions

Table 2.2 Comparative summary of Lave and Wenger's (1991), Wenger's (1998) and Wenger, McDermott and Snyder's (2002) conceptions of CoP (Cox 2005, p. 537)

	Lave and Wenger (1991)	*Wenger (1998)*	*Wenger, McDermott and Snyder (2002)*
Concept of community	A group of people involved in a coherent craft or practice, eg, butchers OR not neatly a group at all	A set of social relations and meanings that grow up around a work process when it is appropriated by participants	An informal club or Special Interest Group inside an organisation, set up explicitly to allow collective learning and cultivated by management action
View of learning	Central and seen as occurring through becoming a member—mostly the socialisation of new members by peripheral participation	An individual learning history is identification with different CoP and trajectories through communities	Learning/problem solving by deliberately bringing together multiple experts in learning focussed communities
Power and conflict	Between generations, between masters, journeymen and novices	Conflict is mostly internal conflict within identity, caused by multi-membership	It is assumed that the good of the organisation is the good: managerialist. Attempts to level relationships within community
Change	Gradual change through generations, but rather static	Individual change through trajectories and multi-membership	Follows a simple group formation pattern familiar from small group 'forming, storing, norming, performing, dissolving'

(*continued*)

Table 2.2 (continued)

	Lave and Wenger (1991)	*Wenger (1998)*	*Wenger, McDermott and Snyder (2002)*
Formailty/informality	Could be in the setting of a formal system of apprenticeship, but sees most learning as informal, ie, unstructured, unplanned, not taught	Authentic engagement around an enterprise, therefore beyond formality. May have a shape and purposes unexpected by the designer of the formal system	Pre-exists management interest May pursue its own path of evolution, has no formally constituted objective Its membership cuts across formal organisational boundaries Relations are based on expertise not formal position Has no formal organisational leader
Diversity	Masters/journeymen/novices—but the practice itself does not have a high division of labour	Includes everyone working on the collective enterprise, mutually defining identities—so could be very diverse	Diversity is designed into the group
Level	Short monograph proposing a theoretical concept in outline	Full book length development of the concept at a theoretical level	Easy to read management handbook to guide practice

of communities of practice are drawn upon' (p. 2). Barton and Tusting (2005) go on to highlight that the concept of CoP has been

> taken up particularly in management, in education and understanding virtual worlds. It has been most developed practically in business management but has also proved useful to the radical educator and to the political activist. The range of interests in the concept is broad—from religious missionaries using it to draw up the management frameworks for overseas evangelising (Goh et al. 2003) to social scientists using it to understand contemporary witches (Merriam et al. 2003). (Barton and Tusting 2005, pp. 2–3)

More recently, research has indicated that CoP investigations are prevalent across multiple social science disciplines and professional fields. A par-

ticularly comprehensive review of literature regarding the utilisation and interpretation of CoP has been undertaken by Koliba and Gajda (2009), which confirms over 230 studies using CoP as a theoretical basis, and a representative sample of these is listed in Table 2.3.

Despite the differences in the way the concept has been understood and applied, Wenger's (1998) theory of CoP has received considerable

Table 2.3 Uses of CoP across social science and professional disciplines (Koliba and Gajda 2009, pp. 99–100)

Field	*Citation*
Anthropology	Sassaman and Rudolphi 2001; Bradley 2004
Business management	Stamps 1997; Lundberg 1998; Wenger and Snyder 2000; Allen et al. 2000; Snell 2001; Fox 2002; Kuhn 2002; Ashkanasy 2002; Hung and Nichani 2002a; Swan et al. 2002; Breu and Hemingway 2002; Lee and Valderrama 2003; Contu and Wilmott 2003; Ardichvili et al. 2003; Smits and de Moon 2004; Manville 2004; Martin et al. 2004; Vestal and Lopez 2004; Zook 2004; Down and Reveley 2004; Sense and Clements 2007
Computer Science	Davenport and Hall 2002; O'Hara et al. 2003; Alani et al. 2003; Henri and Pudelko 2003; Drake et al. 2004; Preece 2004
Education, adult	Merriam et al. 2003; Mitchell and Young 2004
Education, early childhood development	Wesley and Buysse 2001; Buysse et al. 2003
Education, primary and secondary education	Pugach 1999; Maynard 2001; Evenbeck and Kahn 2001; Au 2002; Burton 2002; Hung and Nichani 2002b; Smith 2003; Gallucci 2003; Boud and Middleton 2003; Wixson and Yochum 2004; Hodkinson and Hodkinson 2004a; Bradley 2004; Bloom and Stein 2004; Schlagaer and Fusco 2004; Palincsar et al. 2004; Foulger 2004; Wixson and Yochum 2004; Sergiovanni 2004; Chalmers and Koewn 2006; Levinson and Brantmeier 2006; Anthony 2007
Engineering	Winsor 2001; McMahon et al. 2004
Gender studies	Wagner 1994; Bergvall 1999; Ehrlich 1999; Freed 1999; Holmes and Meyerhoff 1999; Stapleton 2001; Paechter 2003; Mills 2003; Levinson 2003; Baxter and Hughes 2004
Health care	Katsenberg 1998; Pereles et al. 2002; Lathlean and le May 2002; Parboosingh 2002; Roos 2003; Bate and Robert 2002; Swan et al. 2002; Gabbay et al. 2003; Zanetich 2003; Faber et al. 2003; Popay et al. 2004; Dewhurst and Navarro 2004; Adams et al. 2005; Hara and Hew 2007; Andrew et al. 2008
Higher education	Mandl et al. 1996; Waddock 1999; Blimling 2001; Van Note Chism et al. 2002; Trank and Marie 2002; Kwon 2003;
Political science	Torney-Purta and Richardson 2001; Youngblood 2004

(*continued*)

Table 2.3 (continued)

Field	*Citation*
Public administration	Burk 2000; VanWynsberghe 2001; Kilner 2002; Gabbay et al. 2003; Snyder et al. 2003; Derksen 2003; Zanetich 2003; de Laat and Broer 2004; Kolbotn 2004; Rohde 2004; White 2004; Dekker and Hansen 2004; Drake et al. 2004; Fontaine and Millen 2004; Garcia and Dorohovich 2005; Attwater and Derry 2005; Pavlin 2006; Novicevic et al. 2007; Koliba and Gajda 2007; McNabb 2007
Social psychology	Mandl et al. 1996; Linehan and McCarthy 2000; O'Brien and O'Brien 2002; Bouwen and Taillieu 2004
Social work	Adams and McCullough 2003; Crase 2007; Gotto et al. 2007

attention and has been proposed as a valuable theoretical framework for operationalising the notion of situated learning (Fuller 2007; Korthagen 2010; Somekh 2007). Fuller (2007) asserts that Wenger's 'theorization promotes the collective or group as the important unit of analysis rather than the individual. Individuals are important in so far as they learn by being in social relation to others' (p. 19). In this regard, situated learning and particularly CoP could provide a lens for understanding teachers' learning in the sociocultural context (Hughes 2007) of their workplaces. Indeed, Barton and Tusting (2005) considered CoP in educational settings in a broader context than other researchers who see schools as places of education for students and not their teachers. They highlight the opportunities to 'take learning out of the classroom and address the variety of groups and locations where learning takes place, including adult learning, learning in the workplace and learning in everyday life' (p. 3). Within this context, the notion of teachers' learning to integrate technology could be viewed as a process of participation and identity formation in the CoP within their workplaces. Therefore, this research adopts the broad framework of situated learning and, more specifically, Wenger's (1998) CoP framework as the theoretical lens to examine teachers' knowledge enactment within the social and cultural dimensions of their workplaces.

Community Membership

This chapter has positioned teachers' work within particular, situated, socially and culturally mediated contexts. As a result, in-service teachers' ongoing development of various forms of knowledge needs to be contextualised within this setting. Wenger's (1998) CoP framework has been reviewed as an appropriate lens through which both practice and identity can be considered as influences on knowledge development; however, dimensions within this framework require elaboration and discussion to allow them to be applied to the wicked problem of in-service teachers' knowledge development and enactment.

This elaboration begins with a discussion focussing on the traits associated with community membership. Wenger (1998) argues that 'practice defines a community through three dimensions: mutual engagement, joint enterprise and a shared repertoire' (p. 152); however, as membership of a CoP does not necessarily carry a label or other reified marker, 'our membership constitutes our identity … fundamentally through the forms of competence that it entails' (Wenger 1998, p. 152).

Participation and Reification

Participation is a central construct in both situated learning and the CoP framework (Glazer et al. 2005). From a CoP perspective, Wenger (1998) argues that, 'participation in social communities shapes our experience, and it also shapes those communities.... Indeed, our ability to (or inability) to shape the practice of our communities is an important aspect of our experience of participation' (p. 56); however, participation is more than just engagement in an activity. As members of a CoP, individuals may continue to participate even after any physical activity ceases. A teacher, for example, may be involved in a discussion with someone outside of the teaching profession in which she may relay something that happened to her at school. In this example, the teacher is no longer engaged in teaching, but her description would be influenced by her community membership.

Furthermore, Wenger (1998) highlights that participation is a social activity even when a member is alone. As Henderson (2007) points out, a teacher may develop his or her lesson plan in isolation but will constantly be making decisions based on his or her understanding of his or her students' needs as well as a sense of what is acceptable according to the institution's

expectations and a need for his or her colleagues' approval. What appears to be a solitary pursuit is actually a socially negotiated practice.

Interestingly, in this example, the lesson plan that was created through participation is an example of reification. Reification describes the situation in which something abstract is treated as a concrete object (Wenger 1998) or in which 'we project our meanings into the world and then we perceive them as existing in the world, as having a reality of their own' (Wenger 1998, p. 58). This concept covers a wide range of participation processes and artefacts involved in the mutual and individual negotiation of meaning, and may be represented in a variety of forms such as documents, monuments, instruments or stories. Both participation and reification are complementary in the process of negotiating meaning in CoP as reflected in the comment 'the process of reification complements participation in the sense that mutual engagement typically involves the use of artefacts that are the products of prior reifications' (Cobb et al. 2003, p. 22).

Wenger (1998) argued that through reification we create something that acts as a focal point for the negotiation of meaning and identity. In the case of the teacher's lesson plan, although it is a concrete object in terms of being written on paper, it is at the same time a projection of the teacher's participation. It lends some sense of 'concreteness' to the ideas of time management, pedagogy and accountability. Henderson (2007) argues that we make meaning through such projections and highlights this meaning making with the following example:

> if a lesson goes horribly wrong the teacher may turn to his lesson plan considering that his manifestation of a particular pedagogical strategy was deficient. The plan serves as a focal point by which his participation can be evaluated and meaning can be (re)negotiated. (p. 54)

In addition to making meaning through these reified projections, the term reification can refer to both an object and the process of its production (Wenger 1998). For instance, a teacher might comment to another teacher 'I spent the weekend planning'. This is a reification of an aspect of a teacher's practice but also his or her identity as someone who is engaged with the practices of teaching.

Wenger (1998) stated that 'a good tool can reify an activity so as to amplify its effects while making the activity effortless' (p. 61). A lesson plan template, for example, may make planning lessons simpler by providing a framework to guide the teacher's thinking. This may include sec-

tions such as a column to note how long each activity should take and a column with the heading 'description of learning activity'; however, in this example, the template, among other things, may amplify pedagogical considerations of time management and marginalise certain practices (Wenger 1998). For instance, the second column of the template may leave no room for anything other than learning activities. In this way, other components of teaching practice such as administration or behaviour management may be marginalised. This in turn may cause teachers to renegotiate their understanding of the importance of different practices.

Clearly, participation and reification cannot be separated; however, researchers investigating a CoP need to understand that participation and reification within a community are influenced through three dimensions: mutual engagement, joint enterprise and a shared repertoire. Wenger (1998) argues that in combination, these three dimensions provide a distinction between CoP and other notions of 'community'.

Practices Enabling Participation and Identity Formation

Mutual engagement in the context of a CoP is dependent on participants doing things together and allowing them to develop a sense of belonging. This sense of belonging in turn influences participants' perspectives of the practices within the community and enables them to take on a new meaning. The development of this common frame of reference or joint enterprise then forms the basis of common understandings within the CoP for identifying and prioritising activities and resolving problems as they occur (Wenger 1998). An example of mutual engagement in secondary schools can be found in the ways in which teachers respond to the general norms that are specific to teaching, such as the standards to which teachers are accountable, when they justify pedagogical decisions and judgements.

The joint enterprise of a CoP involves participants responding together to the organisation's needs and goals. Wenger (1998) notes that individuals within a CoP do not need to have a uniform understanding of their enterprise for it to be a collective product and that 'the power—benevolent or malevolent—that institutions, prescriptions or individuals have over the practice of a community is always mediated by the community's production of its practice' (Wenger 1998, p. 80). Examples of the joint enterprise of teachers in secondary schools can be found in research

literature. Cobb et al. (2003) provided an example of involving secondary school mathematics teachers whose joint enterprise was ensuring that students understood central mathematical ideas and were able to perform well on the assessments of mathematics achievement.

As the members of the CoP engage with each other in their socially negotiated practices, they develop a shared repertoire which 'includes routines, words, tools, ways of doing things, stories, gestures, symbols, genres, actions or concepts that the community has produced or adopted in the course of its existence, and which have become part of its practice' (Wenger 1998, p. 83). This creates, in essence, a unique social history that includes not only the tools, concepts and language associated with mutual engagement in a joint enterprise but also a communal memory of action that informs and shapes future directions of the CoP. The interrelationship between the elements of mutual engagement, joint enterprise and shared repertoire in a CoP was summarised by Wenger (1998) and includes elements such as

- mutual engagement: engaged diversity, relationships, social complexity and community maintenance.
- joint enterprise: mutual accountability, interpretations, rhythms and local response.
- shared repertoire: styles, artefacts, stories, actions, tools, discourses and concepts.

Wenger's (1998) graphical representation of these three dimensions of his CoP provides a perspective highlighting the interlinked nature of these components; however, the simplicity of the diagram belies the complexity of these constructs in practice. An examination of 11 pieces of empirical research particularly invested in the exploration of mutual engagement, joint enterprise and shared repertoire (including Wenger 1998) reveals a wide variety of descriptors used to illustrate these aspects of CoP. Building on Henderson's (2007) work, Table 2.4 illustrates the variety and length of these descriptions from which a universal description and application of these aspects is difficult to synthesise.

While the rich descriptions of mutual engagement, joint enterprise and shared repertoire highlighted above provide an insight into the variety of ways in which researchers have operationalized these different theoretical dimensions, the variation and breadth of use makes it difficult to gain a consistent or succinct definition of any one of these elements. While this

Table 2.4 Descriptions and characteristics of mutual engagement, joint enterprise and shared repertoire

CoP Dimension	*Characteristics*
Mutual engagement	Engaging in a common negotiated activity (Rogers 2000) Doing things together (Wenger 1998) Sharing in an activity with a common goal (MacBeath 2003) Being included in what matters (Wenger 1998) There must be a means for community members to engage meaningfully in shared activities (Rogers 2000) Typically involving regular interaction: it is the basis for the relationships that make the CoP possible. People who work together in policy units typically interact regularly (Holmes and Meyerhoff 1999, p. 175) Through mutual negotiation, relationships form amongst the members of a community (Rogers 2000) Members form mutual relations of engagement (Wenger 1998) Making sense of the world: people are engaged in actions whose meanings they negotiate with one another (Wenger 1998) Defining membership, that is, the practices of a community and the context for belonging (Wenger 1998) Community maintenance: the formal and informal work that enables engagement (Wenger 1998) Understanding partiality: individuals cannot define or encapsulate the entirety of the CoP. Mutual engagement is understanding members' competencies, that is, what each member can and cannot do and is able to tap into those skills and knowledge (Wenger 1998) Negotiating diversity: members are not homogeneous, they find a unique place and identity within the community. Mutual engagement is as likely to facilitate differentiation as homogenisation (Wenger 1998) Maintaining identities: a result of the negotiated aspect of mutual engagement is that members maintain their identity, providing both complementary and overlapping competencies to the group (Rogers 2000)

(*continued*)

Table 2.4 (continued)

CoP Dimension	*Characteristics*
Joint enterprise	Collective negotiation (MacBeath 2003) Understanding and judging quality (MacBeath 2003) A negotiated response to their situation and thus belongs to them in a profound way, which also makes it difficult for non-members to observe and articulate (Wenger 1998) Not necessarily a harmonious or identical response, but rather a response that has been shaped, and given meaning through mutual engagement (Wenger 1998) Responding together (Wenger 1998) Enterprise allows a community to extend the boundaries and interpretation of practice beyond those that were created (Rogers 2000) Sharing a common goal, members negotiate their situations in their reactions to them (Rogers 2000) Enterprise is substantially different from the original An essential characteristic of joint enterprise is the product that results from negotiation that is substantially different from the original (Rogers 2000) Disagreements can be part of the joint enterprise as individuals may not necessarily hold the same viewpoint. This should not, however, be construed to be anti-productive as disagreement can result in further negotiation in the enterprise (Rogers 2000) Locally responding to global needs and institutional pressures (Wenger 1998) Reconciling competing demands (MacBeath 2003) Not immune to the 'pervasive influence of the institution' (Wenger 1998, p. 79). A CoP can be influenced, manipulated, duped and intimidated, but it can also be inspired, helped, supported, enlightened and empowered A local means to satisfying or avoiding institutional demands. 'Even if strict submission is the response its form and its interpretation in practice is a local collective creation' (Wenger 1998, p. 80)

(*continued*)

Table 2.4 (continued)

CoP Dimension	*Characteristics*
Shared repertoire	The joint pursuit of an enterprise results in a shared repertoire of joint resources for negotiating meaning (Wenger 1998, p. 85). This includes linguistic resources such as specialised terminology and linguistic routines, but also resources such as pictures, regular meals and gestures that have become part of the community's practice (Holmes and Meyerhoff 1999, p. 176) Meaning is negotiated in a community through its shared repertoire. This repertoire refers to the fact that there is a pool of resources that members not only share but also contribute to and therefore renew. These resources can be physical, such as e-mail, word processors and a common textbook, or they can be intangible, such as a common discourse, a common means or methodology for accomplishing tasks (Rogers 2000) Shared points of reference provide a common discourse upon which members can create their own responses and ideas within the community (Rogers 2000) New ideas are created from the shared repertoire: the shared repertoire common discourse is attained from a common history but should not impose a boundary. In the negotiation of the enterprise, members may renegotiate the common interpretations and ambiguities creating new ideas and trajectories (Rogers 2000) Resolving problems together (Wenger 1998) Routines, tools, norms and mores of relationships (MacBeath 2003) Using and creating communal resources in the process of negotiating meaning (Wenger 1998) A socially negotiated, and therefore profoundly unique, understanding of routines, words, tools, ways of doing things, stories, gestures, symbols and actions of community (Wenger 1998) A historical reflection of mutual engagement (Wenger 1998) People who cannot understand the reified objects of a community and who do not share the community's discourse cannot fully participate in that community (Thorpe 2003)

provides particular challenges for research using a CoP lens, it does provide an effective example of mutual negotiation and joint enterprise in a research context with academics working towards an outcome of both reified objects (research papers) and practices (methodologies) underpinned by a shared repertoire (mutual engagement, joint enterprise and shared repertoire). Without a definitive description of these terms, researchers investigating this complicated, socially mediated and situated form of

practice and identity formation are thus required to infer meaning from what they observe within a CoP and from what the participants report.

The three dimensions of practice within a CoP, namely mutuality of engagement, accountability to an enterprise and negotiability of a repertoire, have been discussed in this section. However, as this study is examining the processes by which teachers enact knowledge, particularly knowledge related to pedagogical technology integration, it is important that the focus is not solely on what constitutes competent practice in a CoP but also on understanding of the processes of membership. Specifically the ways in which newcomers become old-timers, by which the foreign becomes familiar, the mysterious obvious, what is opaque becomes transparent (Wenger 1998). The following section will focus particularly on such processes.

Modes of Belonging

Belonging to a CoP requires an individual not only to develop skills deemed competent and useful by other members of the community but also to develop an identity that is perceived by the participant and the other members of the community as one that reflects the CoP mutual engagement in a joint enterprise. To make sense of the formation of identities, practices and knowledge within a CoP, 'it is necessary to consider modes of belonging other than engagement in practice' (Wenger 1998, p. 173). Wenger contends that rather than classifying communities under fixed categories, considering modes of belonging provides a framework for understanding how different communities are constituted. Considering modes of belonging, one must examine three different components, namely engagement, imagination and alignment.

One of the distinct mechanisms of belonging to a CoP is engagement. In conjunction with the concept of mutuality, this term has been discussed as part of the ongoing negotiation of meaning as part of this literature review; however, there are two important additions associated with engagement that need to be highlighted.

First, the bounded character of engagement needs to be understood. There are obvious physical limits in terms of time and space that bound one's engagement. As Wenger (1998) states

> we can only be in one place at a time and dispose of only a finite number of hours per day. In addition, there are physiological limits to the complexity

> that each of us can handle, to the scope of activities that we can be directly involved in, and to the number of people and artifacts with which we can sustain substantial relationships of engagement. (p. 175)

This bounded notion of engagement is one that is important to consider particularly for newcomers to a CoP who may be participating on the periphery of the community. These individuals, while seeking increasing engagement in the CoP, are bounded in their opportunity to engage with people and artefacts that may develop their identity as a result of the physical limits of time and space; however, it also means that the relationships and artefacts that have the most substantive effect on the development of a newcomer's practice and identity receive a proportionately larger amount of time. This bounded character of engagement can be considered as both a strength and a weakness of this mode of belonging.

Second, the notion of trajectories becomes important when considering the role of engagement as a mechanism of belonging for different members of a CoP. It has been highlighted in previous sections of this literature review that identity in practice arises out of an interplay of participation and reification. As such, identity cannot be considered an object but a 'constant becoming' (Wenger 1998, p. 154). Wenger argues that our identities are constantly changing, moving in a trajectory that ties in both the past and the future. In this way, we identify ourselves as much by where we have come from and where we believe we are going as by our current competence as members of the CoP. In doing so, the concept of trajectory within the CoP framework is used to argue that

1. Identity is fundamentally temporal;
2. The work of identity is ongoing;
3. Because it is constructed in social contexts, the temporality of identity is much more complex than a linear notion of time;
4. Identities are defined with respect to the interaction of multiple convergent and divergent trajectories. (Wenger 1998, p. 154)

When considering the different forms of engagement contained within a CoP and the inseparable link between this engagement and identity formation, it becomes important to consider the different types of trajectories various members of the community may be pursuing. Such considerations may help differentiate the difference between the forms of engagement of old-timers in comparison to newcomers, those who consider themselves as

legitimately peripheral to a CoP compared to those who may be peripheral as a result of liminality (Cook Sather 2006) or those who are preparing to leave rather than to enter a CoP. Wenger (1998, pp. 154–155) describes the following five trajectories:

1. *Peripheral trajectories:* By choice or by necessity, some trajectories never lead to full participation. Yet they may well provide a kind of access to a community and its practice that becomes significant enough to contribute to one's identity.
2. *Inbound trajectories:* Newcomers joining the community with the prospect of becoming full participants in its practice. Their identities are invested in their future participation, even though their present participation may be peripheral.
3. *Insider trajectories:* The formation of an identity does not end with full membership. The evolution of the practice continues—new events, new demands, new inventions and new generations all create occasions for renegotiating one's identity.
4. *Boundary trajectories:* Some trajectories find their value in spanning boundaries and linking communities of practice. Sustaining and identity across boundaries is one of the most delicate challenges of this kind of brokering work [for more details regarding brokering, please see the following section discussing multi-membership].
5. *Outbound trajectories:* Some trajectories lead out of a community, as when children grow up. What matters then is how a form of participation enables what comes next. It seems perhaps more natural to think of identity formation in terms of all the learning involved in entering a community of practice. Yet being on the way out of such a community also involves developing new relationships, finding a different position with respect to a community and seeing the world and oneself in new ways.

The bounded nature of engagement and the way this can be considered through defining various trajectories or paths that tie an individual's past and future allow for an examination of power. Engagement can afford or limit individuals' power when negotiating their enterprises and therefore to shape the context in which people can construct and experience an identity of competence (Wenger 1998). The construction and maintenance of an identity of competence also requires imagination as a mode of belonging.

Imagination

Imagination can be an important component of our experience of the world and our place within it. When considering the role of imagination as a mode of belonging to a CoP, Wenger (1998) recounts the story of two stonecutters who are asked what they are doing. One replies: 'I am cutting this stone in a perfectly square shape.' The other responds: 'I am building a cathedral.' The difference in these two responses does not indicate that one is a better stonecutter than another, nor is it a reflection on their level of engagement as they may both be doing the same thing. The difference does suggest that their experiences of what they are doing and their sense of self in the process are rather different. Wenger (1998) claims that this difference is a result of imagination and, as a result, 'they may be learning very different things from the same activity' (p. 176).

Unlike some uses of the term imagination that connote fantasy or distance from reality, Wenger's (1998) use of imagination 'involves unconstrained assumptions of relatedness, it can create relations of identity anywhere, throughout history, and in unrestricted number' (p. 181). The imagination of a new teacher to a secondary school CoP may be an important factor determining his or her mode of belonging. Depending on the newcomers' imagination and the trajectory they perceive themselves as being on, they may choose to engage with members of the leadership team if that is how they perceive their career path progressing. Alternatively, they may identify their practices and identity to have a closer alignment to a group of technology-using teachers within the school. As such, they may imagine what it would be like to participate more centrally in this CoP within the school and, as a result, shape their engagement, enterprise and repertoire in an attempt to make the imagined future a reality. Imagination therefore has a potentially important role to play in a teacher's knowledge development as it can define a future competent identity for a newcomer and provide an insight into the skills and practices that underpin this competent identity.

In contrast to affording possibilities, imagination can also provide challenges for a participant within a CoP. One's imagination can lead one to stereotypes that can simply be projected onto the world as an assumption of specific practices. In addition, an imagined future can be 'so far removed from any lived form of membership that it detaches our identity and leaves us in a state of up rootedness' (Wenger 1998, p. 178).

Alignment

Alignment requires a specific form of participation and reification to coordinate different perspectives and to direct energies to a common purpose connecting local efforts to broader styles and discourses which 'allow learners to invest their energy into them' (Wenger 1998, p. 186). The work of aligning perspectives and directing energies entails processes such as negotiation, convincing, inspiring and uniting, and commonly involves individuals who are members of multiple, interrelated CoP. These people straddle the boundaries of a number of CoP and, using reified, sharable artefacts create fixed points around which participation and identity development can be focussed. The following section of this chapter explains the processes associated with the work of individuals who belong to multiple CoP.

Practice Defined Globally, Experienced Locally

Situated learning theory positions a CoP as the context in which an individual develops his or her practices. However, in contrast to theories of socialisation that predict the smooth reproduction of communities over time, considerations of CoP highlight the possibilities for adaptation and even intra-community conflict.

Handley et al. (2006) consider the complexity around membership of multiple CoP, stating

> individuals bring to a community a personal history of involvement with workplace, social and familial groups whose norms may complement or conflict with one other. These conflicts need to be negotiated and reconciled at least in part if the individual is to achieve a coherent sense of self. An analysis of (individual) situated learning and knowledge transfer (across communities) thus requires not only a conceptualization of 'community of practice', but also an understanding of what happens within and beyond such communities. (p. 642)

To better understand the knowledge transfer across CoP, the following section uses a secondary school CoP as a context to illustrate the role and influence of boundaries, brokers and sharable artefacts.

Boundaries, Brokers and Identity: The Nexus of Multi-Membership

A secondary school is an example of a CoP in which groups of teachers with common interests and shared practices mutually engage in collaborative works and socially relate to each other (Butler et al. 2004; Hennessy et al. 2005; Skerrett 2010). However, this CoP can been described as a series of smaller CoP as 'each subject community could be said to share a set of tools and resources; approaches to teaching and learning; curriculum practices; cultural values, expectations, and aims' (Hennessy et al. 2005, p. 160). The discussion of CoP has, until this point, focussed on a community as if it was isolated from other CoP; however, this is not the case.

As Wenger (1998) points out,

> communities of practice cannot be considered in isolation from the rest of the world, or understood independently of other practices. Their various enterprises are closely interconnected. Their members and their artifacts are not theirs alone. Their histories are not just internal; they are histories of articulation with the rest of the world. (p. 103)

Teachers within the CoP of their secondary school may simultaneously belong to multiple CoP and be required to deal with the metaphorical boundaries that enclose each community to which they belong. For example, a group of history teachers would have strong mutuality regarding the improvement of their enterprise improving their history teaching practices to enhance their students' learning outcomes and, in doing so, share a repertoire which is based on a shared discipline interest. A member of the history teachers' CoP may also be a member of another CoP within the same school that brings together teachers from different subject backgrounds who have an interest to integrate technology in their teaching and learning. Similarly, another member of the history teachers' CoP may also teach in a different discipline area such as English and therefore provide continuity between communities. The same teacher may also be a member of a broader CoP that exists outside the school CoP such as a member of a state, a national or an international professional association.

A teacher who is a member of a variety of CoP may act as a change agent or a broker. According to Wenger (1998), brokers are people who can provide connections between communities by introducing 'elements of

one practice into another' (p. 105). These teachers might learn new practices in one CoP and represent them to the members of another CoP. For example, a teacher could convince a whole school CoP of the value of some software he or she has used in a previous school, thus brokering the mode of participation in one community to another. These multiple, complex and simultaneous memberships are represented in Fig. 2.2.

In addition to brokers, connections between CoP can be made through boundary objects or 'artefacts, documents, terms, concepts, and other form of reification around which communities of practice can organize their interconnections' (Wenger 1998, p. 105). In a secondary school setting, lesson plans are examples of boundary objects. A teacher from a particular discipline area such as physics may create a lesson plan that incorporates technology integration strategies that could then be used by a teacher from a different CoP (such as a mathematics teacher) to use as a basis for technology integration in his or her own practice. While the objects are understood by the different CoP in different ways, they create the opportunity for meaning to be renegotiated through understanding the reification of CoP and TPACK: considering identity as an aspect of workplace learning

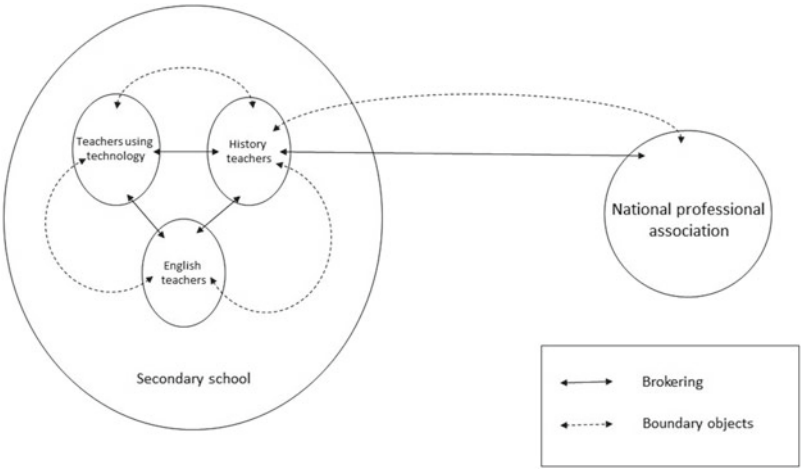

Fig. 2.2 An example of multiple CoPs

The ideas underpinning the CoP framework have their origins in Lave and Wenger's research in situated learning in the 1980s. The term CoP was first coined in the Lave and Wenger's (1991) book *Situated Learning: Legitimate Peripheral Participation*, which places emphasis on learning in a shared, situated and culturally mediated context. Wenger's (1998) subsequent and more detailed examination of CoP provided a greater insight into the factors that underpin this complex socially mediated practice, and it is in this work that the distinction is made between a CoP and other forms of 'community'.

This distinction has been highlighted by other researchers using CoP as a theoretical lens, including Skerrett (2010) who stated that 'communities of practice are groups of people that are mutually engaged in a joint enterprise and who share a common repertoire … for engaging in their work' (p. 648). CoPs differ, therefore, from other definitions of 'community' such as 'communities of learners', 'discourse communities', 'learning communities', 'school communities' and 'teacher communities' (Branch et al. 2010) as membership of a CoP is not necessarily based on formal notions of membership rather a sense of belonging to the particular community which is reflected in mutual engagement, joint enterprise and shared repertoire (Wenger 1998). These three concepts regularly appear in CoP literature and are often described as the core CoP concepts which 'associate practice with community' (Wenger 1998, p. 72).

While there is little doubt that these concepts can add to our understanding of how teachers develop knowledge in workplace settings (eg, see Brouwer et al. 2012; Hartnell-Young 2006; Henderson 2007; Hodkinson and Hodkinson 2004; Phillips 2012; Printy 2008), it is hoped that the remainder of this chapter can draw attention to an additional aspect of the CoP framework that remains comparatively underexplored: identity.

Identity

While mutual engagement, joint enterprise and shared repertoire in a school CoP are inevitably implicated in the development of secondary school teachers' professional knowledge, Wenger (1998) also points out, 'the formation of a community of practice is also the negotiation of identities' (p. 149) and 'issues of identity are an integral aspect of a social theory of learning and are thus inseparable from the issues of practice, community and meaning' (p. 145). Identity in this sense is defined socially; that is, it is produced through participation in a community and 'expands

the focus beyond communities of practice, calling attention to broader processes of identification and social structures' (Wenger 1998, p. 145). Changing the focus from individuals to a broader conceptualisation of identity challenges, our understanding of TPACK as we are required to consider TPACK not simply as an individually acquired attribute (Phillips 2013a, b) but as part of a broader set of social forces that suggest TPACK may also be thought of 'as something outside of the individual's head, or even body' (Hager 2005, p. 833).

The individual acquisition of TPACK is therefore challenged by situated, workplace learning frameworks such as CoP in which the influence of knowledge on participation and identity can no longer be considered in 'pedagogical solitude' but instead as 'communal property' (Shulman 1993, p. 6). In this sense, TPACK may be considered as knowledge that grows and develops through participation, knowledge sharing and negotiation as a productive member of a community and therefore as knowledge 'as something outside of the individual's head, or even body' (Hager 2005, p. 833).

If one accepts the connection between TPACK development and the negotiation of identity development within a CoP, then this brings additional challenges to the theoretical concepts underpinning the TPACK framework. Such challenges are typified by Wenger's (1998) notion that identity cannot be considered an object but a 'constant becoming' (p. 154). Wenger argues that our identities are constantly changing, moving in a trajectory that ties both the past and the future. In this way, we identify ourselves as much by where we have come from and where we believe we are going as by our current competence as members of the CoP. In doing so, the concept of trajectory within the CoP framework is used to argue that:

1. identity is fundamentally temporal;
2. the work of identity is ongoing;
3. because it is constructed in social contexts, the temporality of identity is much more complex than a linear notion of time;
4. identities are defined with respect to the interaction of multiple convergent and divergent trajectories. (Wenger 1998, p. 154)

If this is the case, then TPACK also needs to be considered as a fundamentally temporal, ongoing, and multifaceted concept. The complexity that is brought to the TPACK framework when considering it in the

light of the CoP notion of identity is considerable and challenges the idea published in previous research that TPACK represents an aspirational end point, acquired by individuals. The remainder of this book presents the first record of research that considers how teachers' TPACK enactment is influenced by their participation in a school-based CoP.

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CHAPTER 3

Studying a School and Its Teachers

Chapter 2 highlighted the complicated and 'messy' reality of teachers' (non)use of digital technologies in schools. This chapter is the first of four chapters that draw on the TPACK framework and situated learning theory of communities of practice outlined in Chap. 2 to explore the ways in which teachers in a secondary school use digital technologies. In particular, these chapters utilised the situated, social and micro political context of the school to understand the ways in which policy, practice and identity shape teachers' (non)use of digital technologies.

This approach challenges the established epistemological position inherent in the TPACK framework that considers knowledge only as an epistemological possession rather than also considering knowing as an epistemology of practice. Utilising CoP alongside TPACK recasts TPACK as both individual knowledge but also as a sociocultural transformation that also requires considerations of the communal workplace context—that is, practice and identity development as factors influencing TPACK enactment.

It is important to emphasise that this book does neither argues that TPACK is the only way that teachers' technology use can be understood, nor argues that CoP (as defined by Wenger 1998) is the only way to understand TPACK development and enactment. Rather, it aims to examine the ways in which CoP may help to explain the processes that shape teachers' TPACK enactment in their workplace contexts. Consequently, the scope and limitations of this research need to be clearly defined in

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order to understand why certain avenues have been pursued while others have been left for future research.

The definitions of community, including CoP, vary considerably across the professional development, workplace learning and CoP research literature. In order to strengthen the analytical generalizability of this research, the theoretical focus on community has been limited to Wenger's (1998) CoP framework. The reasons for choosing this specific framework are included in Chap. 2 along with a discussion of other perspectives. As a result of this choice, the research literature which has been used to build a theoretical understanding of a communal context and its applicability to teachers' workplace contexts is critically considered or rejected where it does not use or specify this specific CoP framework. Similarly, the data collection, analysis and findings rigorously focus on the processes of CoP according to Wenger's (1998) framework.

This book purposely does not consider how participants' behaviour, or the processes described by the CoP framework, may be explained by other theories. This book does not aim to validate CoP as a theory, but rather investigate if, from this theoretical perspective, themes and processes can be identified that help explain in-service teachers' TPACK enactment. Consequently, the observed and reported enactment of TPACK in this investigation could be recast as examinations of power relations, culture, gender differences, socioeconomic class or any other sociocultural phenomenon, as these mediate the enactment of particular knowledge forms. However, it has been a deliberate choice not to do this and to address these issues to the extent that they emerge as significant themes which help to clarify the role of CoP. Indeed, 'CoP as a social theory of situated learning is compatible with these socio-cultural influences in the way it considers them as personal histories and trajectories of identity' (Henderson 2007, p. 5).

This book draws on a case study methodology with a small number of participants in a specialised workplace context described in detail later in this chapter. Consequently, the findings of this research are limited in generalizability. The challenges of case study research, specifically credibility as 'communicative validity' and 'trustworthiness', and generalizability are carefully addressed later in this chapter, the methodology section. In an attempt to strengthen the findings, this research uses a variety of strategies including, but not limited to, triangulation across multiple collection points, tools and cases. Nevertheless, the research findings should be considered heavily contextualised, a deliberate and thoughtful research choice

that provides the reader with ways of making meaning, however these come with limited analytical generalizability.

As a final point, it should be noted that this study is exploratory in nature and attempts to explore aspects of TPACK that have not been undertaken in previous research projects. This study uses CoP as a situated learning framework to explore the sociocultural influences on teachers' knowledge enactment, changes in their pedagogical technology practices and identity transformations. Therefore, it is limited in its generalizability and the findings should be considered critically; however, the scope of this research is to identify issues relating to the situated CoP processes that influence TPACK enactment in a school workplace. These matters are theoretically generalizable and the aim is to provide the research literature with avenues for future research which may, in turn, lead to generalizable principles that individual teachers or school organisations can use to better understand teachers' TPACK enactment.

Chapter 1 proposed that TPACK is a framework that enables researchers to develop an understanding of the ways in which different forms of knowledge impact on teachers' pedagogical technology use; however, I argued that a limitation with the framework is that researchers are yet to effectively establish an understanding of the processes that mediate the ways in-service teachers enact these forms of knowledge. The notion of context as a component of the TPACK framework has been explored through Wenger's (1998) CoP framework as one example of a theory of workplace learning. Discussion in Chap. 2 demonstrated that the value of the CoP framework lies in the participatory perspective that takes account of the social, cultural and political dimensions; however, the processes by which learning takes place or, in this study, how do teachers learn to enact TPACK remains unexplored. This chapter discusses the research design and the methodological approach developed to investigate teachers' TPACK enactment within their workplace CoP.

A Research Framework

This research is grounded in the TPACK framework that provides teachers with an aspirational mixture of technological, pedagogical and content knowledge and utilises the situated learning framework of CoP as a theoretical lens through which the social processes influencing the context of teachers' TPACK enactment can be understood. It is important to emphasise that this research uses Wenger's (1998) framework of CoP in

which participation, social negotiation and identity formation are privileged. Consequently, this research is based in literature that falls within a paradigm of sociocultural and constructivist theories of learning (Lave and Wenger 1991) that have been described more fully in Chap. 2. The following discussion builds on these earlier descriptions by highlighting the ways in which each of these paradigms contribute to the ontological and epistemological aspects of this research.

There is academic debate over the relation between sociocultural and constructivist perspectives on learning (e.g., see Packer and Goicoechea 2000). Underpinning many of the contentions in the debate theorising human learning are the ways in which each perspective differs 'not just in their conceptions of knowledge (epistemological assumptions) but also in their assumptions about the known world and the knowing human (ontological assumptions)' (Packer and Goicoechea 2000, p. 227). Despite these differences, some researchers have argued that sociocultural and constructivist approaches are not irreconcilable but that each 'tells half of a good story' (Cobb 1994, p. 17) with their synthesis being 'an important scientific agenda' (Greeno 1997, p. 14). Considering the synthesis offered by researchers, Packer and Goicoechea (2000) propose that 'sociocultural and constructivist perspectives are not two halves of a whole, but that the constructivist perspective attends to epistemological structures and processes that the sociocultural perspective can and must place in a broader [ontological] historical and cultural context' (p. 228). As such, discussions considering the ontology of sociocultural and constructivist approaches need to concurrently contemplate the associated epistemological structures.

It has been argued that 'scholarly paradigms, like other forms of human consciousness, are the expression of specific worldviews' (Sprague 2010, p. 78), each with their own proponents and critics. In contrast to the objective notions associated with quantitative paradigms, social constructivist perspectives consider knowledge and its development to be a personal construct and not an absolute fact (Flick 2006; Lave and Wenger 1991; Winner 1993). This concept does not deny the existence of the objective world but argues that our understanding of it is mediated by our experiences, perceptions and understanding or as Hung (2001) argues, 'learning is an active process of constructing rather than acquiring knowledge' (p. 282). In articulating the connection between an individual, their environment and knowledge development, social constructivist theories

promote rather than hide the relationship between the knower and the known (Sprague 2010).

Despite the clear espousal of the attributes of the social constructivist paradigm, the ontological assumptions associated with it often go unnoticed 'due in part to a lingering anxiety, traceable to the logical positivists, that discussion of ontology is merely "metaphysical", untestable, and therefore unscientific' (Packer and Goicoechea 2000, pp. 227–228). The metaphysical connection between ontology and epistemology has also resulted in many researchers shying away from considerations of the impact of epistemology on research methodology; however, with the adoption of post-positivist paradigms, the unnoticed assumptions of these ethereal constructs can be examined in an academically rigorous manner.

Paker and Goicoechea (2000) provide researchers with a detailed synthesis of the ontology and epistemology of sociocultural and constructivist theories of learning in which they articulate six themes of a nondualist sociocultural ontology: that the person is constructed in a social context, formed through practical activity and in relationships of desire and recognition that can split the person, motivating the search for identity in which 'the constructivist perspective attends to the epistemological processes and structures that the sociocultural perspective is able to locate in an ontological process, and so trace their cultural and historical genesis' (Packer and Goicoechea 2000, p. 235)

This account 'introduces a different distinction, between epistemological and ontological aspects of human change' in which 'the former is always an aspect of the latter' (Packer and Goicoechea 2000, p. 239). This perspective allows a constructivist orientation to learning to be considered as part of a larger process of human change and transformation which is the process called learning by socioculturalists (Packer and Goicoechea 2000) which 'always entails participation in relationship and community and transformation both of the person and of the social world. CoP are consistent with pragmatism and they place special emphasis on the problem-driven nature of inquiry and learning' (Packer and Goicoechea 2000, p. 239). The combination of sociocultural and constructivist theories of learning, evident in Lave and Wenger's (1991) legitimate peripheral participation framework and Wenger's (1998) subsequent consideration of CoP, which do not 'tie methodological choices to metaphysical principles (epistemology and ontology) but allows, instead, methods to be chosen in terms of their practical value for dealing with a specific research problem' (Denscombe 2008, p. 283). As such, it is necessary to examine

the practical value of different methodological approaches when considering how CoP can be used as a framework to understand in-service teachers' TPACK development and enactment.

When considering the practicality of different methodological approaches, Waring (2012) highlights that it is still necessary to provide evidence of some relational connection between ontology, epistemology and methodology without necessarily being mechanically bound by metaphysical considerations. As has been highlighted in earlier discussions, the social constructivist and situated learning paradigms emphasise the important role of the social environment in the process of meaning making and, as such, 'any attempt to explain the dynamics, influences, or issues of significance in a social organisation or community must necessarily value the stories of the people involved' (Henderson 2007, p. 76). Kayrooz and Trevitt (2005) also indicate the importance of the social environment in their examination of research communities, claiming if researchers wish to inquire about the nature of social events, they need to gather evidence of people's perceptions according to the context in which they occur (p. 10). Accordingly, a social constructivist paradigm values naturalistic enquiry where the social context is more likely to be in a natural state when compared to experimental or other modes of enquiry. This is reflected in Cox and Graham's (2009) recommendations for TPACK research, also highlighted in Chap. 1, in which they suggest that 'studies must include extended observation paired with interviews that aim at understanding the purposes and knowledge behind teacher action with technology' (p. 69). The focus suggested by Cox and Graham (2009) and explicated by descriptions of a social constructivist lens (e.g., see Creswell 2012; Grünbaum 2007; Jones et al. 2011; Lincoln and Guba 2000) is on understanding participant experiences and how they are interpreted.

Henderson's (2007) examination of situated learning, particularly within an educational environment highlights challenging aspects of research design in this field stating:

> it is difficult to measure or interrogate the social environment, particularly from a social constructivist paradigm and CoP lens, it is necessary to discern its agency through the community members' perceptions. Consequently, this [form of] research needs to be able to access participants' subjective experience and interpretations of the social context through a rich exchange in dialogue. (p. 78)

The suggestion in Henderson's (2007) statement and in the discussions of Creswell (2012); Cox and Graham (2009); Grünbaum (2007); Jones et al. (2011); Kayrooz and Trevitt (2005) and Lincoln and Guba (2000) is that a qualitative approach is well suited to this rich exchange in dialogue in a natural state. As Fosnot (1996) suggests, we 'cannot understand in the same way as another human who has had different experiences, but with language, with stories, with metaphors and models we can listen and probe one another's understanding, thereby negotiating 'taken-as-shared' meanings' (p. 26). To this end, the methodological approach to this research study accommodates participant stories with ill-defined concepts, multiple interpretations and agency in the social environment.

Methodological Approach: Case Study

The previous section of this chapter has highlighted the sociocultural and constructivist learning in the ontological and epistemological standpoints taken in this research. This section describes the qualitative approach to this study, in which a multiple case study methodology is adopted.

Researchers provide different definitions of case study design depending on their emphases on either the process of conducting case research, the case as a unit of analysis or the end product of a study (Merriam 1998). Stake (1995) and Merriam (1998) focus on the unit of analysis and frame cases as 'bounded' or 'integrated' systems. Geertz (1973) illustrates the complexity involved in the notion of integrated systems describing the way in which such systems are situated within larger networks: how cases are always cases within larger cases, superimposed and knotted into one another and therefore are context specific. As Bulfin (2009) suggests, contexts are interactively achieved phenomena rather than predefined sets of forms and content; they are dynamically made and remade in the flow of everyday life. A question such as 'where does phenomenon end and context begin?' quickly unravels the idea that cases and contexts can be neatly bounded and traced. As Dyson and Genishi (2005) remind us, 'cases are constructed, not found' (p. 2).

This study builds on this productive tension between the blurred boundaries of case and context by recognising that cases and their boundedness are situated and interrelated entities which are only ever partially understood and always with reference to the range of intricate relations between the phenomenon and its biography and history (Mills 1959). This tension illustrates how context is not a static physical setting—it is

not an empty container which holds or influences social action in a causal way. Instead, both context and case are constituted in and through language and social practices. The importance of context in understanding the ways in which teachers develop TPACK is central to this study and the relationship of both case and context to language and in particular social practices provides the necessary methodological practicality highlighted by Denscombe (2008) and discussed in the previous section.

Willis (2007) provides a broader contextual summary of case study research and suggests that case studies are 'about real people and real situations … [they commonly] rely on inductive reasoning … [and] illuminate the reader's understanding of the phenomenon under study' (p. 239). In contrast, Yin (2009) begins his conceptualisation of case study by mapping different forms of qualitative research against different conditions and positions case study research as a method which responds to investigations asking how or why questions, where the researcher does not have control of the behavioural events yet the focus is on contemporary events. Following the presentation of the conditions most suited to case study research, Yin (2009, p. 18) provides a more specific two part technical definition of case study research stating:

1. A case study is an empirical inquiry that
    - investigates a contemporary phenomenon in depth and within its real-life context, especially when
    - the boundaries between phenomenon and context are not clearly evident

2. The case study inquiry
    - copes with the technically distinctive situation in which there will be many more variables of interest than data points, and as one result
    - relies on multiple sources of evidence, with data needing to converge in a triangulating fashion, and as another result
    - benefits from the prior development of theoretical propositions to guide data collection and analysis.

This research is based on a single research question asking how teachers' TPACK enactment is influenced in a CoP? To answer this question, a multiple case study methodology was adopted in which 'the same study

may contain more than a single case' (Yin 2003, p. 46). According to Yin (2003) 'a common example is a [multiple case] study of school innovations (such as the use of new curricula, rearranged school schedules, or new educational technology), in which individual schools adopt some new innovation' (p. 46).

This research involved four cases of individual teachers in one school in which each of the data collection methods were designed to gather empirical evidence to examine this contemporary phenomenon within a real-life, secondary school context. As such, this research needs to consider a wide range of variables in attempting to provide answers to the research question. The factors involved in the development of teachers' TPACK are too numerous to quantify, let alone establish causality. The complex, contradicting and changing interdependencies between the technological, pedagogical and content demands and their mediation by the situated and social contexts that bound teachers' practices are unlikely to be effectively represented or explained by a simple equation.

These reasons support the use of case study as a suitable methodological approach for this study. This suitability is also supported by Johnson's (2001) review of literature utilising CoP as a theoretical basis. This review reports that 'the vast majority of the current literature in this new research area consists of case studies' (p. 45). This is borne out in a number of investigations (e.g., see Abramovich and Schunn 2012; Barkley 2012; Jain et al. 2012; Kensler et al. 2012; Squires and Van De Vanter 2012).

Methods of Data Generation

In this section, I outline the methods adopted in the study to generate data and the processes used to recruit participants. In doing so, I aim to describe what I did, but also to reflect on and evaluate the processes, methods and tools. In this investigation, data generation is used to describe the process commonly referred to as data collection. This is in acknowledgment of the thoughts of researchers (e.g., see Baker 1997; Freebody 2003) who have highlighted that amassing a data set is not a neutral process but actively involves authoring particular accounts, representations or versions of phenomena in particular times and places, according to particular epistemological positions. The active role of the researcher in data generation is most clearly seen in interviews or observations and less obvious in the collection and curation of artefacts; how-

ever, the researcher is still involved in the selection and designation of these objects as data.

This research examined the role of CoP as a framework to understand in-service teachers' TPACK development through four case studies of in-service teachers in one Australian secondary school over 1 year. As a result of my interactions with the staff at Drake Secondary College, four teachers indicated that they would be willing to participate in my research.

Working with the participants at different times over the course of a school year I generated a range of data including interview recordings and transcripts, observational records and other documents and artefacts (e.g., school policies, lesson planning templates and publically accessible espousals of the school's philosophy). In addition, after each participant's initial interview, they were asked to nominate as many people from within the school who they felt influenced their professional knowledge development (key professional learning colleagues) who were also interviewed.

This process resulted in data related to four cases centred on the four initial participants who volunteered to participate in this study. Chapter 4 presents Anna's case and uses data from Anna and her two key professional learning colleagues to examine how a (re)construction perspective can be used to understand participation and TPACK development in a CoP. Chapter 5 focuses on John's case in which his participation with one of his key professional learning colleagues challenges the consensual notions of 'joint', 'shared' and 'mutual' on participation and TPACK development in a CoP.

Chapter 6 presents both Felicity and Nick's cases and provides examples of both the messiness of ethnographic research and the close connections that can form in a CoP. As part of the research design, I had initially assumed that each of the participants would either be an initial, core participant or a key professional learning colleague. Unexpectedly, Felicity and Nick, both initial, core participants also nominated one another as key professional learning colleagues and presented a challenge in terms of representing the data associated with their cases. In total, 14 interviews were conducted across the four cases, generating approximately 14 hours of interview data which were transcribed in full. Each of these data sources is discussed in more detail in the following section.

Data Sources

The choice of methods for sourcing data is an important consideration in the design of any study and the development of these tools should not only maintain the communicative validity and trustworthiness (Freebody 2003; Silverman 2005) but it should, in addition, provide multiple sources of evidence. Yin (2003) indicates that there are a number of sources of data available to researchers utilising a case study methodology and argues that 'no single source has a complete advantage over all the others. In fact, the various sources are highly complementary, and a good case study will want to use as many sources as possible' (p. 85). The comparative strengths and weaknesses of the four forms of data proposed for this study are summarised in Table 3.1.

Based on the comparative strengths and weaknesses of each data source (presented in Table 3.1) and the need to include multiple data sources

Table 3.1 Four sources of evidence: Strengths and weaknesses (Yin 2003, p. 86)

Sources of evidence	*Strengths*	*Weaknesses*
Documentation	Stable—can be reviewed repeatedly Unobtrusive—not created as a result of the case study Broad coverage—long span of time, many events and many settings	Retrievability—can be low Biased selectivity if collection is incomplete Reporting bias—reflects (unknown) bias of author Access—may be deliberately blocked
Interviews	Targeted—focuses directly on case study topic Insightful—provides perceived causal inferences	Bias due to poorly constructed questions Response bias Inaccuracies due to poor recall Reflexivity—interviewee gives what interviewer wants to hear
Participant observation	Reality—covers events in real time Contextual—covers extent of event Insightful into interpersonal behaviour and motives	Time consuming Selectivity—unless broad coverage Reflexivity—event may proceed differently because it is being observed Cost—hours needed by human observers Bias due to investigator's manipulation of events

to provide opportunities for triangulation through converging lines of inquiry, the current study has focussed on three qualitative data sources; namely documentation, semi-structured interviews and participant observation. While the other sources of data suggested by Yin (2003) were considered and benefits of additional forms of data were recognised, these data sources were rejected as a result of the time and physical limitations of this study and the large amount of data anticipated from the interview process.

Documentation

The strength of documentary evidence in case study research has been shown over time 'and is likely to be relevant to every case study topic' (Yin 2003, p. 85). Documentary data is stable according to Yin (2003) and it can be reviewed repeatedly, it is unobtrusive and generally is not created as a result of the case study. Despite these strengths, there are a number of limitations and weaknesses that must be considered when using documentary evidence. Documents provided by participants in case study research may be subject to reporting bias and may reflect the recognised or unrecognised preconceptions or prejudices of the author. Yin (2003) argues that reporting bias is a weakness of documentary evidence. It is argued that in this study, such reporting bias may not be a weakness of the documentary evidence but rather a strength, as the recognised or unrecognised preconceptions or prejudices of the author of the documentary evidence can also be considered as part of their participation as a member of a CoP.

Yin (2003) warns of a particular weakness of documentary evidence that should be taken into account in this particular study, namely access to particular information. It is posited that in this study, one of the potential weaknesses in the data collection model may be that the participants deliberately block access to pieces of information in their documentary evidence as a result of conscious or unconscious reflexivity, that is the interviewee provides the researcher with what he or she thinks the researcher wants to see or hear.

In this study, several forms of documentation were collected including teachers' lesson plans and curriculum documents for the science and mathematics departments to provide evidence and supportive data for describing teachers' workplace contexts and their engagement in their CoP. These documents provided an insight into teachers' technology integration practice in their CoP and also reflected a shared repertoire

or symbol of reification in CoP. The interpretation of these documents was checked with participants during the participant observation or semi-structured interview stage of the data collection.

Semi-Structured Interviews

Literature suggests that interviews are one of the most important sources of data in case study research (Burns 1997; Yin 2003). Indeed, Burns (1997) suggests that 'interviews are essential, as most case studies are about people and their activities' (p. 372). In a study that examines teachers' use of technology and the associated knowledge development, it is argued that these need to be reported and interpreted through the eyes of the interviewees who may be able to provide additional insights and identify other sources of evidence (Burns 2000, p. 372). Yin (2003) suggests that this is a particular strength of interviews and he describes this as insightful as 'it provides perceived causal influences' (p. 86).

Semi-structured interviews are ones where respondents are asked about the facts of a matter as well as their opinions about events. Yin (2003) also suggests that an interviewer may also 'ask the respondent to propose his or her own insights into certain occurrences and may use such propositions for the basis for further inquiry' (p. 90). Burns (1997) claims that the use of semi-structured interviews in this manner creates a scenario where the respondent 'is more of an informer rather than a respondent' (p. 372).

Semi-structured or guided interviews allow some flexibility in changing, deleting or adding questions depending on the nature of the interview (Lichtman 2006). For instance, Patton (2002) suggests that an interviewer should maintain rapport with interviewee and neutrality with the content. On the other hand, Lichtman (2006) provides useful hints on the nature of the interview questions while Yin (2003) offers advice on the case study interviews and how they help strengthen constructing validity through the chain of evidence. The semi-structured interview questions for this research were developed from the literature reviewed in Chaps. 1 and 2. Questions and prompts were developed to elicit responses from the participants around the themes of general knowledge development, mutual engagement, joint enterprise, identity and TPACK.

A number of caveats are offered to researchers who use semi-structured interviews in their research. Burns (2000) warns of the dangers of an investigator becoming too dependent on one respondent and suggests that the cautious researcher uses other sources of evidence for confirmatory and

contrary evidence. Yin (2003) suggests that different forms of bias can negatively affect the interview data as the questions or themes for the interview may be poorly chosen. Responses may also be biased due to poor recall or respondent reflexivity where the interviewee provides the responses he or she thinks the interviewer wants to hear. These caveats were also considered when designing the interview questions.

The major purpose of conducting interviews in this study was to capture different teachers' perspectives, experiences and real-life stories regarding their participation and engagement in their CoP within a school. The information gathered from the interviews may provide insights into ways a CoP influences the development of different forms of knowledge in different individuals.

Participant Observation

Participant observation is an observation method in which the researcher is not merely a passive observer but 'may assume a variety of roles within a case study situation and may actually participate in the events being studied' (Yin 2003, pp. 93–94). While this method of data collection has potential problems, particularly related to potential biases associated with the conflicting roles that the researcher must assume, Angrosino and Mays de Perez (2000) argue that 'even cultural anthropologists, who have usually thought of themselves as "participant observers" and who have deliberately set out to achieve some degree of subjective immersion in the cultures they study still claim to be able to maintain their scientific objectivity' (p. 674). The researcher's ability to maintain objectivity in this study was supported by more than 15 years of teaching experience in a variety of school settings and was tested through various checks for communicative validity and trustworthiness including triangulation and participant checks.

In contrast to the potential weaknesses associated with participant observation, Yin (2003) highlights three particular strengths of this method that have relevance to this investigation namely (i) the ability to gain access to events or groups that are otherwise inaccessible to scientific investigation, (ii) the ability to perceive reality from the viewpoint of someone 'inside' the case rather than external to it and (iii) the ability to manipulate minor events (e.g., convening a meeting of a group of people involved in the case study) which can produce a greater variety of situations for the purposes of collecting the data.

The major purpose of conducting participant observations in this study was to gather data related to the nature of teachers' participation and engagement in their CoP. This observation was important to capture the elements of teachers' CoP, which the teachers might not espouse in other phases of the data collection, such as during semi-structured interviews. The informal conversations that may occur on the periphery of activities central to the CoP, such as staff meetings, for example, provided particular insights into the relationships between members of the community through elements such as shared repertoire or a conversation affirming or negotiating a joint enterprise. Participant observation in more informal settings such as the teachers' staff room was also conducted to look at the nature of teachers' development of their own identity through engagement with peers and other school members.

It was originally anticipated that the participant observation phase would extend over four weeks to satisfy the test of internal validity satisfied by long-term observation. While the majority of observations were conducted in the first planned four-week phase, final observations were not completed for one participant (Anna) due to an extended, unplanned absence from work. While this extension to the observation period was unplanned, it did not significantly impact on the progress of this research nor did it impact on the original design which limited observations to approximately three days per week and for a period of a few hours per day in recognition of the imposition this type of data collection poses to the work of teachers and also in anticipation of the large volume of data that will be generated by the various forms of data collection.

Challenges in Case Study Research

The discussion to this point has aimed to demonstrate that a case study methodology is a valid form of inquiry to address the research focus of this study. The strength of case studies in studying highly subjective and ill-defined issues, such as the development of teachers' TPACK, has however, resulted in criticisms of generalizability, validity, reliability and researcher bias (Burns 1997; David and Sutton 2004; LeCompte and Goetz 1982; Yin 2009). While acknowledging these criticisms, the following discussion interrogates the notion of accurately representing data and analysis from a qualitative perspective.

Qualitative educational research poses particular challenges for researchers partly due to the 'diversity and fluidity of cultural practice' (Freebody

2003, p. 69) and partly because it is not always recognised as legitimate by policy makers, governments and the public (Lather 2004). In light of these challenges, Freebody (2003) argues that the onus is on qualitative researchers to be more objective, more empirical and more rigorous than other researchers.

While recognising that research should be rigorous, systematic and objective, qualitative researchers have challenged the notion of a singular, stable and objective reality posited by researchers utilising quantitative methodologies. For example, 'qualitative researchers argue that researcher reflexivity, the unpredictable nature of social and cultural practice and the situatedness of social phenomena are not adequately accounted for in quantitative measures of validity and reliability' (Bulfin 2009, p. 129). Qualitative researchers have sought alternate ways of evaluating the quality of research by rethinking the kind of knowledge claims that can be made about complex social and cultural phenomena and how notions of trust; believability (Lankshear and Knobel 2004); credibility, consensus and coherence (Lincoln and Guba 2000) may be used either as alternatives or as slightly different frames of reference to quantitative, positivist notions such as validity and reliability.

As a result, the study employs two main constructs of research credibility: communicative validity and trustworthiness (Freebody 2003; Lankshear and Knobel 2004; Silverman 2005).

Credibility as 'Communicative Validity'

Validity is a notion derived from positivist research associated with terms including 'internal validity', 'construct validity' and 'criterion-related validity'. In addition, texts often present definitions and discussions of validity alongside reliability, sometimes presenting reliability as an aspect of validity, or suggesting that they operate in tension (Coe 2012). Despite these differences validity is taken to mean whether an instrument measures what it is intended to measure. This definition, however, fails to enable readers to judge the quality of the research process including interpretations and claims made in the final study report (Carspecken 1996; Lather 1991). In contrast, Freebody (2003) provides a post-positivist view on this notion stating that 'validity is fundamentally about the adequacy of the representation of the social events and practices to which the research project refers' (p. 69). Others, including Lankshear and Knobel (2004), have described this form of validity as 'communicative validity' suggesting

that it is better aligned to qualitative research, such as case study, than positivist paradigms such as internal validity.

Effective communicative validity creates a dialogue between a researcher's claims and a reader's own experience or knowledge of similar settings or phenomena. To achieve this:

> researchers must ensure that readers can judge their arguments to be coherent, logical and substantiated. Communicative validity is achieved when readers think 'yes, of course' in response to interpretations and claims made about the data and in relation to the research question driving the study. (Lankshear and Knobel 2004)

Lankshear and Knobel (2004) offer three pragmatic strategies that contribute to the communicative validity of research reports. First Lankshear and Knobel (2004) suggest that researchers cross-examine multiple sources of data or evidence. In this investigation, each case draws on a variety of data sources including interview transcripts, observation notes and other artefacts including lesson planning templates, school policy documents and publically accessible espousals of the school's philosophy.

Second, participants in the study are asked to check and verify researcher constructions or representations of what happened. In doing so, the researcher is asking the participants to see if they have been characterised or described by the researcher in a reasonable way as well as verifying what they have said and meant is compatible with what they remember saying and meaning, and that this is represented appropriately, for example, in an interview transcript. In this research project, all interview transcripts were sent to participants to enable them to verify the way in which they had been represented was accurate and a large number of observed interactions were discussed with participants to ensure that they were described in an accurate and representative manner.

Third, Lankshear and Knobel (2004) suggest that 'asking other researchers to read and evaluate drafts of one's research … notably at conferences (Glesne and Peshkin 1992)' (p. 366) can highlight the researcher's previously unexamined beliefs and presuppositions. To contribute to this component of communicative validity, the theoretical framework underpinning this research was presented at a conference (ACEC 2012) as a peer-reviewed paper and in a journal article (*Learning, Media and Technology*).

In addition, to further strengthen communication validity, the following approaches were used in data analysis:

- I employed theory-driven analysis (Freebody 2003) in that I have attempted to show how my analysis is grounded in clearly articulated theoretical approaches (see Chaps. 1 and 2).
- I have used longer sections of transcript including researcher questions to allow readers to evaluate the interpretations of this data and to allow them to form their own opinions. This avoids 'anecdotalism' (Freebody 2003; Silverman 2005) where evidence is used to support the researcher's views with little engagement with alternate readings.
- Rather than ignore data that do not support my analysis, I have exploited these for their ability to offer new insights (Perakyla 1997). This meant looking across the dataset for 'deviant cases' (Silverman 2001) and employing constant comparison (Strauss and Corbin 1998) to systematically evaluate my informed hunches and hypotheses.

Verifying and validating the quality of a study is an important component of any research report, however it 'is not limited to meeting communicative validity criteria alone. It also requires the researcher to pay attention to trustworthiness' (Lankshear and Knobel 2004, p. 366).

Credibility as 'Trustworthiness'

Unlike the positivist concern with replicability, reliability in qualitative research centres on the openness and trustworthiness of the researcher's method or 'the degree to which a reader has faith in the study's worth' (Lankshear and Knobel 2004, p. 366). Credibility and quality in qualitative research therefore benefit from more transparency and clarity with respect to 'the nature of … publically knowable and inspectable procedures' (Freebody 2003, p. 68). When this is done effectively, readers understand how a researcher moves from research question to data analysis and knowledge and is underpinned by two key criteria: sufficiency and coherence claims (Lankshear and Knobel 2004).

Sufficiency refers to having enough evidence to support claims and interpretations made in relation to the data and research question (Freebody 2003; Lankshear and Knobel 2004; Mertens 1998). Having

adequate and sufficient data helps instil confidence in research claims and avoids analysis which is stretched too thinly (a point that is reached when information begins to be repeated to the point of redundancy) (Fetterman 1998). In addition to the observation notes and artefacts collected, the findings from this research are based on more than 100,000 words of transcribed data from 10 participants representing more than 14 hours of interviews representing a broad and sufficient base from which trustworthy knowledge claims can be made.

Trustworthiness is also enhanced by providing 'detailed accounts of research decisions and reasons behind these decisions' (Lankshear and Knobel 2004, p. 367). Freebody (2003) suggests that this is more challenging in qualitative research in comparison to studies underpinned by a quantitative methodology, in part resulting from the environment in which the research takes place. Qualitative investigations, such as this research, take place in the natural world complete with unclear and unstable boundaries that create a messy unpredictability which contrast markedly with the controlled, laboratory-style environments found in many quantitative investigations. This discussion reinforces the need for researchers undertaking case study research, as used in this investigation, to be transparent and candid in terms of the initial research design and changes that occur whilst undertaking their investigation.

Generalizability

Yin (2009) indicates that an objection to case study research centres around the inability of conclusions and findings drawn from one case study to be generalised to a broader population. It is important to note however that commentators levelling this criticism:

> are implicitly contrasting the situation to survey research, in which the sample is intended to generalise to a larger universe. The analogy to samples and universes is incorrect when dealing with case studies. Survey research relies on statistical generalization, whereas case studies (as with experiments) rely on analytic generalization. In analytical generalization, the investigator is striving to generalize a particular set of results to some broader theory. (Yin 2009, p. 43)

This shift from quantitative or positivist perspectives to an expansion of theories (Burns 2000) changes the nature of the question of generalizability

from one that asks 'is this data representative of the world?' to 'how does this case change our theoretical understanding of this phenomenon?' in which case the selection of 'abnormal' cases may prove more valuable than representative cases.

In case studies, such as those within this investigation, the task of making generalisations to different or wider populations or communities is left to the reader, who, through their own interpretation of the contextual information provided by the case, can decide on the relevance of the study to their own or other situations. It is essential, therefore, that any case study provide readers with sufficiently rich and detailed contextual information from which they can make such a decision.

Yin (2009) has also suggested that all case studies are best served by identifying clear theoretical propositions as they guide both the design of the data collection as well as providing a scope for generalization. This advice is particularly relevant for this study as it is simply not pragmatic to explore every connection and ramification within a social theory of learning. While it would be possible to consider a range of associated theories to develop a 'complete' understanding of social learning, the limitations of this investigation mean that certain dimensions are privileged over others. In line with Wenger's (1998) understanding of the dimensions the CoP framework can consider, readers of this investigation are encouraged to primarily generalise to theories of power and identity, secondly to theories of power and collectivity, thirdly and less specifically to theories of meaning and subjectivity and indicated by the darker rectangle. Finally, it would be unwise to broadly generalise findings from this study to theories of social structure and situated experience as the dimensions of CoP developed in the data collection and analysis of this research have not been designed to allow for such an interrogation. The narrowing of this study to theorise to specific notions improves the analytical generalizability of the study.

Data Analysis

This section reports on how meaning was made of the data generated through the methods previously outlined in this chapter. In doing so, it is worth discussing some of the problems faced by case study research in the process of data analysis. Some of these problems such as validity and reliability, including researcher bias have been explored earlier in this chapter. It is of particular interest here to explain why some data are used and why other data are not. It is also important to explain the analytical

structure used by this research in presenting the data and building a logical description of two complex phenomena: CoP in teachers' workplaces and TPACK.

Data analysis is considered by Yin (2003) to be one of the 'least developed and most difficult aspects of doing case studies' (p. 109). Yin (2003) argues that without clear guidelines on what data is to be collected, reported and analysed and for what purpose the case study can easily drift from the original topic. This is a common argument found in the case study literature, especially with regard to exploratory case studies such as the ones developed in this research (e.g., Burns 1997; Silverman 2005). As a solution it is advised by both Yin (2003) and Silverman (2005) that the researcher constantly refers to the research aim, questions and theoretical propositions which led to the research and which drove the data collection. This is not to suggest that deviant or contradictory evidence is not pursued, but that the researcher needs to justify how the data being pursued is relevant to the research purpose. This strengthens the case study by maximising the relevance of data being presented and analysed (Yin 2003). Consequently, the analysis of data in this research is firmly guided by Wenger's 1998 framework of CoP, and Mishra and Koehler's (2006) TPACK framework. It should be noted that this proposition is carefully worded and does not suggest causality but that there may be a relationship. It was felt important to consider that while CoP could enhance our understanding of the processes and work in the socially mediated contexts in which teachers work, the process of CoP are not clear, linear or formulaic and there are such a variety of other influences which make proposition testing to be impractical.

As a result, the case study chapters are limited to presenting data that illuminate the relationship between CoP dimensions and TPACK. In doing so, the data analysis uses a mixture of the TPACK dimensions (see Chap. 1) and CoP dimensions (see Chap. 2) to structure the case study discussion. This is similar to the linear–analytical structure as described by Yin (2003) who claims that it is suitable for exploratory studies. The key to this structure is that the problem and relevant literature set the scene for the case study findings which then are analysed and from which implications for further research are drawn.

Each chapter begins with a description of the participant's participation, competence, identity and TPACK triangulated from the perspective offered by a number of participants. This not only provides a landscape for the following discussions regarding the role of CoP in TPACK

development but is also intended to provide the reader with enough information to judge the communicative validity and trustworthiness of the research.

Limitations

As discussed earlier in this chapter, the generation of data in this study involved four initial or core participants and their key professional learning colleagues. In total, ten individual teachers participated in this study. While the amount of data produced through the study design outlined in this chapter was significant (e.g., the 14 hours of transcribed interviews alone produced more than 100,000 words of data for analysis), the findings from this study are limited in terms of their generalizability based on the relatively small number of participants.

A further limitation is the context in which these teachers worked. As discussed later in this chapter, the school in which all these teachers worked was atypical for two reasons. First, the school was the only specialist mathematics, science and technology select entry school in the state. This means that the context in which these teachers worked had a particular enterprise that is not representative of many other schools. Moreover, the students that attended the school were particularly academic, high achieving students who did not pose the same classroom management issues experienced by many other teachers in different contexts.

Finally, the classroom practices of the participants in this study were influenced by the presence of another teacher in every class that they taught as all classes (with the exception of languages other than english (LOTE)) were planned and taught by a pair of teachers in a team teaching setting.

These limitations require the reader to interpret the data through the lens of the context of this research and determine for themselves the generalizability of the findings and implications to the context in which they are familiar.

Exploring a School and Introducing Its Teachers

The following section provides a description of the school at the centre of this investigation. This description provides insights into the way knowledge and pressures from the global teaching CoP are interpreted by the school CoP at Drake Secondary College. In addition, the interpretation

and practices negotiated and enacted by members of two subject CoP, the Mathematics Teachers' CoP and the Science Teachers CoP, will be presented as it is in these two contexts that the cases involving the four central participants in this investigation are situated. These insights are provided to allow the reader to perceive reality from the viewpoint of someone 'inside' the case rather than external to it (Yin 2003).

The School

The participants in this study were recruited from a co-educational government secondary school in Melbourne's eastern metropolitan region. In contrast to most schools run by the Victorian Government, Drake Secondary College is a select entry school for students in Year 10–12 and promotes the pursuit of academic excellence in science, mathematics and associated technologies.

Opening in 2010 with an initial enrolment of 187 Year 10 students and18 staff, classes began in a purpose-built, multi-storey facility based on a *learning commons* design that aimed to facilitate the school's pedagogical underpinnings informed by UNESCO's four pillars of education: learning to know, learning to be, learning to do and learning to live together. Staff workspaces are interspersed among teaching spaces or *learning bridges* with no physical barriers such as walls differentiating staff and student work zones. While physically separated from the learning bridges for occupational health and safety reasons, the science laboratories also reflect the notion of a learning common with the work of both staff and students in these state–of-the-art facilities being highly visible through the floor to ceiling glass walls that make up one wall of each laboratory. The only exceptions to the open learning common spaces in the school are eight smaller tutorial rooms that provide enclosed settings for classes such as LOTE and for tests to be conducted under examination conditions.

In this physical setting, Drake Secondary College grew in 3 years to have 640 students in Years 10, 11 and 12 and staff numbers have also expanded to 42 full- and part-time staff in 2012. A strong house system is a vehicle for the school's pastoral co-ordination and gives students, teachers and support staff a point of contact with each other. The various house events, such as swimming, athletics and cross-country provide a healthy source of competition and enjoyment for students and staff alike with photographs, trophies and banners being proudly displayed around the school.

Academically, students undertake a three-year Victorian Certificate of Education (VCE) programme underpinned by the study of science and mathematics. While there is a focus on science and mathematics subjects a range of studies in other subjects from the humanities, physical education, arts and LOTE fields are also offered; however, a key objective for the school is to become nationally and internationally recognised as a centre of excellence in science education.

Irrespective of subject area or learning location, staff and students are encouraged to engage in academically rigorous teaching and learning supported by the school's contemporary digital technology resources. Incorporating the introduction of digital technologies made available through funding resulting from the Australian Federal Government's 2008 *digital education revolution* into the design of the school, rather than by retrofitting existing infrastructure and curricula as many schools have been required to do, staff and students at Drake Secondary College have a range of technology options available to them. In 2010 and 2011, all students attending Drake Secondary College were provided with a laptop to access digital information and resources as a result of the National Secondary Schools Computer Fund Round 6 which was administered by the Victorian State Government. This device was provided at no cost to parents with software that was pre-installed and pre-paid by the Victorian Education Department. Students commencing in Year 10 at the beginning of 2012 were introduced to the School's 'dual device program' that has resulted in all Year 10 students having a parent owning an iPad in addition to their own laptop provided by the school.

Regardless of what subject area they teach, all staff are provided with a laptop and, for the first time in 2012, an iPad. With high-speed wireless internet provision, access to specific digital resources through an emerging e-library, a vast array of additional digital infrastructure including electronic whiteboards and data projectors in all teaching spaces, plasma screens displaying daily information on each of the three levels throughout the school, electronic attendance systems and a blend of digital portals including *Compass, Google Apps, Real Smart*, and *iTunes U* coupled with ongoing technical support services provided by a team of three dedicated technicians, teaching staff are immersed in a technology-rich environment.

The daily practices of the 42 staff members within this whole school CoP have a common foundation in their pastoral and technological enterprise. While practices resulting from these foundations are still open to individual interpretation and negotiation, all staff are able to begin their

negotiation from a clearly articulated perspective publically espoused by the Drake Secondary College's leadership team on the school's website. These foundations are also reinforced during staff professional development sessions and general staff meetings. Teachers working at this school therefore have a foundation from which enterprise can be mutually negotiated utilising a repertoire that is similar to many other educational institutions yet has a distinct flavour stemming from the particular environment that has been described above.

Introducing and Locating the Participants

As discussed in Chap. 2, Wenger's (1998) CoP framework highlights that any one individual is, simultaneously, a member of multiple CoPs. As a result of this multimembership, CoP 'cannot be considered in isolation … their members and their artifacts are not theirs alone' (Wenger 1998, p. 103). The remainder of this chapter introduces the teachers who were involved in the data collection phase of this research. Their intricate relations, practices, identities and influences on TPACK development are difficult to unknot; they are not neatly bounded and traced.

Ten teachers from Drake Secondary College participated in the data collection phase of this research. Four of these teachers—John, Anna, Felicity and Nick—volunteered to become core participants in this investigation. Working with each of these participants at different times over the course of a school year generated particular understandings of each of these individuals through observation and interviews. In addition, after each participant's initial interview, they were asked to nominate as many people from within the school who they felt influenced their professional knowledge development (key professional learning colleagues) who were also interviewed. This resulted in an additional six participants in total providing their understandings and insights into their role influencing the knowledge development of one of the four core participants. Table 3.2 provides demographic details about each of the 10 participants.

As highlighted in the note associated with Table 3.2, the presentation of data in this format highlights an interesting challenge as John, Nick and Felicity independently volunteered to participate in this investigation as core participants; however, they were also nominated as a key professional learning colleague. As such this presents a live example of cases that are interrelated entities, only ever partially understood and always with reference to the range of intricate relations between the phenomenon and its

Table 3.2 Participant demographic data

Alias	*Gender*	*Years teaching*	*Curriculum focus*	*Positions of responsibility*	*Involvement in the case*
John	Male	7	Mathematics, physics	Deputy Head of Mathematics	Core participant/key professional learning colleague
Simon	Male	30	Mathematics	Principal	Key professional learning colleague
Joanne	Female	14	Mathematics	Head of Mathematics, PD co-ordinator	Key professional learning colleague
David	Male	10	French, 'Learn to'	Head of Languages, PD co-ordinator	Key professional learning colleague
Margaret	Female	23	Geography, Italian, English	Head of House	Key professional learning colleague
Anna	Female	12	Mathematics	Daily organiser	Core participant
Jake	Male	4	Mathematics, physics		Key professional learning colleague
Nick	Male	3	Biology	Deputy Head of Science	Core participant/key professional learning colleague
Felicity	Female	16	Chemistry	Head of House	Core participant/key professional learning colleague
Alicia	Female	24	Chemistry	Deputy Principal (Student Welfare)	Key professional learning colleague

biography and history (Mills 1959). In order to achieve a visual representation of the relationships between members of the various communities a mapping exercise was conducted based in the established sociometric tradition established by Moreno (1934).

Sociometry has been defined as 'the measurement of interpersonal relations in small groups' (Wasserman and Faust 1994, p. 11). Hrastinski (2009) indicates that this method of interpreting interpersonal relations is a precursor to social network analysis that provides a set of techniques for understanding patterns of relations between and among people, groups and organisations (Garton et al. 1999). Additionally, Hrastinski (2009) claims that the use of a sociogram, or visual representation of this data, is 'particularly useful for those who view learning and participation … as an inherently social phenomenon' (p. 96). As such, the use of a sociogram

in a study such as this examining the influence of social participation and negotiation on knowledge development is particularly appropriate. Figure 3.1 is a directed sociogram in which the relationships between participants are represented by directional arrows. The four core participants are represented by figures bounded by squares with their key professional learning colleagues represented by figures bounded by circles.

The four core participants in this study represent four different cases through which the role of CoP dimensions in TPACK development is examined at an individual level. While recognising the individual cases in this investigation, the CoP lens through which the TPACK development of these four teachers is examined requires this examination to also consider the broader social and situated elements that influence professional knowledge development.

When considering the CoP dimensions on the TPACK development in these four cases, one needs to clearly articulate within which community

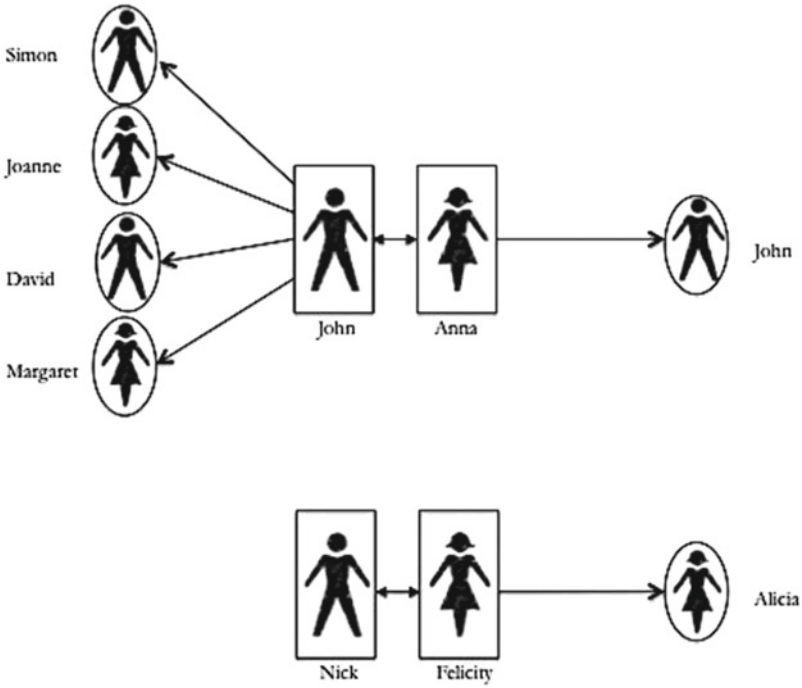

Fig. 3.1 Participant sociogram

these dimensions are being attributed. As was mentioned in Chap. 2, teachers are part of a global CoP through which they share understandings of general practices and notions of competence. One is able to imagine how dimensions of engagement and alignment might have common origins in broader, societal understandings of teachers' practice such as those contained in international documents such as the UNESCO's four pillars of education; however, members do not typically engage at the global level but rather at the local level (Wenger 1998).

The local level in this study is represented through analysis at the level of a whole school CoP. However, within the whole school CoP there are also smaller subcommunities. Printy (2008) highlights that:

> subject paradigms related to knowledge and instruction influence patterns of community of practice participation. In the case of distinctively institutionalized subjects such as mathematics, communities are likely to be strong at the department level. When teaching doctrines are less specific, as is likely the case with science teachers, the most salient communities exist at the subdepartmental level and include only a small group of close colleagues (Bidwell et al. 1997; Bidwell & Yasumoto 1999). In essence, teachers' communities emerge where teachers feel included in work they deem important to do. (p. 191)

It is within these smaller CoP, aligned to subject paradigms that the four cases that are presented in Chaps. 4, 5 and 6 are situated. A representation of the location of the four cases in this investigation and their relationship to subject, school and global CoP is presented in Fig. 3.2. While it is relatively simple to be able to identify the four cases at this early stage of description and analysis, it will become clear in Chaps. 4, 5 and 6 that these four cases are superimposed and knotted together (Geertz 1973) with social practices, routines, artefacts and identities.

As the social practices, routines, artefacts and identities within the local Mathematics Teachers' CoP and Science Teachers' CoP represent the contexts in which John, Anna, Nick and Felicity continue to develop their TPACK, understanding these workplace contexts is important.

While it would be possible to also examine the influence of out-of-school CoP that each of the participants belonged to, the scope of this investigation does not allow for such a complex study. As such, the focus for this study will be on the participants in-school CoP.

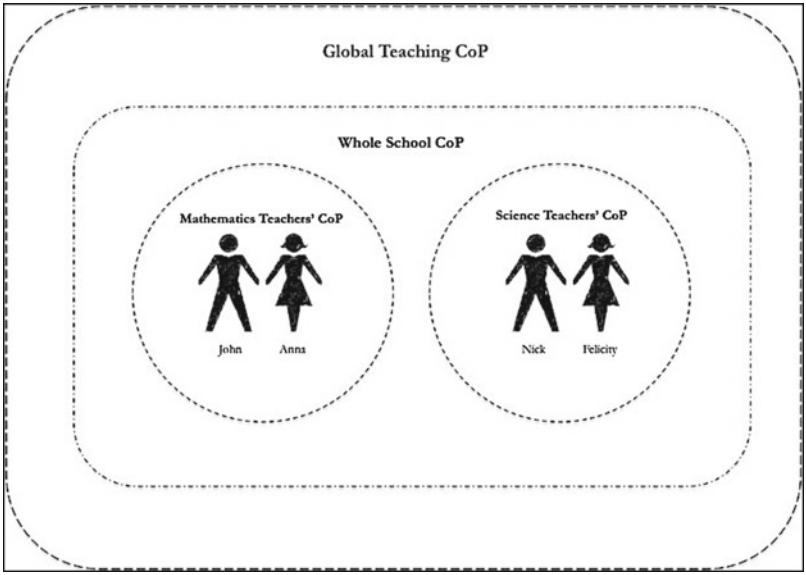

Fig. 3.2 Locating cases within a CoP

Introducing the Mathematics Department

The Mathematics Department at Drake Secondary College comprises nine teachers who deliver a diverse curriculum to students. The specific mathematics curriculum however begins in Year 10 (the intake year at Drake Secondary College) with a core mathematics unit. This unit is intended to prepare students to undertake any of the VCE mathematics units on offer.

In addition to the core mathematics unit, Year 10 students have the opportunity to participate in a mathematics elective subject *From Logic to Magic*. In this unit, students are introduced to mathematical topics outside the usual school curriculum such as infinity and its fundamental role in modern mathematics (calculus, infinity as a number, fractals), visualising higher dimensions, the golden ratio and the Fibonacci numbers in nature, three-dimensional manifolds as the possible shapes of the universe, the nature of numbers (primes, codes and cryptography), mathematical paradoxes and modelling the real world (weather, traffic, finance, DNA mapping).

As part of their studies in their final two years of secondary schooling, students at Drake Secondary College have the opportunity to study eight different mathematics units along with university enhancement mathematics. As well as demonstrating their knowledge and skills in examinations, students from Drake Secondary College also have the opportunity to compete in a variety of local, state and national mathematics competitions. These include Maths Games Days, the Australian Mathematics Trust (AMT) Challenge, the AMT Mathematics Competition, the ICAS Mathematics Competition, the Melbourne University Mathematics Competition and the Australian Mathematics Olympiad.

This broad mathematics curriculum presents the students at Drake Secondary College with academic opportunities that extend those offered by many other state secondary schools and allow them to develop a deeper understanding of mathematical concepts and their relationship with real-life problems. These opportunities also present content, pedagogical and social challenges and opportunities for the nine teachers in this unique mathematics department as a range of the subjects on offer are not offered in other secondary schools. Equally, the team teaching approach in the open physical environment found at Drake Secondary College is not common to many other secondary teaching environments. As such, individuals entering this department are challenged by beliefs and practices that are not routine in most schools and therefore provides a different workplace environment in which changes in knowledge and practice are often required.

Introducing the Science Department

The science department in Victoria's first specialist science school attracts teachers who are interested in delivering a science program of the highest order. At Drake Secondary College, science begins in Year 10 (the intake year at Drake Secondary College) with a core compulsory unit, fundamentals of science which explores the disciplines of biology, chemistry, physics and geoscience designed to expose students to key concepts within each discipline in order to develop the key skills necessary to study science. Additionally, students in Year 10 are also required to participate in a second core science unit titled methods of scientific enquiry. The focus of the unit is on legitimate research methods, designing and conducting experiments, forming hypotheses, understanding ethical research, data collection and understanding how scientists work. While all students in Year

10 are required to complete the two core science units, all students are also offered a vast array of elective science units including: bioinformatics, from cells to systems, marine biology, nanoscience and nanotechnology, our dynamic earth, pharmaceutical science and quarks to quasars.

It is from these core and elective units that students develop a rigorous academic approach to their science studies, which allows them to tackle the rigours of VCE science studies in biology, chemistry and physics.

Conclusion

This chapter focused attention on both the context in which 'presentation of a theory which acknowledges networks and groups which are informal and not the same as formal structures' (Barton and Tusting 2005, p. 3). Informal networks such as those typified in the CoP framework present complex, interwoven representations of groups influenced by socially negotiated, communal practices in contrast to the linear progressions and descriptions proffered by adoption and diffusion models highlighted in the previous chapter. This interlocking of various groups presents a challenge, not only in terms of presenting a clear narrative through which data can be interrogated but also in terms of a clear articulation delineating the interplay between and within notions of context and case.

This chapter has introduced the participants in this research and described their workplace setting. Moreover, this chapter has provided background information on the school CoP as well as the local discipline-based CoP that represent the context in which the participants work. The following three chapters present four cases and illustrate ways in which participation within a CoP can influence in-service teachers' TPACK enactment.

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CHAPTER 4

The Complexity of Community: The Influence of Old, New and Liminal Members in a Team

Introduction

This chapter is the first of three analysis chapters[ii] and presents Anna's case. While considering the influence of other members of the Mathematics Teachers' CoP on Anna's TPACK development and enactment, this case particularly focuses on Anna's team teaching relationship with Jake. First, changes in Anna's TPACK enactment will be explored through an examination of the context in which Anna participates in her CoP. This exploration of context uses the CoP notions of identity and practice to explain how context can influence TPACK enactment. Second, this chapter explores Anna's identity and TPACK from three different perspectives and, in doing so, reveals that TPACK development is an ongoing process rather than an aspirational end point. Finally, Anna's team teaching relationship with Jake brings into question the conventional CoP notions of newcomer and old-timer as Jake, a comparative newcomer, influences Anna's TPACK enactment as well as has his own TPACK enactment shaped by Anna, a relative old-timer.

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Anna's Identity: The Influence of Past Participation, Present Competencies and Future Aspirations

Anna's past participation in a variety of CoP has shaped her identity as an old-timer. She is an experienced teacher and administrator having taught for three years in Eastern Europe and for nine years in Australia, the last two at Drake Secondary College. In addition to her teaching roles, Anna has held daily organiser, timetabler and director of reporting positions in a variety of other schools. The critique of the CoP framework in Chap. 2 revealed Wenger's (1998) conceptualization of identity. Wenger (1998) contends that identity cannot be considered as static but instead a 'constant becoming' (p. 154). Developing his argument for this perspective, Wenger (1998) asserts that our identities are constantly changing, moving in trajectories that 'incorporate the past and future in the very process of negotiating the present' (p. 155). As such, Wenger (1998) argues that 'the work of identity is always going on' (p. 154) as we identify ourselves as much by where we have come from and where we believe we are going as by our current competence as members of a CoP. The following section will discuss Anna's identity and trajectory within her CoP at Drake Secondary College.

One of her current roles requires her to start her work early each day as her first task after arriving at Drake Secondary College is to put in place a number of arrangements for the day ahead. Known in schools as a Daily Organiser, Anna is the individual that other teachers contact if they are going to be away from school for any reason. Daily Organisers are often responding to last-minute telephone calls or emails from teachers who have become unwell, have to care for a sick family member or whose car has broken down on the freeway on the way to work. Finding last-minute replacements to 'cover' classes left by absent teachers not only requires the ability to work effectively with technology to disseminate required information in a timely manner but also involves careful balancing and monitoring to ensure that the extra workload covering classes is shared equitably by all teachers in the school.

Understanding the subtle implications of these types of decisions requires knowledge of the ways in which teachers work within schools, irrespective of subject community differences. For example, an effective Daily Organiser who may not be a member of the Science Teachers' CoP understands the problems associated with allocating extras (additional teaching to cover classes left by absent teachers) to teachers of senior sci-

ence classes in late May as they prepare students for important, externally assessed mid-year examinations. John, the deputy head of mathematics, confirmed Anna's strong administrative knowledge base and competence in her administrative role, stating that Anna was 'very, very organised and understands the different pressures we are all under' and that she 'knows how to get the job done'.

Notwithstanding Anna's competent participation in this aspect of her work, she indicated that the knowledge and practices associated with her administrative role were often 'too boring for me and time passes very slowly'. Despite demonstrating competence through practices developed through her previous experiences working in a number of administrative positions within schools, Anna was not seeking to strengthen this aspect of her identity by pursuing a trajectory that would see her completing more of the organisational tasks she finds onerous.

In contrast, Anna privileges her identity as a mathematics teacher in which she feels most useful over her administrative role in which 'time passes very slowly'. She stated on three occasions throughout the data collection phase of this research that she was not seeking to take on any additional administrative responsibilities and explained that she felt she 'is most useful when [she] is in the classroom'. Her affinity with classroom practices and knowledge was confirmed by Jake who felt that 'she just couldn't hack an office job because [she] needs that contact with students', 'she's got good all-round [classroom] knowledge' and 'I learn so much from working with her because she is such a great teacher'. Jake's opinion carries weight in this case as he is not only a member of the Mathematics Teachers' CoP but, more particularly, Anna's team teaching partner sharing the teaching of five classes with her. Anna also nominated Jake as a key professional learning colleague for this investigation. He is therefore in a unique position to observe and comment on her capacities as a classroom teacher.

While Anna participates as a member of the CoP at Drake Secondary College in a different role, her comments along with Jake's perspective reveal a preference for participation and identification as classroom teacher rather than as an administrator. It is in this role that Anna feels 'most useful' and this perspective is shared by others, for example, Jake's claim that 'she is such a great teacher'. Despite Anna's preference to participate as a classroom teacher, there is part of her identity through which she is perceived as a competent administrator as seen in John's belief that as a Daily Organiser Anna 'knows how to get the job done'.

These two different trajectories therefore contribute to Anna's identity at Drake Secondary College. From a CoP perspective, 'there is a profound connection between identity and practice' (Wenger 1998, p. 149), and this connection between identity and practice can help explain why individuals such as Anna 'often behave rather differently in each [context], construct different aspects of ourselves, and gain different perspectives' (Wenger 1998, p. 159). The differences in Anna's practices and identity when participating as an administrator or as a classroom teacher also draw on different forms of Anna's knowledge as 'every practice is in some sense a form of knowledge, and knowing is participating in that practice' (Wenger 1998, p. 141). Wenger (1998) therefore makes a connection between identity, practice and knowledge enactment (behaviour) that helps explain differences in behaviour exhibited in different contexts. The notion of context is also part of the TPACK framework reviewed in Chap. 1 and has been used by researchers such as Cox (2008) to explain why 'TPACK (and PCK) look slightly different … for each teacher in each situation' (p. 47). Unlike the theoretical connections made by Wenger (1998) that show a connection between identity, practice and knowledge enactment from a sociocultural perspective, context in TPACK research is more simply described as a location for the exhibition of knowledge. For example, Cox (2008), echoing Kelly's (2008) understanding of context, indicated that context in the TPACK framework can be thought of as

> the school environment, the physical features of the classroom, the availability of technology, the demographic characteristics of students and teachers including prior experience with technology, the particular topic being taught, the preferred instructional methods of the teacher, etc. (Kelly 2008, as cited in Cox 2008, p. 47)

Additionally, Mishra and Koehler (2006) discuss context as bounded by constraints such as 'subject matter, grade level, student background, and the kinds of computer and software programs' (p. 1032). Despite participating in these different contexts in different ways, it is debatable whether Anna's knowledge changes from one physical context to another. For example, it is unlikely that Anna's knowledge of technology, pedagogy or content change when she moves from her Year 10 core mathematics class to her Year 12 mathematics methods class in the next period.

In contrast to viewpoints that only consider context as the location for the exhibition of knowledge, examining context from a CoP perspec-

tive provides an additional perspective and language through which context can be understood as a sociocultural influence on teachers' TPACK enactment. For example, the remainder of this chapter examines the ways in which mutual engagement and joint enterprise influence Anna's team teaching relationship with Jake and her desire to enhance her TK. Moreover, trajectory and imagination will also be shown as drivers for Anna's TK development and enactment as she strives to maintain her competent identity as a classroom teacher.

Additional examples of a sociocultural understanding of context will be presented in Chap. 5. This chapter will examine the influences on John's TPACK enactment through his professional relationship with Simon. In particular, John's case challenges the notions of joint, shared and mutual as descriptors of practice in a CoP. Additionally, John's imagined future trajectory is shown to challenge the dynamic relationships among his TK, PK and CK and their enactment. Chapter 6 analyses both Felicity's and Nick's cases and shows how joint enterprises can limit an individual's perceived effectiveness in negotiating changes in practice while also revealing Nick's liminal identity in his CoP.

This section has presented the theoretical connection between identity, practice and knowledge enactment (behaviour) from a CoP's perspective through an examination of Anna's past participation, present competencies and future aspirations. The connection between identity and practice has added to previous TPACK descriptions that characterised context as the location for the exhibition of knowledge by providing an additional perspective and language through which context can be understood in terms of sociocultural influences. The particular CoP processes shaping Anna's TPACK enactment will be analysed in greater detail later in this chapter through examinations of Anna's current and anticipated future practices and identity. These examinations of practice and identity will provide answers to Elkjaer's (2003) call for examples of 'how' learning comes about through participation raised earlier in this book.

Exploring Anna's Current TPACK from Three Perspectives

In addition to Anna's perspective, use of the CoP framework as a lens through which in-service teachers' TPACK enactment can be explored necessitates identity to be considered as a socially mediated phenomenon.

As highlighted in Chap. 2, Wenger (1998) argues 'we define who we are by the ways we experience our selves through participation as well as by the ways we and others reify our selves' (p. 149). In Anna's case, her perceptions of her identity, practice and TPACK will be compared with perceptions of Anna's TPACK expressed by her two key professional learning colleagues, Jake and John. In addition to the insights into Anna's current TPACK and future ambitions, this section will also reveal how multiple perspectives of an individual's TPACK can lead to a more detailed understanding of their TPACK strengths and weaknesses that are enacted in different contexts.

Anna's Perspective

To elucidate Anna's beliefs about her own TPACK, I concluded my final interview with Anna by describing the TPACK model to her in some detail, explaining the different knowledge components and their overlaps as defined by Cox (2008) and detailed in Chap. 1, as well as showing her a printed copy of the TPACK diagram shown in Fig. 1.1.

Initially, the TPACK diagram was taken into the interview as a reference point for the researcher, however, as the interview with Anna developed the TPACK diagram was shown to her as she was becoming confused by the various combinations of knowledge that were being discussed. The TPACK diagram was used in the interview with Anna as a stimulus to elicit responses about the ways in which she combined different forms of knowledge and the ways in which she developed these forms of knowledge.

Visual materials have been 'usefully employed as representations of a research domain and [to] act as stimulus materials in interviews' (Crilly et al. 2006, p. 341) and have been effectively used by a range of researchers (e.g., see Bagnoli 2009; Rose 2012; Varga-Atkins and O'Brien 2009). Despite the reported effectiveness of this approach, it should be noted that certain limitations exist with this process.

For this research, there are limitations of the strength of conclusions that can be drawn from such a process that presents knowledge in binary forms on a diagram. The 'fuzzy boundaries' (Angeli and Valanides 2009; Archambault and Crippen 2009; Cox and Graham 2009; Jimoyiannis 2010) that characterise the TPACK framework and that were reported in Chap. 1 mean that any conclusions that rely on identification of exact locations on the TPACK diagram may be problematic as they may not take into account the dynamic relationship among TK, PK and CK.

With this understanding of the TPACK framework, I asked Anna to identify where she felt her knowledge would be best located. After looking at the TPACK framework depicted on an A4 page in front of her for approximately 30 seconds, Anna replied 'I'm not in the middle because I am still missing some of the technological knowledge. So that will be my aim to be here' pointing to the TPACK nexus.

While acknowledging the importance of Anna's future aspirations, I also asked her to indicate where she thought her current knowledge would best be represented on the TPACK diagram in front of her. Anna replied,

> I think I am actually using technology for pedagogical knowledge, but I need more [pausing and pointing to TPK] … I don't have problem with this one [marking PCK on the TPACK diagram]. But I think that for now, I'm lacking the technological knowledge in this area [pointing to TPK], because I would like to start developing some more things in this [marking TPK] area.

Anna concluded her reply marking a point at the upper end of the PCK section of the TPACK diagram as shown in Fig. 4.1, indicating her belief about the best location for her current TPACK.

Anna's comments are valuable for this investigation for two reasons. First, understanding Anna's desire to be identified and participate as a classroom teacher rather than as an administrator Anna's established earlier in the chapter and her espoused desire to achieve TPACK, 'that is my aim to be here [TPACK]' reinforces the inherent tenet underpinning the TPACK framework that dynamic transactional relationships among technological, pedagogical and content knowledge are required for effective teaching with technology.

Second, Anna's espoused desire to have a TPACK coupled with her preference to participate and be identified as a classroom teacher provides an example of Wenger's (1998) theoretical connection between knowledge, practice and identity. However, Anna's comments also reveal a different way of conceptualising TPACK: as future, desired knowledge that might support an imagined trajectory and identity.

Anna's identification of her lower TK that she was 'still missing some of the technological knowledge' and her desire to 'start developing some more things in this [marking the TPK] area' illustrates that Anna was not only considering TPACK as knowledge that she had already formed and complete but also considering TPACK as knowledge in development.

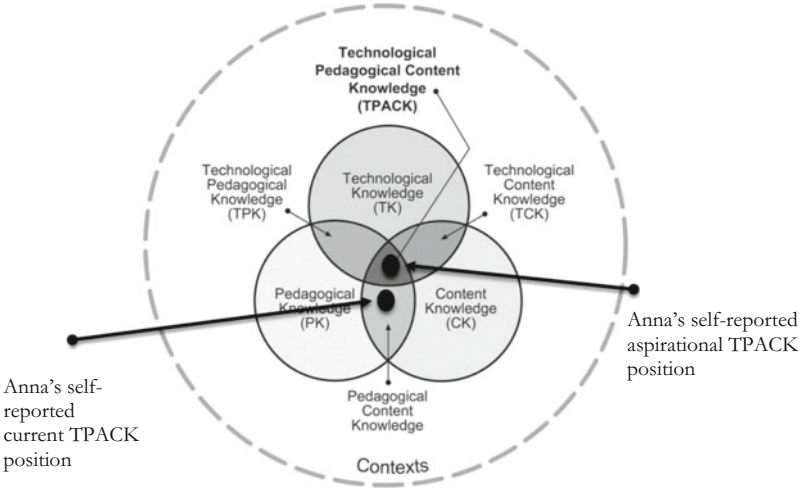

Fig. 4.1 Anna's reported current and aspirational TPACK positions (Each of the participants in this case were provided with an individual A4 copy of the TPACK diagram. Each of the participants marked a place on the TPACK diagram to represent where they believed Anna's TPACK was positioned.) The TPACK framework reproduced with permission of the publisher, © 2012 by tpack.org.

Moreover, Anna's reply when asked to indicate where Anna thought her current knowledge would best be represented on the TPACK diagram still included references to desired, future competencies, for example, 'I *would like to start developing* [emphasis added]'.

As discussed in Chap. 2, Wenger (1998) regards trajectory as an important part of identity development that is not 'a fixed course or a fixed destination … [nor] a path that can be foreseen or charted but a continuous motion' (p. 154). Anna's case provides an example of this continuous motion. Anna's previous participation established her competent identity as both an administrator and a classroom teacher. Her current participation and identification as an administrator sits in contrast to her preferred form of participation and identification as a classroom teacher. Furthermore, it is Anna's anticipated identity development as a competent classroom teacher that appears to influence Anna's anticipated TPK development.

Discussing Anna's TPACK not only showed her beliefs about her current TPACK but also revealed her imagined future trajectory and her

desire to participate and be identified as a classroom teacher. Anna's comments indicate that to pursue this trajectory, she feels as though she needs to develop her TK to achieve TPACK. Anna's espoused desire to enhance her TK provides a lived example of the way the CoP framework, in particular an imagined future trajectory, may influence an in-service teacher's TPACK enactment and therefore provide an example of how learning comes about through participation.

Jake's Perspective

As highlighted previously, use of the CoP framework as a lens through which in-service teachers' TPACK enactment can be explored necessitates identity to be considered as a socially mediated phenomenon. As highlighted in Chap. 2, Wenger (1998) argues, 'we define who we are by the ways we experience our selves through participation as well as by the ways we and others reify our selves' (p. 149). In Anna's case, we are able to compare her perceptions of her participation, identity and TPACK with those expressed by her two key professional learning colleagues, Jake and John, thereby gaining a range of perspectives about Anna's TPACK.

In a similar manner to the way the TPACK framework was explained and shown to Anna, both Jake and John were asked to discuss Anna's TPACK. In contrast to Anna's self-reported TPACK position in which she identifies her TK as being comparatively weak in comparison with her PCK, both Anna's key professional learning colleagues held a different perspective.

When looking at the TPACK diagram on the A4 piece of paper in front of him, Jake, Anna's team teaching partner for five classes, stated that 'all-rounder is a really good description for her. She's got good pedagogical knowledge, really good knowledge of content and resources, really good ICT use. So she's just that real all-rounder'. When asked to indicate where he would position Anna on the TPACK diagram, Jake commented, 'I think in the middle. Her technological skill set is different from mine, but it's still very strong. I feel she fits genuinely in the middle of this', marking the TPACK nexus shown in Fig. 4.2.

Jake's indication that Anna has 'really good ICT use' suggests that he believes Anna's TK is higher than she believes while his claim that Anna's 'technological skill set is different from mine' provides a distinction between Jake's perception of his own TK and Anna's TK. Jake's belief that Anna is a 'real all-rounder' and has 'really good ICT use' sits in contrast

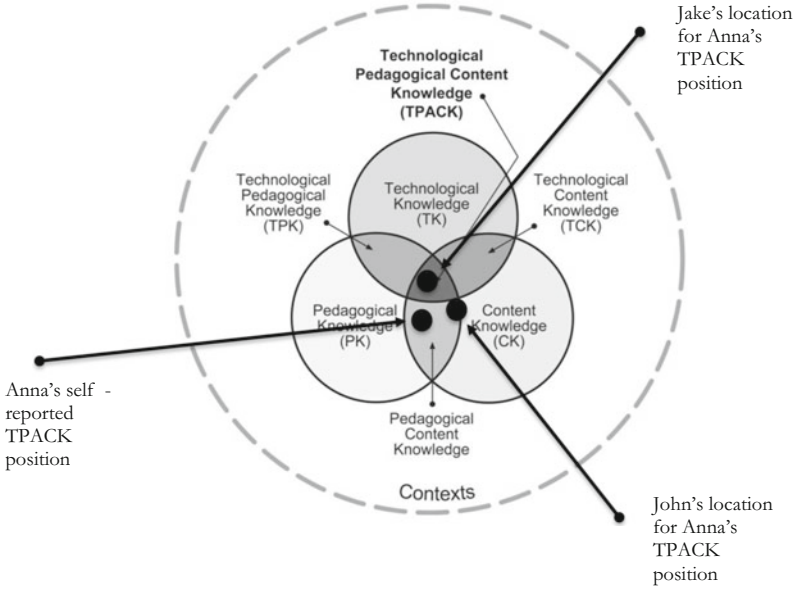

Fig. 4.2 Anna's reported TPACK position. The TPACK framework reproduced with permission of the publisher, © 2012 by tpack.org.

to Anna's belief that her TK, in particular her TPK, is weaker than other parts of her TPACK. In contrast to a singular conceptualisation of TPACK as an epistemology of possession (Cook and Brown 1999), knowledge developed 'inside individual human heads' (Simon 1991, p. 125), as an individually acquired, aspirational point (Phillips 2013) or as a static form of knowledge that, once obtained is not lost (cf Cook and Brown 1999), the contrast between Anna's and Jake's perception of Anna's TPACK indicates that maintaining TPACK requires ongoing work and development, particularly in Anna's case of TK.

While Jake located Anna's classroom practices in the TPACK nexus, suggesting she had strong PK, he also recognised that her 'technological skill set is different from mine'. When asked to provide examples of these differences, Jake highlighted Anna's extensive 'collection of PowerPoints [from which she] is always able to find one which really summarises key information'. In contrast, Jake indicated, 'I like dynamic sort of geometry software where kids can move things and you can see the effect and hope

that the students get more meaning from that than from a static image'. When asked where he developed his pedagogical preference for dynamic software, Jake indicated that his father was 'one of the first computer science teachers in the state so I have always seen and been interested in the ways in which teachers use different forms of new technology in their lessons', in particular 'the way my father was always looking for ways for his students to make sense of [content] for themselves by using technology'. Jake's digital technology preferences therefore differ from Anna's as he prefers students to be in control of dynamic software from which they can construct meaning at their own pace, in contrast to Anna's teacher focussed use of PowerPoint.

Anna confirmed Jake's belief about her use of PowerPoint presentations explaining 'there is not enough space to fit everything that you want to be on one board so they [students] can actually make a [conceptual] connection. With a PowerPoint presentation I can go backwards so they can see the connection'. Anna further explained that the ability to be able to go backwards and forwards and show the development of equations and graphs was important and reinforced her earlier comment that this was 'not possible in my past schools because I couldn't find a board big enough to fit it all on'. While Anna indicated that she had the technological hardware that enabled her to overcome the physical limitation imposed by smaller chalk- or whiteboards, she also indicated that when using PowerPoint it was important to use technology in class as 'nowadays students are born with technology, they need something more visual. I really enjoy using technology because it is faster for me to bring the ideas to the students', 'I can create more accurate graphs for students to look at' and 'I want to do more [technologically based] things like Jake and John to improve the way we visualise [content] problems for students'.

Anna and Jake's differing use of PowerPoint provides one example of the different ways in which they used digital technologies as part of their classroom practice while teaching the same content to the same students at the same time. Despite their mutual engagement in planning and delivering their shared classes, the differences evident in the way Anna and Jake enacted their TPACK, in particular their TPK, draw into question the effectiveness of previous descriptions of context as part of the TPACK framework (e.g., see S. Cox 2008; Kelly 2008; Koehler and Mishra 2008) that only consider context as the location for the exhibition of knowledge or the physical factors that constrain or enable teachers' practices. In contrast, the differences in Anna and Jake's current and future TPACK

enactment may be better explained by also incorporating considerations of identity and practice that consider ways in which their past participation (e.g., making connections between TK and PK through Jake's familial participation) helps shape current practices and future identities. Understanding context as both a location for the exhibition of knowledge and a series of socially mediated processes that shape enactment addresses Hager's (2005) criticism of workplace learning theories that rely on single-factor or universally applicable explanations detailed in Chap. 2.

John's Perspective

John, Anna's other key professional learning colleague and the deputy head of mathematics, commented on different strengths in Anna's professional knowledge, claiming 'her content knowledge is very, very good. And her technological knowledge is quite good now too'. However, when asked to indicate on the TPACK diagram where he believed Anna would be best represented, he said, 'she is pushing towards the centre. It's difficult with pedagogical knowledge, because I haven't taught with her in a classroom … but yeah towards the middle' while marking the bottom right-hand corner of the TPACK nexus as shown in Fig. 4.2.

While a member of the Mathematics Teachers' CoP, John's professional relationship with Anna is different to her team teaching relationship with Jake. In contrast to Jake's perspective developed through a mutual engagement in classroom practice as a member of a teaching team, John relies upon the understanding of Anna's TPACK developed through emails, conversation, lesson plans and observation in professional development sessions 'to [know] what kinds of activities she comes up with'. The ways in which John understands Anna's TPACK and the ways she enacts TPACK are somewhat removed from observations of classroom practice 'because I haven't taught with her in a classroom'. John's understanding is developed through different forms of interaction compared to the way Anna interacts with Jake. John's abstraction from the classroom environment appears to limit his ability to make specific or accurate judgements about certain forms of knowledge, in this case Anna's PK. John's difficulty judging Anna's PK because he 'hasn't taught with her in a classroom' suggests that John feels as though he can't accurately comment on Anna's PK without observing her enactment of her knowledge (her practice). This may mean that TPACK studies that rely on abstracted understandings of knowledge (e.g., see Barab and Duffy 2000; Barton and Tusting 2005;

Drath and Palus 1994; Fuller et al. 2005; Gray 2004; Handley et al. 2006; Hildreth et al. 1998), such as John's understanding of Anna's PK, without seeing the enactment of that knowledge, may be less informed than those understandings developed through observation of the enactment of that knowledge such as Jake's understanding revealed earlier in this chapter.

While providing an additional perspective of Anna's TPACK, John's comments also reinforce the importance of changes over time when considering in-service teachers' TPACK. John's comments that Anna's TK is 'quite good now *too* [emphasis added]' and 'she is *pushing* towards the centre [emphasis added]' indicate that from John's perspective, Anna's TK has developed from where it was at a previous point in time and that she is now closer to achieving TPACK than she may have been in the past. John's comments confirm that TPACK connects past participation with current competence and when considered in Anna's case with her desire to improve TK, also connecting TPACK development to future aspirations.

Figure 4.2 highlights a weakness with this representation of the TPACK framework; namely that the TPACK nexus is small compared to the six areas representing the other individual and overlapping forms of knowledge, thereby making TPACK differentiation difficult. This difficulty is compounded when considering the way in which the overlapping circles representing technological, pedagogical and content knowledge are overlapped. In this case, this is evident in the location Anna chose as representative of her current TPACK. As illustrated in Fig. 4.2, Anna's self-reported TPACK position was in the overlap between pedagogical and content knowledge. While this position provides a general sense of Anna's belief about her relative TPACK strengths and weaknesses, this representation of her TPACK also indicates that she has no TK. While data presented in this chapter indicates that Anna believes her TK is weaker than her PCK, it is very clear that Anna does have *some* TK. The challenge therefore is to develop a representation of TPACK in which the individual forms of knowledge are overlapped in a different way that allows for a more nuanced representation of an individual's knowledge.

While the representation of TPACK used in this research presents some challenges, it is helpful to illustrate the relative position of Anna's TPACK indicated by each of the participants in this case. Figure 4.2 shows some differences in individual beliefs about Anna's TPACK; however, the positions marked by Anna, Jake and John are not disparate, suggesting that the TPACK model is useful as a method for broad identification. As such, general conclusions can be drawn from the identification of the location of

Anna's TPACK by each of the participants in this case and the descriptions that accompanied them. In particular, one is able to surmise that:

1. Anna believes:
   (a) her PCK is stronger than her TK;
   (b) however, her TCK is stronger than her TPK;
   (c) that she aspires more TK to reach the TPACK nexus.

2. Jake believes:
   (a) Anna's TK, CK and PK are thoughtfully interwoven in her classroom practices;
   (b) while Anna has strong TK, it is different to his own;
   (c) her knowledge is best located in the centre of the TPACK nexus.

3. John believes:
   (a) that Anna's TK and CK are high;
   (b) with some reservation, Anna has relatively strong PK;
   (c) she is 'pushing' towards and therefore may not have quite reached the aspirational TPACK nexus.

This summary serves to provide two reminders: First, TPACK may be judged from a communal perspective as well as from an individual's perspective. Anna's mutual engagement with John and Jake provides her key professional learning colleagues with an understanding of Anna's practices and identity. Second, this understanding of Anna's practices and identity draws on her past participation and future aspirations, suggesting that TPACK is both knowledge used to support current practices and knowledge in the making. Anna's case shows how TPACK development is an ongoing process rather than an acquired end point.

Anna's imagined future trajectory in which she reinforces her identity as a competent classroom teacher by developing and enacting a stronger TK echoes Hager's (2005) theoretical proposition of a (re)construction metaphor discussed in Chap. 2. Anna's desired (re)construction of her TPACK, practices and identity helps to explain her mutual engagement and provides an additional example of how TPACK enactment is influenced in a CoP.

Team Teaching and TPACK: Disrupting the Newcomer/Old-Timer Paradigm

The previous section provided three accounts of Anna's TPACK and highlighted Jake's particular understanding of Anna's PK resulting from his close professional relationship developed as Anna's team teaching partner. The remainder of this chapter builds on the details of Jake and Anna's team teaching relationship and will show how Jake and Anna's relationship within a CoP disrupts the anticipated newcomer/old-timer identities described in the CoP framework. Furthermore, this section will show how the introduction of digital technologies into Jake and Anna's team teaching relationship was a critical factor in disrupting the expected apprentice/master identities and practices instead of promoting a relationship of reciprocity in which knowledge was shared and practices consensually negotiated. This section concludes that those looking through a CoP lens need to be cautious when simplifying the roles of members into categories of old and new.

Anna and Jake: A Teaching Team with a Reciprocal Near-Peer Relationship

As discussed in Chap. 3 and earlier in this chapter, all classes in the school (with the exception of LOTE classes) are planned and taught by a team of two teachers. In contrast to an individual teacher working in a classroom, regularly teaching in a team replaces the 'pedagogical solitude' (Shulman 1993, p. 6) often experienced by secondary school teachers with a sense of teaching as 'community property' (Shulman 1993, p. 6). This change to a team teaching approach in this school represents a 'new event' placing 'new demands' (Wenger 1998, p. 154) on teachers in this CoP, including Simon, the principal of Drake Secondary College.

Despite working for 30 years in a variety of secondary schools, Simon indicated that the introduction of team teaching as a whole-school approach was a new event for him, claiming 'this is the first time in my life I've done something like this. This is very different for me'. One of the differences that a number of participants in this research mentioned in their interviews was the change in lesson planning. For example, Nick stated, 'planning in teams is very time consuming, more so than teaching by yourself'. Jake also mentioned the frequency of his communications with Anna regarding the planning of their shared classes:

> we do team teach together a lot so have a lot of conversations when we're planning what we're going to do with our classes, about where we would like to get to and how we are going to teach. You want to know who is doing what and it is important to take the time to get it right.

When asked to expand on what he felt was important to 'get right', Jake stated,

> I suppose it's a combination of things that we share when we are planning. I don't want to say resources because resources can just be shared. It's more like activities in the class or ways to structure our classes. I think we both have a very strong content knowledge so we often talk about the content for our classes but one of the main things is we talk about is the delivery of the content. We discuss our pedagogy and specifically how to work that.

Jake's discussion about his planning with Anna reveals a joint enterprise expressed through notions of shared practice, 'our classes' and shared activities, resources and structures. Both Anna and Jake's contributions to this joint enterprise also reflect Rogers' (2000) description of mutual engagement reported in Chap. 2 in which members of a CoP engage in a commonly negotiated activity. Rogers (2000) also indicates that through mutual negotiation, relationships form between members of a community. Anna also commented on the importance of regularly meeting with Jake to plan their shared lessons, indicating that she would meet with Jake 'each day for 10–15 minutes to plan what we are doing next and how we can approach that. We always try to have that conversation about what we will do next and how we will organise our next lesson'. Anna not only confirms the frequency of her meetings with Jake but also reveals a sense of mutuality as she mentions 'what *we* are doing next', 'how *we* can approach that' and 'how *we* will organise *our* [emphasis added] next lesson'. This sense of mutuality was also evident in the language Jake used to describe his planning with Anna, for example, 'ways to structure *our* classes', 'we often talk about the content for *our* [emphasis added] classes'. When describing their regular meetings, Anna and Jake are revealing their engagement in a socially negotiated activity (Rogers 2000) in which members form mutual relations of engagement (Wenger 1998); in short mutual engagement. The mutuality of Anna and Jake's professional relationship not only shapes their TPACK, for example, 'we discuss our pedagogy and specifically how to work that' but also contributes to negotiations of the enactment of their TPACK or 'how we are going to teach'.

Jake's and Anna's comments were confirmed in several researchers' observations of their planning meetings typified by observations of mutual engagement such as 'both [Anna and Jake] contributed to wide-ranging discussions about technological, pedagogical and content aspects of their upcoming classes' (Researcher Observations, 12/3/2012). Anna and Jake's comments and actions appear to reflect a common belief that they are sharing a class and confirm some of the positive findings from other research investigating teams of teachers such as Sandholz (2000) who found that careful selection of teaching teams can foster greater mutuality through collaborative professional classroom practices and collective resources. However, Jake's comments reveal more than just the sharing of resources. Importantly for this research, Jake's comments clearly indicate that he and Anna are sharing a range of practices and past experiences. For example, Jake's acknowledgement that he and Anna talk about different activities and structures for their classes presumably requires them to share past experiences of activities or structures that have worked in past teaching experiences or to share an imagined possibility. In sharing an aspect of their past or imagined future, Jake and Anna are revealing aspects of one another's past and future trajectories and, in doing so, create a present in which they share a repertoire or points of reference that provide a common discourse upon which Anna and Jake can negotiate their responses to knowledge and practices within the Mathematics Teachers' CoP. Jake and Anna's team teaching relationship provides examples of the ways in which identity, in particular the sharing of trajectories, can shape TPACK enactment.

This pairing of teachers therefore changes the context in which Anna and Jake enact their TPACK, particularly how they mutually engage with one another and align their practices to a joint enterprise through the development of a shared repertoire. As previously discussed, changes in the context in which teachers enact their practice can be understood as sociocultural influences that include not only aspects of practice such as mutual engagement, joint enterprise and shared repertoire but also considerations of identity such as trajectory.

Researchers examining trajectory and identity through a CoP lens frequently explore trajectory as the transition from legitimately peripheral participant to centripetal participant or from newcomer to old-timer (e.g., see Barab and Duffy 2000; Barton and Tusting 2005; Drath and Palus 1994; Fuller et al. 2005; Gray 2004; Handley et al. 2006; Hildreth et al. 1998). In this case study examining Anna's partnership with Jake, one

could argue that Anna's extensive experience working in schools would categorise her as an old-timer, particularly in comparison with Jake's relative inexperience which could classify him as a newcomer (see Table 3.2 for detailed participant demographic data). Jake commented on the combination of old-timers and newcomers when considering the formation of teaching teams in the school:

> they [members of the school leadership] try to match up teachers and look for a range of experience … probably one consideration is to always to try to get a new staff member with an older one because then they [the older staff member] are more aware of what is going on so they can support them [the younger staff member] in that way.

When asked to consider the ways in which teams of teachers were created, Anna provided a contrasting explanation, claiming 'that the ratio of young teachers and teachers like me in this school is balanced. So I think there is a big chance that you will always have that combination of a young teacher and a bit more experienced teacher'. Anna's comment reflects a belief that the selection of teaching teams is less strategic than Jake assumes there is a 'chance', albeit a big chance, that a newcomer will be partnered with an old-timer; however, both Anna and Jake indicate that the pairing of teachers at Drake Secondary College often involves a younger, less experienced teacher being partnered with an older, more experienced teacher, and such pairings have positive benefits for the team.

The newcomer/old-timer continuum is also reflected in literature examining team teaching relationships. For example, Roth et al. (2004) and Jang (2006) presented research findings based on longitudinal data that show the careful selection of team teaching members can provide particularly rich learning experiences and professional growth for novice teachers. Implicit in each of these examinations of social relationships is the notion that master old-timers have expertise and experience through which they induct an apprentice newcomer.

However, a close reading of Lave and Wenger's (1991) work presents an alternative to the 'teacher/learner dyad' (p. 56), typically represented as newcomer/old-timer relationships. Lave and Wenger's (1991) alternative 'points to a richly diverse field of essential actors and, with it, other forms of relationships of participation' (p. 56), including 'young masters with apprentices or journeyfolk' (p. 57) who are '*relative* old-timers with respect to newcomers' (p. 57) and can therefore be thought of as 'near-

peers' (p. 57). Lave and Wenger's (1991) identification of near-peers provides an alternative to the binary newcomer/old-timer categorisation that dominates CoP research (e.g., see Barab and Duffy 2000; Barton and Tusting 2005; Fuller et al. 2005; Gray 2004; Handley et al. 2006; Hildreth et al. 1998) and appears to be particularly apt for Anna in her relationship with Jake as her experience and mastery is greater than Jake's but not as extensive as other old-timers such as Simon (see Table 3.2 for demographic details of all participants).

While providing an intermediate point on the continuum linking newcomers to old-timers, Lave and Wenger (1991) and Wenger (1998) do not provide any additional insights into the role of near-peers in the five cases that support their theorisation of apprentices' transition from legitimate peripheral to centripetal participant. Moreover, Lave and Wenger (1991) and Wenger (1998) do not discuss the differences in near-peer relationships compared to newcomer/old-timer relationships.

Anna's team teaching relationship with Jake challenged the newcomer/old-timer binary often reported in CoP literature through the reciprocity evident in their planning meetings and in their observed interactions. In contrast to the apprentice/master relationship evident in many studies using CoP as a focus, Anna's case provides an opportunity to examine the role of near-peers as members of a CoP. In particular, the final section of this chapter will examine the reciprocal nature of Anna and Jake's relationship to show the ways in which TPACK, practice and identities can be negotiated in a CoP.

Negotiating Relationships with Near-Peers

Anna's professional relationships with Jake and John challenge the common representation of membership of a CoP as a 'teacher/learner dyad' (Lave and Wenger 1991, p. 56). In contrast to the unidirectional flow of information from an old-timer to a newcomer, the previous section has argued that Anna's professional relationships with her two key professional learning colleagues, particularly with her team teaching partner Jake, may be better thought of as near-peer relationships characterised by relationships of reciprocity. Data presented earlier in this chapter revealed Anna's desire to improve her TK, in particular her TPK. This section will examine how Anna's near-peer relationships with Jake and John shaped her TPK while also illustrating the ways in which Anna's TPACK enact-

ment shapes Jake's teaching practices as 'I learn so much from working with her because she is such a great teacher'.

Three perceptions of Anna's TPACK were explored earlier in this chapter in which Anna revealed a desire to improve her TPK, and it was this desire that was a motivating factor guiding who she liked to work with. Despite Anna's competent identity as an established and effective classroom teacher revealed earlier in this chapter, Anna chose to work with less experienced and younger teachers in an attempt to improve her TPK. When Anna was asked to explain why she nominated Jake and John as key professional learning colleagues, she replied 'I really like to work with Jake and John because they are very good at using technology in class. I think they are the best people that can actually influence and improve my knowledge and use of technology'. Jake confirmed Anna's assessment: 'we're absolute nerds. We're thoroughly known as techno-nerds and we have very similar technological skill sets'. Similarly, Joanne, the head of mathematics, recognised similar competencies in Jake and John, claiming 'Jake is as good as John in terms of innovative uses of technology I would say', while John indicated that there was 'a lot of overlap in our [Jake and John's] interest areas when it comes to technology'. Jake and John's use of digital technologies is recognised by multiple members of their CoP and contributes to their identities as 'techno-nerds'.

Anna's willingness to work with Jake and John to improve her TPK provides an example of workplace learning that contradicts the 'teacher/learner dyad' (Lave and Wenger 1991, p. 56), which is a typical focal point of situated learning theories such as CoP. When further discussing her preparedness to work with Jake and John, Anna provided several examples of the ways in which her key professional learning colleagues contributed to her professional development. Initially, Anna stated that she liked to work with Jake and John because she 'enjoy[ed] listening to their ideas about the way we can teach with technology … moving from an old fashioned [approach] to improve with lessons with newer technology is fantastic'. Anna's initial statement reveals not only that Anna was developing her TK through her interactions with Jake and John but that her TK development was shaped by listening to their ideas.

In addition to developing her TK by listening to Jake and John's ideas about teaching with technology, Anna provided an additional example of how John shaped her enactment of her TK. In contrast to simply listening to ideas about ways in which TK could be enacted, Anna recounted a time when she

> wanted something similar to what John was doing [with his spreadsheets]. So I went to ask him. He showed me how to create it and after that it's not a problem so now I can do it next time. But it was much easier to ask him than research how to do it on the [Inter]net. Sometimes it's not explained well if you Google [for a solution] and you can't ask questions if you get stuck.

Anna's TK in this example was mediated through her CoP relationship with John. Anna indicates that her professional relationship with John helped her to enact her TK more easily than if she had attempted to find a solution to her technological problem herself. In describing how John showed her how to create the solution she wanted, Anna illustrates an example of the way in which a younger, less experienced teacher helped her shape her TK enactment. Furthermore, these statements indicate Anna's preference for knowledge development and enactment in a socially mediated, participatory setting in which she can negotiate joint enterprise in contrast to her perception of learning from an Internet search that is more closely aligned to an acquisitional model of knowledge development.

Anna further explained that she would usually ask Jake or John rather than one of the other members of the school CoP, such as Hamish, the e-learning coordinator. Despite being a colleague with high TK, Anna would prefer to ask Jake or John because 'Jake and John know what I actually want because they are in exactly the same subject. So instead of starting from "why I need this" with Hamish, it is much easier because they [Jake and John] already know what I need' and 'it doesn't need any extra explanation'. While Hamish is recognised as an individual with high TK, he is perceived as someone who could not help Anna with her particular, nuanced use of technologies in a mathematics classroom nor her development of a competent identity within the Mathematics Teachers' CoP. Anna's preference working with John and Jake provides an example of the importance of a shared repertoire when developing TPK and TCK, and illustrates that a shared approach to the development of practice, identity and knowledge is not easily understood by those outside a CoP.

Anna's descriptions of her interactions with Jake and John have provided examples of the ways in which joint enterprise and shared repertoire can influence Anna's TPACK and her enactment of this knowledge. However, Anna's comments also reveal her willingness to work with Jake and John to develop her TK, despite the fact that they are less experienced, younger members of the CoP. Despite their comparative inexperience, Jake and John's identities as 'techno-nerds' appeared to provide

Anna with opportunities to mutually engage with TK experts to enhance her own TK. Anna's engagement with Jake and John sits in contrast to the expected unidirectional flow of knowledge and skills from masters to apprentices described in the CoP framework.

While Anna's TK is developed and shaped through her socially mediated interactions with Jake and John, her relationship with Jake, evidenced earlier in this chapter, is reciprocal and is characterised by the sharing of resources, activities and practices. Moreover, Jake's statement that 'I learn so much from working with her because she is such a great teacher' indicates that Anna's 'good pedagogical knowledge [and] really good knowledge of content' may be aspects of practice that he is developing as part of their team teaching relationship.

This section has explored Anna's reciprocal near-peer relationships with Jake and John and has challenged the expected newcomer/old-timer relationship, which is reported in many studies using CoP as a theoretical lens. In contrast, it has demonstrated Anna's willingness to mutually engage with two members who are younger and less experienced teachers as their identities as TK experts provide her with the opportunity to develop her own TK. As revealed earlier in this chapter, Anna's desire to strengthen her TK is part of her anticipated trajectory and (re)construction of her identity as a centripetally participating classroom teacher. Anna's case therefore provides an example of the way mutual engagement in a reciprocal near-peer relationship can align with identity development and TPACK development in a CoP.

Conclusion

This chapter presented Anna's case through a focus on Anna's team teaching relationship with Jake. Discussion and analysis of this case has resulted in three main conclusions:

1. **Processes of identity and practice constitute aspects of context in which an individual enacts his or her TPACK.**

Analysis of Anna's case highlighted the importance of the theoretical connection between identity, practice and knowledge enactment (behaviour) from a CoP perspective. In Anna's case, the connection between identity, practice and TPACK enactment was revealed through her imagined future trajectory as a classroom teacher and her consequent TK devel-

opment through her near-peer relationships with Jake. In particular, the connection between identity and practice exemplified in Anna's case adds to previous TPACK descriptions that characterised context as the location for the exhibition of knowledge by broadening out our understanding of context and through a set of socially mediated practices.

This finding has theoretical implications for the TPACK framework as it changes the way the interplay between technological, pedagogical and content knowledge unfolds: first, context can be thought of as a series of processes grouped around practice and identity, and these help to explain how TPACK development and enactment occurs in a workplace. Second, changes in TPACK can be considered as changes that occur in context; that is, TPACK may not change within an individual but the context in which it is situated may shape the way it is enacted among individuals. Third, Anna's case reveals that TPACK can be thought of as an aspect of trajectory that connects an individual's past participation in a CoP with his or her current competence and anticipated future competence.

The primacy of context, as seen in these three findings, broadens what comprises context to include practice and identity. It also unsettles assumptions of previous TPACK investigations that have attempted to measure current TPACK levels and retrospective changes in TPACK without considering the socially mediated context in which TPACK is enacted.

2. **Mutual engagement reveals TPACK as knowledge in the making.**

Anna's case presents three different perspectives of her TPACK. Comparing Anna's perception of her own TPACK with the perceptions of Jake and John provided an understanding of Anna's TPACK from a communal perspective as well as from an individual's perspective. These different perspectives were valuable for three reasons: first, the value of mutual engagement in identifying TPACK was revealed as it was Anna's mutual engagement with John and Jake, which provided her key professional learning colleagues with an understanding of Anna's practices and identity.

Second, Anna's practices and identity drew on her past participation and future aspirations, suggesting that TPACK is therefore not only knowledge currently possessed and used to support current practices but also prospective knowledge in the making. Anna's case shows how the constitution of TPACK and its development is an ongoing process rather than as an acquired static end point.

Third, Anna's imagined future trajectory in which she reinforces her identity as a competent classroom teacher by developing and enacting stronger technological knowledge echoes Hager's (2005) theoretical proposition of a (re)construction metaphor, which presents an additional perspective to the often-used acquisition and participation metaphors in workplace and discussed in Chap. 2. Anna's desired (re)construction of her TPACK, practices and identity helps to explain aspects of her participation in a CoP through mutual engagement; for example, the reason for which Anna chose to mutually engage with John and Jake in a CoP despite their relative inexperience as secondary school teachers was to enhance her technological knowledge in pursuit of her desired future trajectory as a centripetally participating classroom teacher.

3. **Membership categories of newcomers and old-timers in a CoP require extension.**

Anna's case also challenged the old-timer/newcomer paradigm that dominates CoP research and indicates the importance of a near-peer in shaping TPACK development and enactment. Anna's reciprocal relationship with Jake in which both individuals helped each other to better enact their TPACK challenges the unidirectional flow of knowledge and skills from old-timers to newcomers described by the CoP framework. The implication is that researchers using the CoP framework might consider not only members of a CoP in terms of the newcomer/old-timer dichotomy but also midway points on the newcomer/old-timer continuum. In contrast to considering members of a CoP as fully formed old-timers or still to be formed newcomers, the additional consideration of members at a midway point encourages considerations of knowledge in the making. This theme will be further developed in Chap. 6.

Additionally, this finding has implications for those developing staff teams and professional development or mentoring programmes in schools. In contrast to pairing a master (old-timer) with an apprentice (newcomer), school leaders seeking to develop effective teams of teachers should also consider the potentially valuable role of near-peers and the mix of TPACK expertise that sit within these positions in forming such teams.

In sum, this chapter has established the ways in which a professional's identity within a CoP shapes the enactment of his or her TPACK. It has been identified that the connection between identity and practice broadens out our understanding of context beyond the established considerations of context as the location of TPACK enactment. This draws attention to

the socially mediated processes that shape practice and identity development, and demonstrates TPACK as both current knowledge and prospective knowledge in the making. This fluid conceptualisation of TPACK in Anna's case helped to reveal the importance of near-peers in shaping prospective knowledge enactment in the pursuit of a desired future trajectory.

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CHAPTER 5

Leading Teachers' Technology Use: The Influence of Perceived Power and Authority on Digital Practices

This chapter analyses John's case in which John's TPACK enactment is examined through his participation as a member of the Mathematics Teachers' CoP. This exploration builds on Anna's case which revealed that the processes which shape identity development in a CoP also shape TPACK enactment. In particular, discussion and analysis in this chapter reveals John's identity as a TK expert in the Mathematics Teachers' CoP and the broader Drake Secondary College CoP. Establishing John's identity as a TK expert also reveals perceptions of John's PCK, particularly his PK, as areas of comparative weakness. Despite this TPACK imbalance, John is identified as a competent and accepted member of his CoP and his imagined future trajectory in which he is identified as a leader is revealed.

The second part of this chapter explores the influence of Simon's mentorship as school principal and team teaching partner on John's TPACK development and enactment. Despite John being recognised as a TK expert, John's deference to Simon's PCK expertise results in John's technological competencies being less visible in the reification of their shared practices and their lesson plans. This chapter highlights the potential of such reified objects in influencing the negotiation of enterprise and TPACK development within a CoP.

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John's Identity as a TK Expert in a CoP

Beginning work as a teacher at Drake Secondary College in its first year of operation, John taught a variety of subjects from both the science and mathematics curricula including quarks to quasars, maths methods and logic to magic with his teaching load becoming increasingly dominated by mathematics classes in more recent years. Despite predominantly working with teachers from the mathematics department, John's reputation as a well-liked and respected member of staff at Drake Secondary College was recognised by many members of the broader school CoP including John's professional learning colleagues. David, for example, commented that 'John's a terribly nice man', while Margaret claimed John 'is incredibly gifted and very, very talented' and Simon who confirmed that 'he's a genuinely nice guy … such a nice bloke'.

These perceptions of John's identity in the school CoP suggest that John is an accepted and valued member of the community. However, these are not the only aspects of John's identity that were recognised by his key professional learning colleagues. John's use of digital technology at Drake Secondary College is also widely acknowledged as being a particularly noteworthy aspect of John's identity. For example, the Chap. 4 presented Anna's understanding of John's innovative use of digital technologies and, with Jake, was one of 'the best people that can actually influence and improve my knowledge and use of technology'. John's work helping improve the knowledge and use of technology with other members of the school community was also an aspect of John's practice and identity that was widely recognised. Providing one example of the numerous ways in which John's TK contributes to the practices of others and mediates John's participation, David stated that other teachers in the school go to John for assistance with technology in general and spreadsheets in particular as John 'has such a high level of technical knowledge, in making [Microsoft's] Excel [software] do this, that and the other'.

Joanne, the head of mathematics also highlighted John's expert use of Excel:

> We all know he's very good at Excel because he's been doing our weekly spreadsheets in the Maths department for collating of data [related to student performance], it's our thing. He's always shown to be the one to create these spreadsheets and he creates the most amazing spreadsheets that will do everything but make my cup of tea in the morning.

While Joanne's statement confirms John's particular expertise with Excel, it also reveals John's centripetal participation in the Mathematics Teachers' CoP at Drake Secondary College. Enacting his TK in this way, John not only reinforces his identity as a member of the CoP but contributes to the joint enterprise of the community as the collation of student data is perceived as 'our thing'. John's enactment of his TK not only enables him to contribute to the joint enterprise of the Mathematics Teachers' CoP but also contributes to John's centripetal identity where he is seen 'as a leader and every way I deal with him is in that manner'.

John is seen by a number of teachers as a centripetal participant and many also drew on John's work with Excel to illustrate their case. For example, Anna described John's work putting together impressive spreadsheets:

> When I came here John already had some amazing ways of using Excel that he showed us. I really loved the way he organised his spreadsheet, the way John was able to mark each test in the Excel spreadsheet so that it tells you the question that they didn't answer, the student's percentage and everything.

Anna went on to describe how John's development of his spreadsheets influenced others to use them in different ways within the CoP:

> I started doing the same thing that John was doing, but my spreadsheets were not as sophisticated as his. I don't know how to do some of the things he makes his spreadsheets do, he is the technology expert. So we [members of the Mathematics Faculty] decided that he should develop a template for all teachers to use. Now we are all using his template to find where the students are at in terms of their knowledge, what we need to work on to help them improve. We are even using the spreadsheet for next year's planning. John is the one who's always sharing what he's developed in his spreadsheets with the whole faculty.

John's enactment of his strong TK is reflected in the spreadsheets that he has developed and shared with other members of the CoP. In addition to reinforcing the perception of John as a member of the CoP who has high levels of TK, Anna's comments also provide evidence of how John's TPACK enactment in the Mathematics Teachers' CoP influenced the practices of other members of the community, for example, 'we are all using his template'. Second, Anna's remarks reinforce the perception that

John's practices and identity within the Mathematics Teachers' CoP are closely aligned with his TK: 'John is the one who's always sharing what he's developed in his spreadsheets with the whole faculty', 'he is the technology expert'.

John's use of Excel not only contributes to his practices and identity in the Mathematics Teachers' CoP but his high levels of TK contribute to his identity in the broader school CoP, as illustrated through David's comments presented earlier in this chapter. This perception was reinforced when Jake discussed the way John's enactment of his TK was not only shaping his practices and identity within the Mathematics Teachers' CoP but his use of Excel also contributed to his identity in other faculties within the broader school CoP:

> A lot of the materials that the Maths Faculty has created and developed such as how we manage solutions, our timelines for writing work are filtering out to other faculties. John has written an excellent spreadsheet for recording [School Assessed Courseware] SAC marks and you see that being used in a lot more faculties.

John's recognition as a TK expert was also revealed in Margaret's interview. As a humanities teacher, Margaret had also been very aware of John's identity as a technology expert. During her interview Margaret not only commented on John's strong TK, but also on another way in which John's enactment of this knowledge reinforces his identity in the school CoP:

> Have you seen John's spreadsheets in Excel? They're just amazing. I don't know where he has managed to learn so much on spreadsheets. He really is incredibly gifted and very, very talented in putting together those spreadsheets. I have no idea where to start. Mine are extremely simplistic. I learn by making mistakes, but he teaches me when it comes to computer technology. In fact he teaches quite a few of us how to put things together.

John's participation as a member of the CoP is not only reinforced through his creation of Excel spreadsheets that help his colleagues' practices and shape the enterprise of the Mathematics Teachers' CoP but also shape the participation and enterprise of the broader school CoP, according to Jake. While Margaret's comments describe how John himself reinforces his identity as a TK expert by teaching other members of the CoP about how they can use digital technology. John was observed on six

occasions throughout the data collection phase of this research helping other teachers who approached John seeking help with Excel spreadsheets confirming Margaret and Jake's perceptions.

In addition to John's use of Excel in the Mathematics Teachers' CoP, his reputation as an individual with high TK or a 'techno nerd' extends to the use of other digital technologies that play a role in the joint enterprise of the Mathematics Teachers' CoP. As Joanne indicated, John has

> shown himself to be au fait with all the technology we use in maths and he has a strong interest in using it and playing with it. The use of technology is important and anything related to that or to do with that, John is the go-to man and everybody knows it.

John's high levels of TK are therefore not associated solely with Excel but also include the use of additional forms of technology such as computer algebra system (CAS) calculators used particularly by members of the Mathematics Teachers' CoP. David, Margaret and Joanne's comments all reveal a similar understanding of John's generally strong TK and his use of Excel in particular. This common understanding of John's knowledge and practices enables John to 'express [his] form of membership and [his] identity as a member' (Wenger 1998, p. 83) as a technology expert in the CoP.

Concluding my final discussion with each of the participants in this case (see Table 3.2 for demographic data on the participants), I described the TPACK model individually to each of them in the same way it was described to Anna and her professional colleagues outlined in Chap. 4. In their individual interviews, John and his four key professional learning colleagues were asked to mark a position on a TPACK diagram that illustrated where they felt John's current knowledge would be best represented.

Carefully considering each of the different forms of knowledge represented in the diagram before him, John deliberated for some time before indicating:

> that's a tough one, because my technological knowledge, I think is very strong, so in terms of that, I'm looking at what the links would be between these two [PK and CK]. My pedagogical knowledge is probably the bit that I would say is weak, as my content knowledge is pretty strong, so it's probably going to be an overlap between the three, but pushed more towards these [TK and CK].

John marked the diagram on the TPACK boundary midway between the TK and CK circles as shown in Fig. 5.1, indicating that he believed that his TCK was a strong aspect of his professional knowledge.

Locating his TPACK on the diagram in front of him, John indicated that his PK was 'probably the bit that I would say is weak'; however, in Chap. 4 Anna's comments indicated that John's PK, particularly his TPK was an aspect of TPACK that distinguished John's knowledge from Jake's. It was John's knowledge of how to work with students to come up with a technological solution to a problem that was an aspect of John's practice that Anna was drawn to. Attempting to understand the magnitude of these differences is complicated by the representation of TPACK presented in Fig. 5.1. As discussed in Chap. 4, the positions marked by participants in Anna's case provided a general sense of their belief about Anna's relative TPACK strengths and weaknesses. This general sense of comparative TPACK strengths and weaknesses is also evident in John's case, however a similar challenge is evident in both cases as scales of strength and weakness cannot be easily represented on the TPACK diagram. In John's case, he is not able to illustrate how his PK is somewhat weaker than other aspects of his TPACK while still showing that he has some PK. The challenge presented in Chap. 4 is reinforced in this case and demonstrates a need

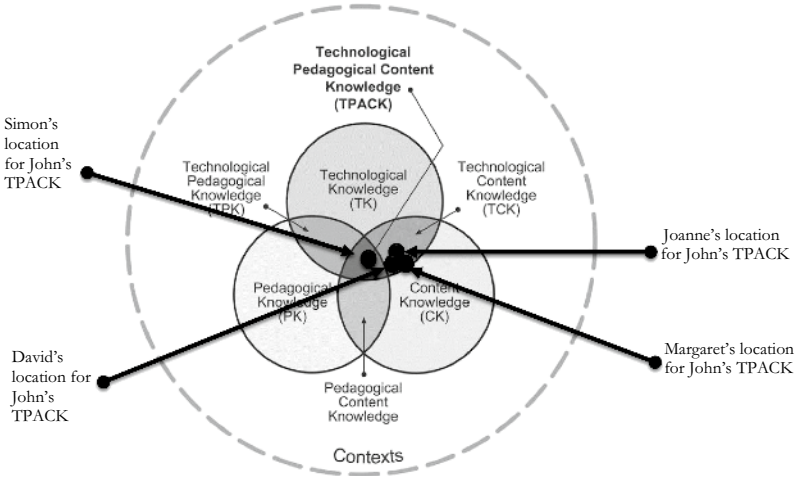

Fig. 5.1 John's reported TPACK position. The TPACK framework from reproduced by permission of the publisher, © 2012 by tpack.org.

to develop a representation of TPACK in which the individual forms of knowledge are overlapped in a different way that allows for a more nuanced representation of an individual's knowledge.

Despite the challenges representing nuanced understanding of an individual's relative strength and weakness, the TPACK diagram does allow for a general sense of comparative strength and weakness. Considering the similar positions chosen by Joanne, David and Margaret when locating John's TPACK shown in Fig. 5.1, it is clear that all three indicate a belief that John's PK is weaker than his TK and CK. Margaret provided an explanation for marking her choice on the TPACK diagram:

> My understanding of his pedagogical knowledge is more anecdotal rather than being in there [the classroom] and seeing it. I'll see him come back to his desk saying 'maybe I should have done it this way' but I don't know for sure what he tries.

While Joanne, Margaret and David all felt as though John had sound PK, they were unable to provide specific examples to support their tacit belief as none of them had spent a significant period of time watching John teach. This echoed John's comments presented in Chap. 4 where he claimed Anna's PK was difficult to identify 'because I haven't taught with her in a classroom'. Joanne, Margaret and David's inability to support their beliefs with specific examples of John's PK highlights a potential weakness when using the TPACK framework with a teacher's colleagues; namely, that the data gathered may be somewhat biased towards TK or CK as these forms of knowledge can easily be expressed and negotiated in staff meetings or other interactions that occur outside the classroom. Data from John's case indicates that it is harder for a teacher's colleagues to form an opinion about a colleague's PK as the classroom context in which PK is often evident is not one that is regularly shared with colleagues.

In contrast to Joanne, Margaret and David's challenges identifying John's PK, Simon marked a position reflecting a belief that John had a strong PK. Simon's position for John's TPACK was located within the TPACK nexus, albeit slightly favouring the TCK rather than the TPK side of the nexus. Simon explained his choice of the TPACK nexus claiming John's:

> a young guy who's 'a gun', he's going to be a great teacher, the kids love him, genuinely interested in kids and doing the right thing by them, he's got a lot of knowledge and he's developing in all these areas really, really well.

Simon's different view of John's TPACK may not only be, because he not only shares an understanding of John's TK and CK, demonstrated in settings outside the classroom, but of John's four key professional learning colleagues, Simon also has a particular understanding of John's PK as he shares the classroom context in which John enacts this form of knowledge. As such, Simon's professional relationship as John's team teaching partner within the Mathematics Teachers' CoP provides Simon with access to a classroom context in which he can judge John's TPACK through enactment; a setting in which Simon is able to see John's TPACK in action.

In addition to providing a different perspective informed through a close team teaching relationship with John, Simon's comments also reveal a connection between TPACK and identity, particularly trajectory, reflecting the connection between TPACK and identity that emerged in Anna's case. Despite locating John's TPACK in the nexus on the TPACK diagram in front of him, Simon also mentioned that John's '*going to be* [emphasis added] a great teacher'. Simon appears to suggest that, while a teacher may have TPACK, that is, balance of TK, PK and CK, it is possible for each of these forms of knowledge to be strengthened. This is reinforced in Simon's suggestion that John has 'got a lot of knowledge and he's developing in all these areas really, really well'. Simon's indication that John has 'got a lot of knowledge' provides a summative indication of Simon's belief about the forms of John's current knowledge; however, Simon's addition that John is 'developing in all these areas really, really well' illustrates a future potential for greater TK, PK and CK development as part of John's imagined future trajectory.

Simon's indication of John's potential TPACK development reiterates the connection between TPACK and trajectory presented in Chap. 4. While Chap. 4 presented the theoretical connection between identity, practice and knowledge enactment (behaviour) and demonstrated this, in part, through Anna's own imagined future trajectory involving her desire to strengthen her TK, Simon's indication that John has the potential for stronger TK, PK and CK signals that the connection between an imagined future identity and TPACK development can be understood from the perspective of the individual themselves or from other members of the CoP. As identity development and TPACK are connected through an imagined future trajectory, TPACK can therefore be understood as knowledge that exists inside 'individual human heads' (Simon 1991, p. 125) or as an epistemology of possession (Cook and Brown 1999), but rather as an epistemology of practice (Cook and Brown 1999) in which TPACK

as knowing in a situated context in which the group and the tacit can be considered alongside the individual and the explicit.

Despite the differences in Anna, David, Joanne, Margaret and John's own understanding of his TPACK, it is clear that they all agree that John's TK is a particularly strong aspect of his TPACK and his identity within the Mathematics Teachers' CoP. As illustrated earlier in this chapter, John's strong TK is widely recognised and contributes to his 'belonging to a community but with a unique identity' (Wenger 1998, p. 146) as a TK expert within the Mathematics Teachers' CoP at Drake Secondary College. However, the challenges in developing and maintaining a unique identity within the Mathematics Teachers' CoP were apparent when Joanne was asked to locate where she believed John's TPACK would be best represented on a TPACK diagram. While considering the location she felt best represented John's TPACK, Joanne articulated the pressure she felt John was under given his strong TK:

> I think the pressure is that then he needs to stay ahead of the game because he's the go-to man. I think he gets distracted by that. His energy goes into making the technology work and he may forget to focus on other things. I think that he needs to learn how to balance his work.

Joanne's comments reveal her understanding of the efforts and energy that John invests as the 'go-to man'. Joanne believes that John's efforts in 'making the technology work' for other teachers can result in a lack of focus on other aspects of John's work. Joanne's comments reinforce the aspirational aims of teachers' development of TK, CK and PK that characterises TPACK research literature (Cox 2008; Cox and Graham 2009; Mishra and Koehler 2006) which was also evident in Anna's case in Chap. 4.

Despite recognising that his PK was weaker than his TK and his CK, John expressed little desire in interviews or throughout any observations to develop this aspect of his knowledge or practice in an attempt to enhance his identity as a competent teacher. Data provided in this section appears to suggest that John's identity as a TK expert within his CoP not only contributed to the establishment of his unique identity as a classroom teacher but also mediates John's relationships with his colleagues within the Mathematics Teachers' CoP and across the school CoP. Unlike Anna's desire to develop her TK to (re)construct her identity as a competent classroom teacher, John's TK bias appears to contribute

to his unique, competent identity in and his centripetal participation as a teacher. The pursuit of a unique identity, in John's case as a TK expert in the Mathematics Teachers' CoP, can upset an individual's TPACK balance.

Despite John's centripetal participation in the Mathematics Teachers' CoP mediated through his identification as a TK expert, John revealed a desired future trajectory as a school principal. The following section will explore the ways in which John modelled his knowledge and practices on other leaders, particularly Simon the principal of Drake Secondary College, in pursuit of his leadership aspirations. Moreover, the following analysis and discussion will show how participation in pursuit of a future trajectory caused John to (re)construct his identity by developing his PK in an attempt to align his practices and identity with those leaders John used as mentors.

John's Desired Future Trajectory: Learning for Leadership

In contrast to Anna's future aspirations which would see her identified as a competent classroom teacher with TK, PK and CK in dynamic equilibrium, John confirmed his desire to pursue a trajectory that involved a move into a leadership path, initially aiming to become a leading teacher:

> I'm very driven towards my leadership goal. Next, I want to become a Leading Teacher, so I'm constantly looking at other leaders to see what is required of me, and I want to keep improving in that way. Other teachers might be happy where they are, in which case, they might not want to look around, they might just be happy doing their thing. They might identify one knowledge area as being their thing, the thing that they're really valuing, and not look towards the other [areas] which is what I am doing.

Leading teachers are those teachers with high levels of ability who have been formally appointed to leadership roles and are charged with the responsibility to 'improve the skill, knowledge and performance of the teaching workforce in a school or group of schools and to improve the curriculum program of a school' (Department of Education and Early Childhood Development 2013, p. 5). This work requires leading teachers to not only continue to exhibit exemplary practice in their own teaching but to assist others to develop knowledge and skills to also improve the

quality of their classroom practice and is the way in which John would like to be identified in the future.

John's comment about his desired future trajectory showed John's belief that the best way for him to achieve his goal of promotion to leading teacher is to 'constantly [look] at other leaders to see what is required of me'. In contrast to colleagues who are 'happy where they are … happy doing their thing', John indicated that he was extending himself by developing greater knowledge in a variety of areas rather than identifying 'one knowledge area as being their thing, the thing that they're really valuing'. While not specifically mentioning TPACK, John's comments do distinguish between those individuals who may only look to one aspect of knowledge and those who look to 'other areas'.

John's comments suggest a tension in regard to his current participation and identity in his school-based CoP and the way in which John imagines his future participation and identity. Data analysed earlier in this chapter indicated John's own identification as a TK expert. This identity was confirmed by all four of John's key professional learning colleagues whose comments suggested that this perception was shared by numerous other members of the Drake Secondary College CoP. Despite John's identity as the 'go-to man' with strong TK, John claimed that he did not see a relationship between TK and leadership stating, 'actually, they're probably somewhat separate. For me, the technology aspect is not necessarily for leadership'. John's imagined future trajectory as a leading teacher and 'one day try[ing] to take on a [Principal] role like Simon's' can be understood as an influence on John's observations of other leading teachers to develop knowledge in "other areas" despite "really valuing" TK as a significant contributing factor to John's unique identity in his CoP.

While John stated that he looked to a number of leading teachers to understand what was required of him, John regularly commented on Simon's influence, for example stating 'I try and emulate the leaders that I look up to myself. So like with Simon, I try and pick up on how he's done stuff and do the same myself'. In addition to Simon's role as principal of Drake Secondary College, he is also John's team teaching partner. John's close working relationship with Simon provides John with a unique opportunity to see a leader at work in classroom settings as well as in other settings such as staff meetings and professional development sessions. As such, John regularly looks to Simon as a professional mentor who can help guide John's knowledge and practices on his imagined future trajectory on the way to becoming a school leader:

> Simon's leadership is something which I guess I follow very closely. I watch what he does because I think his whole style is quite inspiring in a way and I guess try and emulate that. So with Simon, as a Principal, as a leader of a large cohort, it's really interesting to watch how he addresses different issues with staff, students and parents because he's always got in the back of his head, it seems, that whole picture view of how this school should be running.

Simon's 'inspiring leadership' is visible to John as Simon 'addresses different issues' in a range of settings. While Simon's leadership may be visible to a range of people in highly public situations such as parent meetings, school assemblies or staff meetings, John is also able to see how Simon's leadership extends to classroom settings. John indicated that Simon's leadership

> comes across in his teaching as well. Because I'm team teaching with him I can see that in the classroom the way he approaches the whole class is always very much about the big picture and 'this is why we're doing this' and 'this is why we're doing that'. I think very much he is always sort of the same from my perspective. In front of the class, in front of the whole school, in front of the teachers he's the same.

As John is able to see Simon's work as a leader in different settings, it follows that Simon's participation, identity and TPACK are aspects of his identity that would be influential in shaping John's imagined identity in pursuing his extended future trajectory as a school leader. Simon's identity at Drake Secondary College is closely aligned to his strong PCK that is recognised by a number of members of the CoP. Joanne commented on Simon's ability to understand the relationship between PK and CK claiming 'the boss [Simon] is really good at that, he'll do both but he knows where you've got to let the kids run with it and where you've really got to put the teaching points in'. Similarly, David stated:

> Simon's such a great role model for some teachers coming into this school because he doesn't just stand there and lecture the kids. He is really flexible and gives time for some enquiry, some exploration, some reflection time, all those kind of things as well as some direct teaching.

Simon alluded to his PCK when he suggested that 'where I think I've helped John is just those whole range of different interesting ways to introduce what can be really exciting material or can be slightly more

boring material, I suppose, a bit drier'. Simon's recognition of his strength in PCK, engaging students (PK) with content that is exciting or slightly more boring (CK) was supported by Joanne who asserted that Simon 'is really good at that, he knows where you've got to intercede with kids and where you've really got to put the teaching points in and that type of thing'. Simon was also aware of Joanne's recognition of his PCK expertise:

> Joanne would say, she'll say to me overtly and has since the day we got here, 'I want those guys to go and watch you work. I'm putting Jake in your class next lesson to do X. I want John to watch you do this, so he can help me do this.' So when she says it like that, talks to me like that I think, wow okay, that's fantastic.

Simon's PCK strength and centripetal position as an old-timer within the Mathematics Teachers' CoP and school principal has resulted in Joanne, the head of mathematics, promoting Simon's knowledge, practice and identity as a leader as a model for newer members of the CoP. Simon was aware of his mentoring role in the school and this was reflected in comments such as:

> I've had a lot of the youngsters coming in and watching. They'll either say, 'Simon, you're introducing permutations and combinations, I've heard you do that all right, can I watch?' and I reply 'no problem'. We've got it into the heads of the youngsters here to get in there and watch the older guys like me teach. Afterwards you debrief with them after and, I've had a few that come up and go, 'Wow, how did you know that? I never thought of doing it that way.' You think, well there you go.

As one of the 'youngsters', John was in a unique position to benefit from observations of Simon's practice as he was Simon's team teaching partner. As such, John's opportunity to observe Simon, 'an amazing teacher' who was 'so much more experienced' and to debrief about their teaching occurred on a weekly basis. However, John not only benefited from teaching with Simon and observing his TPACK enactment but also to be involved with Simon in planning their shared lessons. John's regular interactions with Simon not only provided him with a mentor and role model who might guide and shape his classroom practice, but John, as mentioned earlier in this section, looked to Simon as a professional mentor who could help guide John's knowledge and practices on his imagined future trajectory on the way to becoming a school leader. Despite the

advantages in working closely with a mentor, the following section will reveal the challenges John faced working with Simon, in particular the limitations on John's willingness to negotiate and shape the practices in their team taught classes.

The Challenges When Team Teaching with the Principal

During the data collection phase of this research, Simon, principal of Drake Secondary College, and John were working together in a team teaching partnership that began 2 years earlier when they both started working at the school. When asked to recount his feelings about teaching with Simon in the school's first year of operation, John claimed:

> in the first year, it felt very much like 'he's the principal', which even though I knew was silly, and he would not want that to be the case. But it was still very much, 'he's the principal', and he's so much more experienced, he's an amazing teacher, and often, I struggled to try and think of something to add, because he just covers it all.

John indicated that, despite the fact that it was 'silly' and that Simon 'would not want that to be the case', he felt pressured teaching with the principal of the school. Simon also recognised these initial pressures on their professional relationship. Reflecting on early developments within their team teaching relationship, Simon stated:

> in our first year, I think, John would probably admit that he was a bit intimidated by team teaching with the Principal and so he probably deferred more on the quiet side, so I consciously tried to push him into the limelight, but sometimes that's really difficult with him. He's a quiet lad.

Both Simon and John's reflections describe Simon as the more capable and possibly dominant teacher in the early stages of their professional relationship based on both his teaching competence as well as the hierarchical position of principal despite the understanding that this is not what Simon intended or desired. It appears, at least superficially, that, despite working as the deputy head of mathematics John was still heavily influenced by Simon's position as principal in the early stages of their professional relationship. The development of Simon and John's professional

relationship brings into focus issues of identity as an interplay between identification and negotiability. Wenger (1998) highlights that 'our identities form in this kind of tension between our investment in various forms of belonging and our ability to negotiate the meanings that matter in those contexts' (p. 188). In contrast to John's participation as a TK expert in the Mathematics Teachers' CoP that saw his participation shape the practices of other members, John's participation in his team teaching relationship with Simon is one in which he defers to Simon's expertise and allows Simon to 'cover it all'.

While it is not suggested that there is anything problematic or improper in Simon's response to his dominant position in his team teaching relationship with John, Simon does indicate the pragmatic outcomes of such a power imbalance indicating that John '*probably deferred* [emphasis added] more on the quiet side, so *I consciously tried to push him* [emphasis added] into the limelight'. The interplay between Simon's identity as the dominant member of the team teaching partnership and his influence over the negotiability of the classroom-based enterprise central to their shared practice brings issues of power to the fore.

From a CoP perspective, issues of power are 'not construed exclusively in terms of conflict or domination, but primarily as the ability to act in line with the enterprises we pursue and only secondly in terms of competing interests' (Wenger 1998, p. 189). This consideration of power shifts the emphasis from considerations of broad political and economic issues to focus on just one aspect of power as an element of social life 'by arguing that a social concept of identity entails a social concept of power and, conversely, that a discussion of power must include considerations of community, negotiation of meaning, and identity' (Wenger 1998, p. 190). This consideration of power in John and Simon's professional relationship provides an opportunity to examine the consensual connotations implicit in Wenger's (1998) use of language such as 'joint', 'shared' and 'mutual' criticised by researchers such as Brown and Duguid (2001) and Contu and Willmott (2003) in Chap. 2.

Planning and Power: Challenging Notions of Joint, Shared and Mutual

Joint enterprise, shared repertoire and mutual engagement are central to the CoP framework as they describe the processes that enable individuals to participate in a community. Discussion in Chap. 2 not only revealed

the importance of these concepts but also highlighted the critique of the language used to describe these processes. In particular, researchers such as Brown and Duguid (2001) and Contu and Willmott (1988) questioned the consensual notions of 'joint', 'shared' and 'mutual' as descriptors of enterprise, repertoire and engagement as they 'tend to assume, or imply coherence and consensus … Such usage, we suggest, glosses over a fractured, dynamic process of formation and reproduction in which there are often schisms and precarious alignments that are held together and papered over by reflexive invocations of hegemonic notions' (Contu and Willmott 2003, p. 287). The remainder of this chapter examines these 'harmonious' participatory processes in light of Simon and John's team teaching relationship beginning with an analysis of their lesson planning.

Teachers' planning processes were discussed in Chap. 2 where it was pointed out that, in a typical (individual teaching) scenario, a teacher may develop his lesson plan in isolation but will constantly be making decisions based on his understanding of his students' needs as well as a sense of what is acceptable according to the institution's expectations and a need for his colleagues' approval. What appears to be a solitary pursuit is actually an intensely socially negotiated practice. In the atypical (team teaching) situation at Drake Secondary College, the joint process of planning lessons to be team taught is even more intensely negotiated in a social context that requires individuals to express various forms of practical and professional knowledge that are otherwise tacit (Rytivaara and Kershner 2012).

Negotiation around a joint enterprise, in this case team teaching, required Simon and John to communicate their tacit beliefs and understandings so that they had an understanding of one another's beliefs and competencies. This collective negotiation (MacBeath 2003) is focused around Simon and John's mutual accountability (Wenger 1998). Mutual accountability in this context refers to not only being part of the group and being responsible for one's own work but also 'being personable, treating information and resources as something to be shared, being responsible to others by not making life harder for others' (Wenger 1998, p. 81). Simon and John's shared lesson planning affords an opportunity through which examinations of mutual accountability influence their TPACK development and enactment.

Simon discussed the lesson planning process on a number of occasions during his interview. His comments provide an insight into the development of the ways in which John and Simon have developed a greater

understanding of the lesson planning process as well as a starting point to examine how CoP dimensions have influenced this process.

Considering the lesson planning that Simon and John did in their first year team teaching together, Simon thought that

> our planning in that first year was good. We would always meet the same day of a lesson and put some time into it … although I think in comparison to what we're doing now, now it's much richer, deeper. We're writing the lesson plans for every lesson and we're thinking about what we're doing, differentiating for the kids. So that journey for the two of us has come a long way.

John particularly noted Simon's dedication to the lesson planning process while providing a possible rationale for his enthusiasm for this task, claiming Simon's:

> driving it [lesson planning] and that's something where he wants the school to start to document the lessons in this lesson plan, and he's doing it by example. So I guess he's trying to show the rest of the school that it is possible to do it, even though we're so busy all the time, so he's got that point of view I think driving him to do it, and I think he realises that he can do it, and he's happy to do that.

When comparing Simon and John's choice of language when discussing the planning for their team taught lessons one is able to start to see some particular differences. Simon, for example, seems to indicate that the process is a mutual, equitable task reflecting many of the indicators Wenger (1998) lists describing mutual engagement. For example, Simon's consensual suggestion that '*we're* writing the lesson plans for every lesson and *we're* thinking about what *we're* doing' [italics added] sits in stark contrast to John's belief that '*he's* [Simon's] driving it and that's something where *he* wants the school to start to document the lessons in this lesson plan, and *he's* doing it by example' [italics added]. While there is no suggestion that there is anything baleful in this dissonance, it does provide a lived example of a challenge to the consensual connotations implicit in Wenger's lexicon typified by terms used to describe negotiations such as 'mutual engagement' (Contu and Willmott 2003).

In contrast to Anna and Jake's team teaching relationship in which the lesson planning process involved mutual negotiation through a shared repertoire resulting in a joint enterprise, Simon's driving force in this

case resulted in Simon 'doing the majority of [the lesson planning] at the moment, I'll do one lesson a fortnight, and he'll do the other five'. Despite the close professional relationship expected in a team teaching partnership, it appears that in this case, Simon constructed the vast majority of lesson plans. While John indicated that Simon would generally 'write up a lesson plan for the lesson, email it through to me, I'll read it, and then the next morning, we'll sit down and talk about it, and it's pretty straightforward, simple stuff'. John's comments intimate that, as the lesson plans contain comparatively simple information there is little negotiation involved in altering a lesson plan once it is created. The lack of negotiation about the content Simon includes or excludes from the lesson plan he creates draws into question the description of 'joint' enterprise.

While John indicated that he felt as though he 'could say anything to Simon if [he] had a better idea' when it came to planning activities for one of their classes, John did not provide one example in more than two hours of interview recordings of an occasion in which he had made a suggestion to alter one of Simon's lesson plans nor did any observations of John and Simon's interactions reveal evidence of this occurring. John's deference to Simon's lesson planning practices was reinforced when he stated:

> I don't know how [Simon] does it, but somehow, he just keeps on coming up with these amazing ways of approaching the same thing, and that's something where I just don't know how he keeps doing it in his lesson plans.

As such, it can be argued that Simon's contribution to the lesson planning process resulted in the majority of plans being created by Simon and that there was little if any negotiation altering the documents representing their shared practice despite the collaborative practices suggested in Wenger's (1998) conceptualisation of mutual engagement, joint enterprise and shared repertoire.

Examining examples of lesson plans Simon created for his classes with John, it is possible to find numerous examples that reflect Simon's TPACK strengths and weaknesses. As highlighted earlier in this chapter, Simon's PCK is a particularly strong aspect of his TPACK and that his TK is not as strong as 'I just haven't had the time'. Simon's weaker TK is reflected in his lesson planning documentation exemplified by an extract taken from a lesson plan for Year 11 maths methods. This first lesson examining cubics and quartics was planned using the team teaching lesson planning tem-

plate used by all teachers in the school. The plan for the first 25 minutes of the lesson is shown in Table 5.1.

Discussing the lesson plan with Simon, he indicated that, for this lesson, he participated as Teacher A while John took on the role of Teacher B. Given John's high levels of TK, it is unsurprising that one of the tasks Simon planned for him was to introduce students to the CAS, how to sketch graphs, how to find key points such as intercepts, how to factorise and how to solve equations. Simon was asked how he felt creating a lesson plan that incorporated TK, a relatively weak aspect of his TPACK, for John who had comparatively strong TK. Simon indicated that the lesson plans he created were

> not for John really. The things we come up with are transferable because we have got six or seven Maths Methods classes. So I feel like we've got a full year of documented lesson plans that people can start with, particularly the youngsters, and they can see what we do.

Simon's comment that the lesson plan wasn't really for John's benefit indicates a belief that the creation of lesson plans isn't necessarily for the benefit of Simon or John. In contrast, providing completed lesson plans for six or seven other teaching teams has the potential to influence teaching practices and knowledge development on a broad scale. Wenger (1998) acknowledges the potential of boundary objects such as lesson plans to transfer knowledge, practices and values within and between CoP. Simon's influence developing, refining and distributing lesson plans within the Mathematics Teachers' CoP not only has the potential to influence the TPACK development of newer members of the CoP but is designed to 'provide a starting point' so that other teachers are able to 'see what we [Simon and John, two exemplary teachers] do'.

The single sentence describing Teacher B's enactment of TK evident in Table 5.1 is contrasted by the detailed instructions for Teacher A who is provided with details of the approach to use in drawing out questions related to the equation $x^3 + 3x^2 - 2x - 5 \div x + 2$. The information for Teacher A is further detailed in a worked, four step solution to the equation. The difference in the level of detail in this example could be interpreted as downplaying TK in the joint enterprise of the CoP. Such a silencing of TK in the reified practices evident in lesson plans could influence newcomers to the Mathematics Teachers' CoP who could develop an understanding of the joint enterprise that focused more on the PCK

Table 5.1 An extract from John and Simon's lesson plan

Lesson phase	*Students*	*Teacher A*	*Teacher B*	*Time*
Demonstration—students demonstrate their new learning in terms of knowledge—presentation, quiz, mini whiteboards etc.	Students learn how to undertake some of the key work in the unit using their CAS calculator	Introduces students to cubic equations and inequations, explains the key requirements Teacher A then poses the question—can we do $x^3+3x^2-2x-5 \div x+2$ the same way? Then demonstrates this to students in linking the method and setting out to the numerical division $\frac{x^3+3x^2-2x-5}{x+2}$ $=\frac{\left(x^3+2x^2\right)+\left(x^2+2x\right)+\left(-4x-8\right)+3}{x+2}$ $=\frac{x^3+2x^2}{x+2}+\frac{x^2+2x}{x+2}+\frac{-4x-8}{x+2}+\frac{3}{x+2}$ $=\frac{x^2(x+2)}{x2}+\frac{x(x+2)}{x+2}+\frac{-4(x+2}{x+2}+\frac{3}{x+2}$ $=x^2+x-4\frac{3}{x+2}$	Introduces students to the CAS, how to sketch graphs, how to find key points such as intercepts, how to factorise, how to solve equations	25 mins

aspects of TPACK than TK. Alternatively, the absence of TK detail in Simon's lesson plan could be seen as a provocation to other members to negotiate an understanding as shown by the number of people who seek John's help. The scope of this investigation limited the data collection to the four core participants and their key professional learning colleagues and therefore data confirming or rejecting one of these hypotheses or suggesting an alternative was not collected; however, it is suggested that this may be a valuable area for future investigations.

Conclusion

This chapter presented John's case in which John's TPACK enactment was examined through his participation as a member of the Mathematics Teachers' CoP. Discussion and analysis in this chapter has resulted in four conclusions.

1. **A teacher's competent identity does not rest on equal TK, PK and CK.**

Data in this chapter reported multiple participant perspectives that identified John as a TK expert within his workplace CoP. While still having PK and CK, John's unique identity as a TK expert mediated many of his relationships with colleagues who sought help with technological problems or questions. John's identity as a competent community member resulted, in a large part, from his TK expertise. John's case therefore provides an alternate view to the assumption evident in the TPACK research literature that teachers should thoughtfully interweave TK, PK and CK or TPACK as part of effective teaching with technology.

2. **The motivations for TPACK development may be driven by broader professional aspirations than more effective classroom teaching.**

John's motivations for developing his TPACK, in particular his PCK, were not to become a more effective classroom teacher but related, instead, to pursuit of his imagined future trajectory as a school leader. John's case indicates that TPACK development is closely linked to professional identity development through an imagined trajectory that is broader than classroom teaching and, in this case, directed toward teacher leadership.

3. **The enactment of TPACK in a CoP is not always consensual.**

The language used to describe participatory processes in the CoP framework has been questioned by some researchers. For example, Brown and Duguid (2001) and Contu and Willmott (1988) have questioned the consensual notions of 'joint', 'shared' and 'mutual' as descriptors of enterprise, repertoire and engagement suggesting from a theoretical perspective that such language 'tend[s] to assume, or imply coherence and consensus' (Contu and Willmott 2003, p. 287) characterised by a consistent, unified understanding by all participants.

John's team teaching relationship with Simon provided examples of enterprise, repertoire and engagement that were dominated by Simon's participation and reification of practice as John's deferred to Simon's leadership and PCK while pursuing his own leadership aspirations. While there is no suggestion that there was anything baleful in the dissonance evident in Simon and John's relationship, their team teaching partnership did present a different perspective to the traditional conceptualisation of the consensual processes of participation alluded to in the CoP framework. While it is important to acknowledge that Simon and John's professional relationship was a unique case study which limits the generalizability somewhat, this case adds empirical evidence to support calls from researchers such as Contu and Willmott (1998) to consider critically the language used to describe participation in situated learning frameworks such as CoP so that it addresses the layers and complexity expressed through it.

4. **The reification of TPACK enactment in a CoP is influenced by the power dynamics of its members.**

This chapter highlighted John's deference to Simon's leadership which was demonstrated through Simon's domination of the lesson planning process. Despite recognising John as a TK expert and a teaching partner, Simon's creation of the vast majority of lesson plans resulted in an over-representation of PCK in the reification of John and Simon's enterprise. Moreover, John's apparent unwillingness to negotiate changes to lesson plans resulted in John's strengths being less evident. While the lack of TK in lesson plans did not appear to restrict John's actual use of digital technologies as part of his classroom practice with Simon, it was Simon and John's provision of completed lesson plans for seven other teaching teams in the Mathematics Teachers' CoP which largely represented Simon's

PCK, that would likely influence teaching practices and knowledge development on a broader scale.

In summary, this chapter has demonstrated and discussed the aspects that influence mutual engagement, joint enterprise and shared repertoire as these shape teachers' TPACK enactment in schools as workplaces. It shows that the three aspects—mutual engagement, joint enterprise and shared repertoire—can be shaped by socially mediated perceptions of leadership and power such that teachers' TPACK enactment may not necessarily be consensual. Further, TPACK enactment may be driven by individuals' professional aspirations that encompass both classroom and school leadership.

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CHAPTER 6

Dispelling the Myth of Teachers' Consensual and Coherent Use of Technology: Discussion, Deliberation and Dispute

Chapters 4 and 5 illustrated how socially mediated perceptions of reciprocity, leadership and power can shape the mutual engagement, joint enterprise and shared repertoire and the ways these can, in turn, influence teachers' technological, pedagogical and content knowledge (TPACK) development in school workplaces. This chapter focuses on the ways in which joint enterprise influenced TPACK enactment. This influence will be established initially through the development of an understanding of joint enterprise from Nick and Felicity's perspectives with the second half of the chapter exploring the impact of joint enterprise on Nick's TPACK enactment and development.

An examination of the CoP framework reveals some generalities around the concept of joint enterprise. For example, Wenger (1998) stated that joint enterprise is an integral part of the CoP framework which

> is a process, not a static agreement. It produces relations of accountability that are not just fixed constraints or norms. These relations are manifested not as conformity but as the ability to negotiate actions as accountable to an enterprise. The whole process is as generative as constraining. It pushes the practice forward as much as it keeps it in check. An enterprise both engenders and directs social energy. It spurs action as much as it gives it focus. It involves our impulses as much as it sorts them out. An enterprise is a resource of coordination, of sense-making, of mutual engagement; it is like rhythm to music. (Wenger 1998, p. 82)

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This description of a joint enterprise provides a sense of a range of processes that produce a coordinating focus and accountability mechanisms generated through negotiation, however, Wenger's (1998) descriptions lack specificity as to how processes such as negotiation or coordination occur. This chapter explores Nick and Felicity's cases and reveals the processes involved in negotiation of joint enterprise in a CoP. Moreover, this chapter challenges the inherent notion in Wenger's (1998) conception of a singular joint enterprise to which participants are accountable by showing how Felicity and Nick's participation and TPACK development in their CoP are influenced by two, simultaneous, context-specific joint enterprises.

Joint Enterprise at Drake Secondary College: Valuing Process or Product?

Felicity was asked to describe what she believed the school professed to be about to which she replied, 'it's not about the ATAR [Australian Tertiary and Admission Rank]. It's about cooperative learning, team teaching, cooperation, all of those sorts of things'. Felicity's comment indicates a belief that despite being a select-entry, highly academic school, the main focus of the school was not producing students who achieved high scores in their VCE exams (resulting in a high ATAR). In contrast to producing students with high levels of content knowledge (CK), Felicity clearly indicated that she believed the joint enterprise of the school was focused on educating students about the process of learning through cooperative learning opportunities and teachers modelling effective collaboration through team teaching.

However, when Nick was asked to describe what he believed was a defining characteristic of Drake Secondary College he replied that 'the biggest thing is you don't want to go into the classroom and get as much information shoved down the kid as possible in as short a time as possible so that they can get a good exam mark'. Nick's statement reveals a similar understanding of the importance Felicity placed on the learning process in preference to, as Nick stated, a 'good exam mark'. In highlighting the value of the processes underpinning learning through practices such as cooperative learning rather than transmitting information into students with the aim of good exam marks, Felicity and Nick are showing a common understanding of aspects of joint enterprise they believed was valued by the school CoP in which they worked.

Felicity and Nick's understanding of the joint enterprise was also shared by Alicia, Felicity's team teaching partner. Discussing their team teaching relationship, Felicity stated that

> we want kids to understand how they think, and all of those particular skills that come with it. You know, problem solving, analysis, interpretation, being reflective. We don't just want kids 'oh, I learned this and I could do that and that didn't work' but saying 'next time, I'm going to do this differently' and when next time comes, there's evidence they've actually used those skills to improve the way they learn.

Felicity's comments not only provided additional specific examples of the processes she believed were associated with the learning process, including problem solving and analysis, but her comment also provides evidence that Alicia, an additional member of the school CoP, also appears to value the learning process in a similar manner to Nick and Felicity. Later in her interview, Felicity reiterated the similar approach she shared with Alicia:

> Working with Alicia helps me see the things that I really value and think are important. When I see someone like her in the classroom, when we work together, I can see that she values the same sorts of things that I do. Our teaching is very much about the whole person and it's not always just about the content. So it's about the learning curriculum as well as the content but also the social side of being a teacher as well. All of those are quite clear when you watch her talk and interact with the students.

This description of Felicity's working relationship with Alicia confirms the joint enterprise they 'really value and think are important' and reveal her belief about the workplace relationship she shares with Alicia, an old-timer who provides her with guidance and support.

Alicia's role in this relationship is in contrast to the descriptions of old-timers and newcomers in Lave and Wenger's (1991) ethnographic case studies. Unlike the master old-timers described by Lave and Wenger (1991) Alicia did not direct Felicity's participation or active knowledge development but instead supported and reinforced her existing knowledge, 'help[ing] me see are the things that I really value and think are important'. Felicity and Alicia's shared sense of what they value, in short a joint enterprise, provides a lived example of one form of harmonious negotiation in a CoP.

This was confirmed in an interview with Alicia where she described a core belief she shared with Felicity:

> I think what works for Felicity and me is that we have the same basic core beliefs. The main core belief that we share is to help students learn. Not just teach them, but support their learning. Both of us like to work on how students learn and how we can best support them and get them engaged. I like to spend my energy in class engaging kids and so does Felicity. Like I said, we have the same core beliefs.

Alicia's comment not only reflects a shared core belief of the joint enterprise of the CoP, but also provides an example of the way this joint enterprise is enacted when both Alicia and Felicity are working with students in classrooms: 'I like to spend my energy engaging kids and so does Felicity'. As such, Alicia and Felicity are involved in the process that Wenger (1998) described as defining joint enterprise 'in the very process of pursuing it. It is their negotiated response to their situation and thus belongs to them in a profound sense' (p. 77).

This sense of joint enterprise was also reported by Nick on a number of occasions. For example, he indicated:

> I think Felicity and I both value the process of the learning and making things engaging and doing things in new ways opposed to just producing kids that are going to do well in an exam, that's probably why we get along so well.

Nick's comments reinforce his earlier belief that the joint enterprise in the school was not solely focused on CK or doing well in an exam, but also that the process of learning and engaging students (PK) was also an integral part of the joint enterprise in this CoP and a reason for the close professional relationship between him and Felicity.

The discussion so far has demonstrated an understanding of the joint enterprise of the Drake Secondary College CoP as expressed by Nick, Felicity and Alicia. The discussion has shown common understandings of the value of teaching that includes CK but focuses particularly on the 'the learning curriculum' or 'help[ing] students learn' by including activities to engage students. Describing this aspect of their practice, Nick, Felicity and Alicia all express an understanding of a joint enterprise that privileges PK over CK and thereby provide an insight into the types of knowledge development that may be valued in this CoP.

Nick, Felicity and Alicia's comments not only reveal that PK was a privileged form of knowledge in this CoP but all three mentioned their efforts to engage students in their learning revealing a manifestation of this knowledge in practice. During one of his interviews, Nick was asked if he believed other people in the science department had a similar enterprise. He replied:

> Yeah, I think so, pretty much most of them but not everyone. I think the majority of science teachers in this school are very keen to teach science in new ways and put a lot of thought into the best way to teach it. You see it more in our [Year 10] electives than anything. I think those same teachers that are able to think creatively and teach things really well in their electives often don't get to do it as well as they'd like in their VCE subjects, which I assume is just the pressure of it and I include myself in that, absolutely.

Despite recognising that the majority of science teachers share a similar belief about the value of PK and teaching science in new ways, Nick also indicated that he doesn't believe that PK is reflected as strongly in teaching practices in all science classes at Drake Secondary College. While Nick describes that the elective subjects taught at Year 10 (see Chap. 3 for details of the elective subjects offered to students) as opportunities for teachers to 'think creatively and teach things really well', Nick suggested that these creative practices privileging PK are not in evidence when the same teachers are teaching students in VCE classes, 'and I include myself in that, absolutely'. Similarly, Felicity commented on the different approach she adopted when teaching VCE classes indicating 'you sort of feel that pressure of Year 12, going "we have got to get through this content", because they will be examined on everything, so I have to do it'.

Nick and Felicity's descriptions of the differences in teaching approach between Year 10 and VCE classes indicate a tension in joint enterprise. Nick describes teachers working with Year 10 students privileging PK, whereas the same teachers working with VCE students focusing on CK. While Nick, Felicity and Alicia all used similar language to describe one aspect of the joint enterprise of the CoP, Nick and Felicity's additional comments indicate that the value of PK is context specific. In this CoP, PK appears to be less significant for teachers working with VCE students despite teachers like Nick, Felicity and Alicia prizing this aspect of their teaching with Year 10 students. This difference in joint enterprise within the CoP illustrates the complexity of joint enterprise mentioned, but not

elaborated upon in Wenger's (1998) CoP framework. In this case, it is evident that the CoP that Nick, Felicity and Alicia belong to has more than one joint enterprise. This discussion has therefore revealed that a CoP can have more than one joint enterprise that occur simultaneously, are sustained and context specific.

These two joint enterprises, on the surface, appear to be in conflict were discussed in further detail by Felicity. She reported differences in the way she taught her VCE classes compared to the approach she adopted with her Year 10 elective classes, indicating that for Year 11 and Year 12 classes 'the curriculum becomes your focus. Your content becomes your focus, rather than the kids that are in the room'. This approach contrasted with her Year 10 classes where the focus was on the 'learning curriculum' and 'when I compare that to my Year 12 Chem class, well, you know, I'm working with a great chemistry teacher, but because of the nature of Year 12, it's just fast-paced and it's just lecture, lecture, lecture', further lamenting 'why do I become that horrible boring Year 12 teacher?'.

Seemingly answering her own question, Felicity claimed 'you sort of feel that pressure of Year 12, going 'we have got to get through this content', because they will be examined on everything, so I have to do it'. Felicity's comments reveal a feeling that she has to bow to the pressure of delivering content to her Year 12 students, driven by the pressure of external exams and the need for students to be able to answer questions that cover the CK outlined in the VCE curriculum. Further reflecting on this pressure, Felicity commented on the influence this had on her practice and of the practice of her colleagues including Nick indicating 'I think he's like me, you conform to what the rest … you know, what everyone's doing'.

Felicity's comments reveal the tensions she faced negotiating the difference in joint enterprises in her CoP. Her preference for PK was clearly evident in her work with Alicia teaching in the Year 10 elective programme, however this preference was challenged by the CK demands of the VCE curriculum, 'because they [students] will be examined on everything, so I have to do it', and the accountability Felicity felt to 'conform to … what everyone's doing' to 'get through this content'.

Felicity's accountability to the joint enterprises of these different contexts therefore requires her to enact her TPACK in different ways: in her Year 10 class, her TPACK has a distinct PK focus whereas in her VCE classes this PK emphasis is changed to one that focuses on CK as this is the joint enterprise to which other VCE teachers are accountable or 'what

everyone's doing'. Felicity's choice of language, particularly the word 'conform' indicates that this process was not easy or comfortable for her as it challenged her 'core beliefs'; however, 'pressure of Year 12' and the need to participate with others in these different contexts brought her to a point whereby she negotiated these differences.

Both Felicity and Nick therefore reveal a difference in their approach to teaching and learning that occurs in their VCE classes when compared to their Year 10 classes; moreover, this is an approach that brings their practice in line with 'what everyone's doing'. Felicity and Nick's comments are significant as they reveal a difference in understanding of what matters or what is important, in short a difference in joint enterprise when working with students at different year levels within the school. Despite clearly valuing creative teaching and engaging students, Felicity and Nick both indicate that when working with VCE students, there are pressures that shift their focus as teachers to the delivery of CK rather than basing their classes on the PK elements.

This section has revealed a difference in multiple, simultaneous, context-specific joint enterprises around which members of the Science Teachers' CoP mutually engage. Evidence from Nick, Felicity and Alicia has indicated that despite valuing PK as part of their repertoire when teaching Year 10 classes, when teaching VCE classes Felicity conformed to a CK-driven approach. Additionally, data presented in this section revealed that the differences in the joint enterprise for teachers working in these different contexts was from Nick and Felicity's perspective widespread in the CoP and despite not enjoying the CK-driven nature of VCE teaching, Nick and Felicity appeared, from Felicity's perspective, to 'conform to what … everyone's doing'.

The following section will demonstrate how these differences in joint enterprises can create tensions within a CoP and are the site of negotiation between a member's identity and joint enterprise. These inconsistencies will be explored from Nick's perspective as a comparative newcomer to the teaching profession who had little VCE teaching experience. In particular, the following section highlights the challenges Nick grappled with as an individual attempting to understand and negotiate joint enterprise characterised, in this case, by the desire to engage students in the learning process contrasted with the imperative for students to achieve high VCE exam marks.

Nick's Challenge: Understanding a Complex Enterprise

The previous section illustrated a clear understanding of the joint enterprise of the Science Teachers' CoP through comments from Felicity, Nick and Alicia. Despite expressing a mutual understanding of the joint enterprise through a shared repertoire, a different perspective of what was valued for VCE classes was also revealed in Nick and Felicity's comments. The joint enterprise for VCE teachers focuses less on the creative and engaging forms of teaching that were valued aspects of teaching in the Year 10 elective programme and instead privileged delivery of CK to students. Nick recognised the importance of delivering CK to students so they could succeed in their VCE exams claiming 'we'd obviously be crazy if we were sitting here and not trying for them to get the best grades they can get because that's what we're here for'. Despite acknowledging that the teachers at Drake Secondary College had an imperative to deliver CK to their students, Nick also revealed the contradictory nature of this aspect of the joint enterprise of the school CoP:

> I think we contradict ourselves a lot too. I think the main point is that we're here to get kids enjoying science. We do want them to do well, but the main focus is the learning itself. Exposing them to science, all our good [Year 10] enrichment sciences, getting them to get good habits with study skills, apply themselves and hopefully end up with good marks and that sort of thing. But marks and grades have always supposed to be not the main focus of our school. It is just the 'sciencey' thing. I do think that is still the main message throughout the school. I just think we contradict ourselves because a lot of the procedures we put in place are very results focused.

Nick's comments provide an insight into the complexity of what is valued and considered important in a CoP. In contrast to the idea that the joint enterprise of a CoP is singular aim or effort toward understanding of what is important evident in Rogers' discussion of joint enterprise in which he describes '*the* joint enterprise [emphasis added]' (p. 388) which involves members of a CoP 'sharing *a* common goal [emphasis added]' (p. 387). Nick's case provides an example of the ways in which a CoP can pursue multiple joint enterprises that can, on the surface, appear to be somewhat contradictory. Nick indicates teachers' working in this school are to provide students with both the opportunity to develop 'sciency'

skills to engage students in learning while also maintaining a focus on student grades 'because that's what we are here for'.

Nick continued to describe his belief about the contradictory and confusing nature of the two joint enterprises:

> I find that at a whole staff level we are always discussing that we don't care what their grades are at the end of the day, you know, it's about 'this and that'. But then a week later we'll have something coming out saying 'any kid that's got less than sixty percent we need to chase them up and have a meeting with them because they're not performing to the class average'. To me that's contradictory.

The difference in these two joint enterprises appear to challenge Nick's understanding of his role in the CoP and his identity as a teacher. On the one hand, Nick understands that his role is to engage students in the learning process, a practice that resonates strongly with him as it represents an approach to teaching and learning that suits his own personal learning style. On the other hand, Nick understands that he would 'obviously be crazy' to not try and assist students in getting the highest marks possible for their VCE studies.

Despite an ability to articulate the differences in these two joint enterprises, the fact that Nick continues to find these two joint enterprises contradictory or incompatible indicates that Nick finds it challenging to reconcile these differing joint enterprises. Nick's perception that this contradictory approach continues to exist three years after he began working at Drake Secondary College suggests that he has found it challenging to either reconcile these two different joint enterprises or to negotiate a response that resolves this contradiction.

Lave and Wenger's (1991) ethnographic studies underpinning much of the CoP framework indicate that newcomers to a CoP participate in a legitimately peripheral manner characterised, among other things by an inability to actively influence the joint enterprises valued by the CoP. While this explanation could help explain Nick's response, the newcomer argument is weakened by the fact that having worked in the school for 3 years, Nick may no longer be considered a newcomer by members of the CoP. Furthermore, Nick's apparent acceptance in the school, for example his promotion to the deputy head of science position, indicates what Wenger (1998) would describe as an inbound trajectory associated

with more centripetal participation including an ability to shape negotiations about joint enterprise.

Despite Nick's apparent transition away from a newcomer position within the CoP, his perception of his own ability to centripetally participate suggests that Nick does not believe he is accepted as a centripetal participant. The remainder of this chapter will explore Nick's identity development and his ability to influence the joint enterprise in a CoP and will show how those participating in a liminal phase have limited success in shaping the knowledge and practices in a CoP.

Identity and Negotiation in a CoP

The previous section highlighted Nick's perception of contradictory joint enterprises influencing the participation of teachers at Drake Secondary College. The following discussion builds on this understanding and shows how these contradictory joint enterprises within a CoP can be understood as threshold concepts. Moreover, threshold concepts invite consideration of different power relations within a CoP through the introduction of the notion of a liminal phase of participation that represents a transition period between newcomer and old-timer. This exploration of liminality within a CoP will provide a more detailed understanding of the under-theorised 'journeyfolk phase' briefly mentioned in Wenger's (1998) work and will examine this transition period through an exploration of the development of professional identities within a CoP.

The Transitory Nature of Professional Identity

In a whole staff professional development day early in the school year, Nick was a vocal member of the community 'not afraid to share his thoughts or a well-intentioned jibe' (Researcher Observations 8/2/2012). These observations were reflected in Felicity's comments that Nick's 'often a bit of a clown and mucks around and can seem like a bit of a wise guy in meetings, yelling out a little'. Confident, athletic and possessing a strong personal presence, Nick appeared to be comfortable participating within the school community. As the deputy head of science and having worked at Drake Secondary College from the beginning of the school's foundation year, Nick's confidence was understandable and could contribute to an impression of Nick as an old-timer; however, as shown in Table 3.2 Nick was also the least experienced of all the teachers who participated in this

investigation having worked as a secondary school teacher only for 3 years. Despite Nick's comparative inexperience working in school settings, his confidence participating in a workplace context may be explained by his professional identity established in different workplaces prior to becoming a teacher.

As Pierce (2007) indicates, many beginning teachers such as Nick have entered the teaching profession following careers in other fields. For teachers such as Nick, the transition or 'rite of passage' (Pierce 2007, p. 31) that separates newcomers from old-timers can be complicated by the 'suspension, even temporary loss' (Pierce 2007, p. 31) of a previously established identity. Despite Nick's comparative inexperience working as a teacher he brought a great deal of life experience to his teaching role. As Nick explained in one of his interviews:

> out of school I did a couple of things. First thing was I went and pursued a professional rugby league career for a little while and then the main thing I did out of school was a plumbing apprenticeship. So I worked as a plumber for about four years and then headed to uni to do education and then I've been teaching here [at Drake Secondary College] since I finished.

According to Johnson (2004), the incoming generation of teachers is more homogeneous in terms of race and gender than the retiring generation, but it is more diverse relative to age, prior experience, preparation, workplace expectations and career conceptions. Many new teachers are first-career entrants, but an increasing proportion (Johnson 2004, reports contexts as high as 47%) of new teachers are entering at a mid-career point. These teachers, like Nick, have established a personal and professional identity in a different setting.

Describing his experiences when developing an understanding of the joint enterprise as an apprentice plumber Nick revealed:

> I suppose if I think of people that influenced me when I was plumbing like I probably think of some qualities in them … probably my main supervisor when I did my apprenticeship was this bloke called Jono and he was a pretty massive role model. Mainly just for his knowledge of what he did really. His knowledge of plumbing was just ridiculous, but he was still a pretty just normal typical sort of tradey type bloke.
>
> He just really knew his craft really well and as a supervisor what was good about him was he was good to learn from, but he didn't just micromanage

> everything and do everything over your shoulder, which I think is good as someone who's trying to develop some skills because there's nothing more annoying than not getting a bit of space to try and feel your way through and make a few mistakes.

This description of Jono provides an indication of the way in which Nick developed his identity during his plumbing apprenticeship, an environment where an old-timer 'didn't just micromanage everything and do everything over your shoulder' but gave the newcomer 'space to try and feel your way through and make a few mistakes'. Having been given some space to develop some skills and an understanding of the practices valued in this CoP, Nick's comments suggest that he believed was able to make the transition from legitimate peripheral participation starting as a plumbing apprentice to more centripetal participation where 'I worked as a plumber for about 4 years'.

As part of this transition, Nick recalled a time when this transition became clear to him:

> I remember in my second year of being a plumbing apprentice my supervisor went on holidays for two weeks and Dave the boss of our company left me in charge. I was like foreman of a commercial high rise building for two weeks. It was good. I just like that approach that they made me feel like you're really developing well because they put a bit of trust in you. So that's what I look for in a role model and I've found that here in varying degrees I reckon.

Nick's experience of being given a foreman's responsibilities in just his second year of a plumbing apprenticeship provided him with the opportunity to experience the acceptance that comes with the recognition of competence and the development of a professional identity. As Wenger (1998) suggests:

> membership in a community of practice translates into an identity as a form of competence. An identity in this sense is relating to the world as a particular mix of the familiar and the foreign, the obvious and the mysterious, the transparent and the opaque. (p. 153)

In two short years, Nick felt as though he had established an identity within his plumbing CoP characterised by competence and familiarity. Despite having established such an identity and membership within a

CoP, Pierce (2007) indicates that a change of career can result not only in a change of community, but also changes in familiar practices, skills, knowledge and identity. As Pierce (2007) highlights, individuals like Nick entering the teaching profession:

> give up the strong identities they have previously established for the sake of being 'called' into the teaching profession. If they are surprised, frustrated, and occasionally angry about their inductions, it might well be because they feel the pain on two levels—professional and personal. They feel that both the significance of teaching and their own budding professional identities are betrayed a bit, rendered ordinary, or even rendered invisible by their new school contexts. (Pierce 2007, pp. 39–40)

In contrast to Pierce's (2007) caveats, Nick's description of his rapid acceptance as a full member in the plumbing CoP, superficially, appeared to have been somewhat replicated in his school. Despite his comparative inexperience in a school setting, Nick, teaching in just his third year, had been formally recognised within the school as the deputy head of science. This substantial achievement is even more meaningful in the context of Drake Secondary College given it is a select entry school for students in Year 10–12 and promotes the pursuit of academic excellence in science, mathematics and associated technologies.

Despite this formal recognition of Nick's abilities, the social negotiation within his school-based CoP did not recognise Nick's competence in the same way:

> It might appear that my role would have me overseeing different things where I'm having a lot of communication with teachers and a bit of authority to try and help guide things in particular directions, but my role hasn't really got there. So my roles sort of like a *pseudo* role, it's a bit more like an 'adminy' type role. I don't really have the status in the Science Faculty where people would see me as being in charge of too many things.

Nick's description of his role as the deputy head of science is characterised by a belief that he does not have 'a lot of communication with teachers' or 'authority to help guide things in particular directions'. Nick's belief that as the deputy head of science 'people would see me as being in charge of too many things' sits in contrast to John's belief that, as the deputy head of mathematics, members of the Mathematics Department 'treat me as being almost the same [as Joanne, the Head of Mathematics],

like we are on par' and Joanne describing John 'as a leader and every way I deal with him is in that manner'.

Contrary to the expectations of centripetal participation, 'help[ing] guide things in particular directions', Nick's understanding of his 'pseudo role' does not allow Nick to engage with forms of social negotiation in the CoP that he seems to expect. Within Nick's comments, one is able to see a live example of Pierce's (2007) suggestion that Nick's budding professional identity is 'betrayed a bit, rendered ordinary, or even rendered invisible by their new school contexts' (p. 40); a peripheral identity that sits in contrast to what may have felt like a centripetal identity Nick established in his former plumbing CoP.

Nick's sense of inability to develop the 'authority to try and help guide things in particular directions' can be interpreted as an inability to negotiate that joint enterprise of the CoP as Nick does not have the 'status in the Science Faculty' to shape the practices of other members. When asked what directions Nick would like the Science Faculty to take, he replied 'my philosophy on teaching really is finding ways to make it engaging and different because I hated school and got bored very easily. So I guess I would like people to engage kids in the process of learning', once again revealing Nick's strong belief in the importance of PK established earlier in this chapter.

Nick's inability to negotiate the joint enterprise of the CoP, to increase the value of PK in the Science Faculty was also reflected in his team teaching relationship with Darren which saw them sharing a VCE biology class. Nick explained the tension in their professional relationship:

> we do take quite different views on what Science teaching is and then we definitely do have, not arguments, but heated, interesting discussions about things. I'm just very much not a … I think he's quite a VCE teacher. Very much 'PowerPointy', talk, tell kids everything, take notes. So it's very much a content driven kind of process, whereas I'm a lot different to that. I hated school when I was a kid and I was hopeless at it. So I don't know I probably get bored easy so I like to make things quite engaging and fun but not to the point where you don't learn anything. So we are a little bit different that way.

In contrast to Nick's belief that he and Darren were 'a little bit different' in their understanding of 'what Science teaching is' Felicity indicated:

> I think that Nick struggles teaching Year 12 Biology with Darren because they are just different in terms of their outlook. Because Nick hasn't taught it before and is a graduate, I don't think that his opinions or his ideas are valued because 'you're just new to this,' and I think that's such a shame because in a lot of respects, he is ahead of Darren in that teaching and learning journey and that understanding about what's important in the classroom.

Felicity's comments provide a supplementary perspective that confirmed the different outlook or perspective that distinguished Nick's preferred PK-focused TPACK enactment from Darren's CK preference. Furthermore, Felicity provides details that, from her perspective, explain why Nick's attempts at negotiating a change in the TPACK enactment in his team-taught classes with Darren were ineffective 'because Nick hasn't taught it before and is a graduate, I don't think that his opinions or his ideas are valued because "you're just new to this"'. Finally, Felicity affirms her alignment with Nick's PK preference revealed earlier in this chapter suggesting Nick 'is ahead of Darren in that teaching and learning journey and that understanding about what's important in the classroom'.

Nick and Felicity's descriptions of Nick's attempts to shape TPACK enactment provide examples of how negotiation takes place within a CoP. This aspect of negotiation is an element missing from Wenger's (1998) description of mutual engagement and shows how two people can have 'heated, interesting discussions' in the pursuit of a joint enterprise. Additionally, Nick's description illustrates how the negotiation of joint enterprise can also involve the negotiation of TPACK enactment. In this case, Nick and Darren are negotiating the balance of TPACK enactment they would like when teaching together with Nick arguing for a PK-influenced repertoire (engaging and fun) while Darren privileges CK ('PowerPointy', take notes). Felicity's comments show a belief that perceived inexperience limits the ability to negotiate the shape of a joint enterprise, in this case TPACK enactment, in a CoP.

While Nick and Darren's negotiation can be understood in terms of their VCE biology class, their pursuit of a joint enterprise and their associated negotiation of TPACK enactment can also be seen in a broader context as Nick is the deputy head of science while Darren is the head of science at Drake Secondary College. As such, their negotiations not only have the potential to shape the TPACK enactment in their shared classes but also in the CoP to which they both belong. Despite some 'heated,

interesting discussions … I know I never really walk away from it thinking we came to a really good conclusion and things keep being done the way they always have been'.

Nick's description of his negotiations with Darren about their joint enterprise builds on Wenger's (1998) idea of collective negotiation. Nick and Darren's efforts negotiating their joint enterprise are not necessarily harmonious or produce identical responses. Characteristics that are often reported in research using a CoP lens. In contrast, Nick and Darren's efforts in negotiating a response in a communal setting brings notions of power to the fore as it is issues of power that are 'not construed exclusively in terms of conflict or domination, but primarily as the ability to act in line with the enterprises we pursue and only secondly in terms of competing interests' (Wenger 1998, p. 189). This consideration of power shifts the emphasis from considerations of broad political and economic issues to focus on just one aspect of power as an element of social life that shapes a socially constructed and negotiated identity 'by arguing that a social concept of identity entails a social concept of power and, conversely, that a discussion of power must include considerations of community, negotiation of meaning, and identity' (Wenger 1998, p. 190).

Nick's understanding of his identity in the Science Teachers' CoP did not reflect the competent identity established in his plumbing CoP. In contrast to his centripetal participation as a plumber, Nick believed his participation was limited, 'a *pseudo* role' where Nick did not 'really have the status in the Science Faculty where people would see me as being in charge of too many things' and an inability to 'help guide things in particular directions'. Nick's inability to negotiate a change in the joint enterprise was also illustrated when he reflected on the outcome of the 'heated, interesting discussions' he had with Darren about the nature of science teaching: 'I know I never really walk away from it thinking we came to a really good conclusion and things keep being done the way they always have been'.

The resistance to change the enterprise evident in Nick's comments show that, in this case, Nick's identity and influence within the CoP were not sufficient to negotiate changes in the joint enterprise of TPACK balance; however, the reasons why Nick had not developed such an identity have not yet been explored. One possible explanation suggested in Wenger's (1998) work is that newcomers participate in a legitimately peripheral manner whereas old-timers participate in a centripetal fashion. While Darren may be considered an old-timer (e.g., see Table 3.2), Nick's

position as the deputy head of science and his membership of the Drake Secondary College CoP for three years means he may no longer be considered as a newcomer to the Drake Secondary College CoP. However, Nick's participation is also not as an old-timer but, instead falling somewhere in between these two points.

Nick's position within the school community therefore problematizes the newcomer/old-timer dichotomy often used by researchers examining CoP (e.g., see Barab and Duffy 2000; Barton and Tusting 2005; Fuller et al. 2005; Gray 2004; Handley et al. 2006; Hildreth et al. 1998). Anna's case also reframed the common categorisation of newcomer or old-timer by bringing Lave and Wenger's (1991) notion of 'journeyfolk' (p. 57) into focus. The addition of journeyfolk to newcomers and old-timers discussed in Chap. 4 contributes to a sense of identity and knowledge development on a continuum that plays out over time. Book-ended by the newcomer and old-timer labels, the notion of journeyfolk describes a phase in which a member of a CoP was neither newcomer nor old-timer, a phase that could be thought of as being in-between these two identities; however, Lave and Wenger's (1991) discussion of journeyfolk does not provide a theorised framework explaining the implications of such a phase. Further research using CoP as a basis has not advanced knowledge of this concept. Nick's case provides an opportunity to more deeply explore the transition period between newcomer and old-timer and the influences on TPACK as an individual moves through this transition. Drawing on the notions of liminality and threshold concepts, Nick's participation will be characterised in the following section as being in a liminal phase in which his ability to negotiate aspects of practice within a CoP appear to be limited.

Nick: The Challenge of Negotiating in a Liminal Phase

The previous section of this chapter provided a live example of Nick's transition into a new CoP at Drake Secondary College which echoed Pierce's (2007) suggestions of surprise, frustration and occasional anger as a professional identity established in a different CoP is 'betrayed a bit, rendered ordinary, or even rendered invisible by [a] new school context' (p. 40). Nick's description of his transition into this new workplace context is characterised by a formal position of responsibility that, in practice, is not one where members of the 'Science Faculty … would see me as

being in charge of too many things'. This section will argue that the challenges Nick experienced when attempting to negotiate and shape the joint enterprise and TPACK in his CoP is associated with the liminal nature of his membership.

Nick's case provides an opportunity to more deeply explore the transition period between newcomer and old-timer. Describing such a transition stage, Turner (1969) coined the phrase *betwixt and between* to capture the essence of his theory of liminality developed in the late 1960s to analyse rites of passage within tribal sociocultural systems. Derived from the Latin *limen* meaning 'threshold', Turner's (1969) description of the liminal phase of cultural initiation captures a unique state when 'the characteristics of the ritual subject (the "passenger") are ambiguous; he passes through a cultural realm that has few or none of the attributes of the past or coming state' (p. 94). Turner (1969) explains further, 'liminal entities are neither here nor there; they are betwixt and between the positions assigned and arrayed by law, custom, convention, and ceremony' (pp. 94–95). More recently researchers (e.g., see Land 2014; Land et al. 2014; Meyer and Land 2003, 2005) have further refined contributions to advancing understandings of liminality. Land et al. (2014) recently suggested that liminality can be thought of as

> a space of transformation in which the transition from an earlier understanding (or practice) to that which is required is effected. This transformation state entails a reformulation of the learner's meaning frame and an accompanying shift in the learner's ontology or subjectivity. The latter tends to be uncomfortable or troublesome for, in many respects, we are what we know. (Land et al. 2014, p. 2)

Investigating the notion of liminality, Land et al. (2014) indicate that those in a liminal phase experience discomfort as their identities undergo transformation along with their knowledge. The transformative nature of liminal spaces mentioned by Land et al. (2014) echoes a similar conception expressed by Schwartzman (2010) when discussing the learner's change in epistemology and an accompanying shift in their subjectivity, thus entailing both a conceptual and ontological shift. The tensions caused by such changes have been reported as uncomfortable or troublesome 'for, in many respects, we are what we know' (Land 2014, p. 2).

The liminal state therefore can be seen to perform a transitory phase which begins with the encountering and integration of something new.

Land et al. (2014) suggest that this transition period subsequently involves the recognition of shortcomings in the learner's existing view of the phenomenon in question and an eventual letting go of the older prevailing view. Meyer and Land (2003, 2005) have proposed that threshold concepts may be a way of understanding the progression of an initiand through a liminal phase as a threshold concept 'represents a transformed way of understanding, or interpreting, or viewing something without which the learner cannot progress' (Meyer and Land 2003, p. 1). In this case, Nick's liminal state began when he encountered the multiple, simultaneous joint enterprises in the Science Teachers' CoP. Nick's existing understanding of 'what Science teaching is' that coalesced around PK by 'engag[ing] kids in the process of learning' was challenged by the 'contradictory' focus on CK and student grades evident in staff meetings and the teaching practices of teachers such as Darren.

Land et al. (2014) suggest that for a learner to progress through this liminal phase, earlier modes of subjectivity need to be let go followed by 'an envisaging (and ultimate accepting) of the alternative version of self which is contemplated through the threshold space' (p. 3). This re-authoring of identity or as Ross (2011) described, an undoing of the script, 'further entails the acquisition and use of new forms of written and spoken discourse and the internalising of these' (Land et al. 2014, p. 3).

Common to such analogies is the idea that the transformation associated with liminal periods can be protracted over considerable periods of time (Meyer and Land 2005). These authors have characterised liminality as 'unsettling, experienced often as a sense of loss, as prevailing earlier conceptual views, and earlier states of subjectivity, and are relinquished' (p. 22). For Nick, the unsettling nature of this liminal period is evident in the sense of contradiction he expressed when describing the importance some members of the school CoP placed on CK in contrast to the preference for PK he experienced when working with others such as Felicity. The sense of contradiction that characterised Nick's belief indicates that he had not undone the script (J. Ross 2011) nor internalised the 'new form of written or spoken discourse' (Land et al. 2014, p. 3) or, from a CoP perspective, adopted the shared repertoire or mutually engaged with the joint enterprise of other members of the CoP.

Unlike Wenger's (1998) newcomer and old-timer dichotomy, those investigating liminal phases often report oscillative experiences (e.g., see Land et al. 2014; Meyer and Land 2003, 2005; Turner 1967, 1969) as new perspectives slip in out of focus and elude the learner's grasp. In

Nick's case, he reports a tension with accepting wholly the focus on CK in VCE teaching. This struggle can be seen in Nick's comments that, on one hand complain about marks and grades being 'the main focus of the school' while on the other claiming 'we'd obviously be crazy if we were sitting here and not trying for them to get the best grades they can get because that's what we're here for'.

In this transformative liminal phase, the destination is also contested: 'an alternative version of self' (Land et al. 2014, p. 3), a new form of negotiated identity is the outcome. In this sense the 'messy, abstract transformations' (Baillie et al. 2012, p. 2) also apply to the unsettling and ongoing formation of identity in a CoP. While going through this liminal phase, Nick's comments indicated the challenges he had been mutually engaging with an unsettling joint enterprise that privileged CK. In contrast to Felicity's acceptance of the two joint enterprises in the CoP, Nick's attempt to negotiate a change in the TPACK enactment in the team taught classes he shared with Darren resulted in 'heated, interesting discussions' with Darren.

Despite attempting to negotiate the joint enterprise to which he and Darren could mutually engage, Nick indicated that 'things keep being done the way they always have been'. Nick's attempts to shape the TPACK enactment in this case bring into question the consensual notions of 'joint' enterprise and 'mutual' engagement. In contrast to the consensual notions implied in 'joint' and 'shared', evidence from Nick's case suggests that those in a liminal phase are less influential in negotiating changes to joint enterprise and mutual engagement than more experienced members such as Darren who had an established identity.

Moreover, Nick's transition through this liminal phase is marked by occasions when he attempts to negotiate and shape TPACK with Darren, in a sense testing the effectiveness of his emerging identity in negotiating an outcome. At other times, Nick's preference to participate with Felicity and Alicia can be interpreted as a retreat from the challenges testing his emerging identity to the familiar, comfortable and harmonious negotiations with members of the CoP who similarly privilege PK. The addition of liminality to the CoP framework helps to explain Nick's oscillative transformation of identity and the tensions he expressed fully accepting the joint enterprises valued in his CoP. Furthermore, expanding the CoP to include notions of liminality helps to explain the struggle Nick expressed in his TPACK enactment in this CoP.

Conclusion

This chapter explored how perceptions of joint enterprise can influence teachers' TPACK enactment through the tensions Nick expressed when reflecting on his participation as a member of the Science Teachers' CoP. Discussion and analysis in this chapter presents the following three conclusions:

1. **A CoP can have multiple, simultaneous and context-specific joint enterprises.**

Nick's participation as a member of the Science Teachers' CoP resulted in him teaching in the Year 10 elective programme and the VCE biology classes. This chapter described the differences encountered in the joint enterprise of these two parts of the CoP. Contrasting preferences for teachers PK in the Year 10 programme with the CK privileged by teachers of VCE classes illustrated that a CoP can have simultaneous, context-specific joint enterprises. In contrast to previous TPACK research that describes context as a location for the enactment of TPACK, the change in context in this case is not only a change in the physical location in which teachers' conducted their classes but, more significantly, was also a change in the knowledge that was valued as part of the joint enterprise. The existence of multiple joint enterprises in a CoP has not been reported in previous CoP researches.

2. **Joint enterprises of a CoP influence TPACK enactment.**

The multiple joint enterprises in this CoP privileged PK and CK, respectively, for teachers working with students at different year levels. This contrasts with the notion of a dynamic interplay between TK, PK and CK for teachers' professional practice inherent in Mishra and Koehler's (2006) framework. Nick's case provides examples of classroom teaching that is considered effective by the CoP for two different contexts which do not have teachers' enacting equal levels of TPACK in both contexts. The balance of TPACK required for competent participation within a CoP needs to be considered in light of the joint enterprise(s) valued by the participants.

3. **Members of a CoP can be in a liminal phase.**

Using Nick's data to identify the existence of multiple, simultaneous and context-specific joint enterprises in a CoP, this chapter used the notion of liminality to provide a lens through which Nick's emerging identity across these contexts could be understood. In contrast to the characterisation of newcomers and old-timers (Wenger 1998) or Lave and Wenger's (1991) reciprocal near-peer relationships discussed in Chap. 4, Nick's liminal identity involves the re-authoring of himself and the giving up of a sense of centripetal participation that characterised his professional identity in his former plumbing CoP.

Moreover, Nick's case demonstrated how challenges with identity, knowledge and practice play out in a CoP context, through his heated discussions with Darren or internally as Nick's perception of his own identity oscillated while attempting to develop a sense of his professional competence. Liminality, in Nick's case, appears to be associated with his perceived inability to shape the joint enterprises of the CoP or to be able to align his TPACK enactment to competently participate in different contexts. Moreover, Nick's liminal participation brings into question the consensual notions of 'joint' enterprise and 'mutual' engagement, suggesting instead that those in a liminal phase are less influential in negotiating changes to joint enterprise and mutual engagement than more experienced members with established, competent identities.

In summary, this chapter has focused on the influence of joint enterprise on teachers' TPACK enactment in a CoP and has shown how a community can have multiple, simultaneous and context-specific joint enterprises that can privilege different forms of professional knowledge. This has implications for the TPACK framework as teachers working in one community within one context can privilege one part of the TPACK framework over another. This contrasts with the notion of the dynamic interplay between TK, PK and CK for teachers' professional knowledge inherent in Mishra and Koehler's (2006) framework. Moreover, the tension caused by the existence of multiple, simultaneous and context-specific joint enterprises provided a new perspective on joint enterprise as a CoP process. Finally, this new understanding of joint enterprises presented challenges for Nick characterised by his perceived inability to shape the joint enterprises of the CoP or to be able to align his TPACK enactment to participate competently in different contexts. This chapter argued that such challenges are characteristic of community members in a liminal phase.

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CHAPTER 7

Teachers and Technology: Looking Forward

This chapter has sought to examine secondary school teachers' pedagogical adoption of digital technology. The literature review indicated that, while numerous adoption–diffusion models had been used as the basis to understand technology adoption in different populations, the particular contexts in which secondary school teachers' work meant that these adoption–diffusion models were inadequate to describe the means by which teachers enacted their knowledge of practice within the complexity of their workplaces. A popular way of exploring teachers' use of digital technologies has been the technological, pedagogical and content knowledge (TPACK) framework (Mishra and Koehler 2006). While TPACK has been used in hundreds of studies as a framework to measure teachers' knowledge and to explain teachers' use and non-use of digital technologies, the literature reviewed in this study found comparatively little attention paid to the ways in which in-service teachers developed their TPACK.

This chapter begins to redress this gap by focussing on the contextual influences that shape teachers' TPACK development and enactment in their workplace settings. Previous investigations have drawn on initial descriptions of context in the TPACK framework that define it as a location for the exhibition of knowledge, using the physical features of the classroom and the physical availability of technology to help explain why 'TPACK (and PCK) look slightly different … for each teacher in each situation' (S. Cox 2008, p. 47). While it is likely that contextual features such as these contribute to the ways in which teachers develop and enact their TPACK, it is unlikely

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that context alone—as place and technological availability—explain all of the differences in teachers' TPACK. This chapter extends previous considerations of context by examining teachers' TPACK enactment through a situated learning (Lave and Wenger 1991) lens, in particular, Wenger's (1998) communities of practice framework. The use of communities of practice provides a framework and language that allows for exploration of socially mediated processes that shape teachers' TPACK enactment and development. While this links the social contexts of professional communities to TPACK enactment, the aim of the study was to explore the particular nature of the relationship between these aspects. In order to focus on this connection, this chapter has explored a single research question: How are teachers' TPACK enactments influenced in a community of practice?

In addressing this question, a case study methodology was applied, examining four teachers in one Australian school. Each of these four core participants were also invited to include colleagues from their workplace whom they considered to be their key professional learning colleagues. In total, ten participants contributed to the four cases which are reported in this investigation. While all the cases were located in the same physical context, the ways in which the participants enacted their TPACK were very different. Despite the differences in TPACK enactment in each of the four cases, explorations of participants' practices and identity through a communities of practice (CoP) lens found evidence that mutual engagement, joint enterprise, shared repertoire, trajectory and imagination—all features of CoP as described in the literature, helped to explain teachers' TPACK enactment.

It is important to emphasise that the aim of this chapter was neither to argue that TPACK is the only way that teachers' technology use can be understood, nor was it to argue that CoP (as defined by Wenger 1998) leads to TPACK enactment. Rather, it was to examine the ways in which CoP may help to explain the processes that shape teachers' TPACK enactment in their workplace contexts. Consequently, the scope and limitations of this research need to be clearly defined in order to understand why certain avenues have been pursued in this book while others have been left for future inquiry.

Scope and Limitations

The literature reviewed in Chap. 2 illustrated that the definitions of community, including CoP, vary considerably across professional development, workplace learning and CoP research literature. In order to strengthen the

analytical generalizability of this research the theoretical focus on community has been limited to Wenger's (1998) CoP framework. The reasons for choosing this specific framework were outlined in Chap. 2. As a result of this choice, the research literature which was used to build a theoretical understanding of a communal context and its applicability to teachers' workplace contexts was critically considered or rejected where it did not use or specify this specific CoP framework. Similarly, the data collection, analysis and findings rigorously focused on the processes of CoP according to Wenger's (1998) framework.

This research did not consider how participants' behaviour, or the processes described by the CoP framework, may be explained by other theories. Its purpose was not to validate CoP as a theory but rather to investigate if, from this theoretical perspective, themes and processes can be identified that help to explain in-service teachers' TPACK enactment. Admittedly, the observed and reported enactment of TPACK in this investigation could be read through other conceptual lenses, for example, as examinations of power relations or of culture, gender and class differences as these mediate the enactment of particular knowledge forms. However, it has been a deliberate choice not to use other lenses and to address these issues to the extent that they emerged as significant themes from the data which help to clarify the role of CoP. Indeed, 'CoP as a social theory of situated learning is compatible with these socio-cultural influences in the way it considers them as personal histories and trajectories of identity' (Henderson 2007, p. 5).

The use of a case study methodology with small numbers of participants in a specialised workplace context limited the generalizability of the findings. The challenges of case study research, specifically credibility as 'communicative validity' and 'trustworthiness', and generalizability were carefully addressed in Chap. 3. To assure the robustness of the findings, the study employed a variety of strategies including, but not limited to, triangulation across multiple collection points, tools and cases. The research findings should be considered as heavily contextualised.

The study was exploratory in nature and attempted to explore aspects of TPACK that had not been examined in previous research. This study used CoP as a situated learning framework to explore socially mediated influences on teachers' knowledge development and enactment and changes in their pedagogical technology practices and identity transformation. The scope of this research is to identify issues relating to the situated CoP processes that influence TPACK enactment in a school workplace. These

matters are theoretically generalizable and the aim is to point to avenues for future research which may, in turn, lead to generalizable principles that individual teachers or school organisations can use to apply to teachers' TPACK development and enactment.

Propositions

In response to the research focus of this study which sought to understand how teachers' TPACK enactments' are influenced in a CoP, six propositions regarding the role of CoP in teachers' TPACK development are offered:

1. **Processes of identity development and practice constitute aspects of context in which an individual enacts his or her TPACK.**

This study highlighted the importance of context as a component of the TPACK framework. Additionally, this study demonstrated the theoretical connection between identity, practice and knowledge enactment (behaviour) from a CoP perspective. In particular, the connection between processes of identity development (imagination, engagement, alignment and trajectory) and processes of practice (mutual engagement, shared repertoire, joint enterprise and reification) add to previous TPACK studies in which context is considered to be the location for the enactment of knowledge.

This finding has three theoretical implications for the TPACK framework as it changes the way the interplay among the technological, pedagogical and content knowledge unfolds.

- First, context can be thought as including a series of processes grouped around practice and identity and these help to explain how TPACK development and enactment occurs in a workplace.
- Second, changes in TPACK enactment can be considered as changes that occur in context understood through processes of identity development and practice; that is, TPACK may not change within an individual but the context in which it is situated may shape the way it is enacted among individuals.
- Third, TPACK can be thought of as an aspect of trajectory that connects an individual's past participation in a CoP with his or her current competence and anticipated future practices and identity.

The primacy of context, as seen in these three findings, broadens what comprises context to include practice and identity. It also unsettles assumptions of previous TPACK investigations that have attempted to measure individuals' TPACK levels and retrospective changes in TPACK without considering the socially mediated context which influences the way individuals' TPACK is enacted.

2. Membership of a CoP is more complex than newcomers and old-timers and includes near-peers and liminal members.

Wenger's (1998) CoP framework characterises members as newcomers and old-timers. This study challenged the newcomer/old-timer paradigm that dominates CoP research and indicates the value of adding other forms of membership to the CoP framework. This research has revealed that membership of a CoP may be better thought of as a continuum book-ended by newcomers and old-timers with members in-between these two points considered as near-peers and liminal members as these additional forms of membership help to explain some teachers' TPACK enactment in their CoP.

(a) Near-peers help each other to align their participation with the joint enterprise of their CoP through reciprocal relationships characterised by mutual engagement

Anna's professional association with Jake in this study was characterised as a reciprocal near-peer relationship. In contrast to the unidirectional flow of information in newcomer/old-timer relationships, near-peer relationships are characterised by members mutually engaging with one another and reciprocally sharing knowledge and practices which help align their participation with the joint enterprise of their CoP. The near-peer relationship examined in this study was characterised by strong mutual engagement by both members of the CoP in pursuit of a greater understanding of the dynamic interplay between technological knowledge, pedagogical knowledge and content knowledge in their classroom practices. The implication of this finding is that near-peer relationships should be encouraged in schools to help develop competent practices and identities for mid-career teachers.

(b) Liminal members find it challenging to centripetally participate as a result of their failure to grasp threshold concepts Nick's case used the notion of liminality to provide a lens through which his emerging

identity across different contexts could be understood. In contrast to the characterisation of newcomers and old-timers (Wenger 1998) or Lave and Wenger's (1991) reciprocal near-peer relationships discussed in Anna's case, Nick's liminal identity was characterised by his apparent failure to grasp a threshold concept. In this case, the threshold concept was the existence of two simultaneous, context-specific joint enterprises that privileged different parts of TPACK.

Moreover, Nick's case demonstrated how challenges around identity, knowledge and practice play out in a CoP context, through his heated discussions with Darren or internally as Nick's perception of his own identity oscillated while attempting to develop a sense of his professional competence. Liminal members such as Nick appear to associate their identity with a perceived inability to shape the joint enterprises of the CoP or to be able to align their TPACK enactment to competently participate in varying contexts.

3. The enactment of TPACK among teachers in a CoP is not always consensual or coherent.

The consensual notions of 'joint', 'shared' and 'mutual' as descriptors of enterprise, repertoire and engagement have been challenged in critiques of CoP along with the choice of the term community as such language 'tend[s] to assume, or imply coherence and consensus' (Contu and Willmott 2003, p. 287) characterised by a consistent, unified understanding by all participants.

Nick's liminal participation brought into question the consensual notions of 'joint' enterprise and 'mutual' engagement, suggesting instead that those in a liminal phase are less influential in negotiating changes to joint enterprise and mutual engagement than more experienced members with established identities and perceptions of competence.

John's team teaching relationship with Simon provided examples of enterprise, repertoire and engagement that were dominated by Simon's participation and reification of practice as John deferred to Simon's leadership and PCK while pursuing his own leadership aspirations. While there is no suggestion that there was anything baleful in the dissonance evident in Simon and John's relationship, their team teaching partnership did present a different perspective to the traditional conceptualisation of the consensual processes of participation alluded to in the CoP framework. This leads to the proposition that:

4. **Challenges to the assumptions of consensus implicit in concepts such as 'joint' enterprise, 'mutual' engagement and 'shared' repertoire are revealed in communal negotiations involving TPACK enactment and reification. As such, the reification of practice is influenced by professionals' perceptions of power and authority.**

While it is important to acknowledge that the professional relationships in this investigation were unique case studies which limits the generalizability somewhat, this research adds empirical evidence to support calls from researchers such as Contu and Willmott (2003) to consider critically the language used to describe participation in situated learning frameworks such as CoP so that it addresses the complexity of socially mediated relationships expressed through it. In particular, this study has shown how John's perceptions of Simon's power and influence restricted John's willingness to negotiate the reification of the enterprise, engagement and repertoire enacted in their team teaching relationship.

5. **A CoP can have multiple, simultaneous and context-specific joint enterprises which can challenge the relationships between the forms of knowledge underpinning TPACK enactment.**

Nick's case illustrated that a CoP can have simultaneous, context-specific joint enterprises. In contrast to previous TPACK research that describes context as a location for the enactment of TPACK, the change in context in Nick's case was not only a change in the physical location in which teachers' conducted their classes but, more significantly, was also a change in the knowledge that was valued as part of the joint enterprise. The existence of multiple joint enterprises in a CoP has not been reported in previous CoP research.

The multiple joint enterprises in this CoP privileged PK and CK, respectively, for teachers working with students at different year levels. This contrasts with the notion of a dynamic interplay between TK, PK and CK for teachers' professional practice inherent in Mishra and Koehler's (2006) framework. This study provided examples of classroom teaching that is considered effective by the CoP for two different contexts which do not have teachers' enacting equal levels of TPACK in both contexts. The thoughtful interweaving of knowledge forms required for competent participation within a CoP needs to be considered in light of the joint enterprise(s) valued by the participants.

6. Mutual engagement reveals TPACK as knowledge in the making.

The imagined future trajectories expressed by individuals in this study echoed Hager's (2005) theoretical proposition of a (re)construction metaphor which presents an additional perspective to the often used acquisition and participation metaphors in investigations of workplace learning. Anna's desired (re)construction of her TPACK, her practices and her identity helped to explain aspects of her participation in a CoP through mutual engagement with John and Jake. Anna's practices and identity also drew on her past participation and her future aspirations suggesting that TPACK is a fluid concept; it references both knowledge currently possessed and used to support current practices and prospective knowledge in the making. The constitution of TPACK and its development is an ongoing process rather than an acquired static end point.

John's imagined future trajectory as a school leader reinforced the idea that TPACK is able to be thought of as current knowledge as well as knowledge in the making. John's aspirations were different to Anna's and revealed the contribution of a unique identity as a TK expert in the context of his CoP in pursuit of his leadership aspirations. Despite these differences in ambition, John and Anna's cases reveal TPACK as knowledge in the making.

These six propositions make a connection between the CoP framework and the ways in which the processes and practices within it influence in-service teachers' TPACK enactment. In this way, this research brings the two conceptual lenses of CoP and TPACK together. Although CoP and TPACK have been used extensively, they have not been used together to explore the socially mediated contexts which shape teachers' TPACK enactment in the school workplace. While limited by the scope of this research as described above, the connections between CoP and TPACK present a set of theoretical implications for both CoP and TPACK as well as for practice in school workplaces.

Implications and Recommendations for Future Research

The implications for TPACK, CoP and for schools as workplaces are drawn from the research findings and from the above propositions and are offered along with recommendations for future research.

1. **The context shaping TPACK enactment should be considered as more than a physical location.**

While there is little doubt about the influence of physical contextual factors on TPACK enactment, this research has clearly shown that, in all cases considered in this book, TPACK enactment was shaped by processes of identity development (imagination, engagement, alignment and trajectory) and process of practice (mutual engagement, shared repertoire, joint enterprise and reification). As a result, TPACK enactment may be better represented by adding the words 'processes of identity development and practice' to the notion of 'contexts' as factors influencing teachers' TPACK enactment. The addition of practices and processes of identity formation to the commonly used TPACK diagram is illustrated in Fig. 7.1.

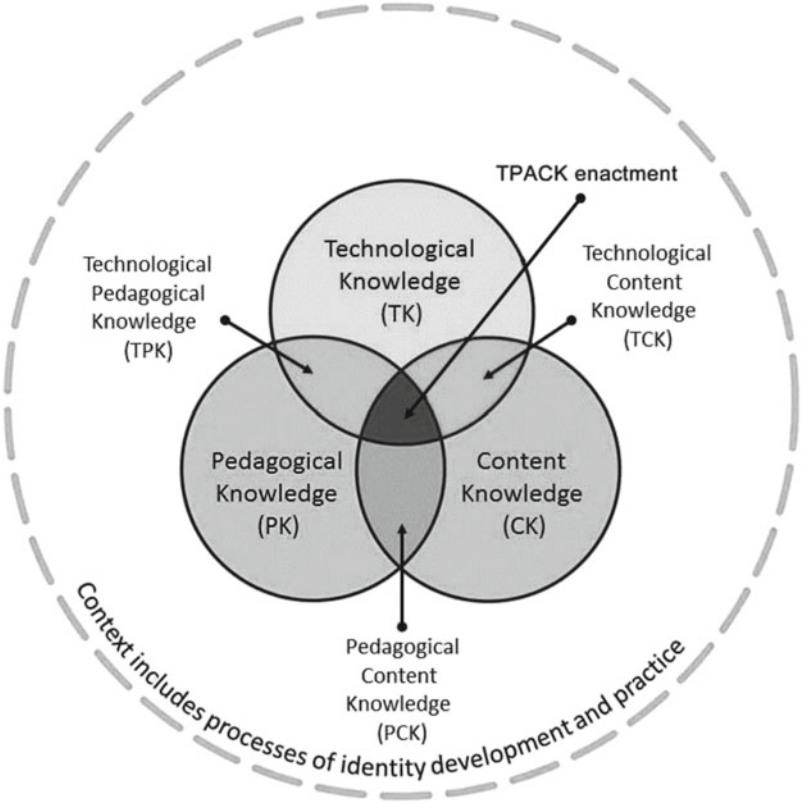

Fig. 7.1 An elaborated representation of TPACK enactment in a CoP

Figure 7.1 presents an elaborated representation of TPACK enactment within the TPACK framework initially presented in this book in Fig. 1.1. The elaborations in Fig. 7.1 represent the major finding from this book and allow researchers to consider the influence of socially mediated processes on teachers' knowledge development and on the enactment of that knowledge. The elaboration of the representation of TPACK enactment represents a significant shift in the way context can be conceptualised and considered and encompasses implications from all six propositions outlined in the previous section through the inclusion of processes of identity formation (imagination, engagement, alignment and trajectory) and processes of practice participation (mutual engagement, shared repertoire, joint enterprise and reification) as theorised in Wenger's (1998) CoP framework as factors influencing teachers' TPACK enactment.

While the addition of processes of identity development and practice have emerged strongly as factors influencing TPACK enactment in this study, the limitations of the study mean that further research needs to be undertaken in different school settings to determine whether the effectiveness of this elaborated understanding of context is transferable to other contexts. Moreover, additional investigation would also assist by exploring the ways identity and practice influence individuals' understandings and responses to identity and practice as socially mediated contextual factors in relation to their TPACK enactment.

2. **TPACK can be considered as knowledge used to support current practices but it is also 'knowledge in the making'.**

In contrast to the idea inherent in much of the research literature that depicts TPACK as an epistemology of possession (Cook and Brown 1999), knowledge developed 'inside individual human heads' (Simon 1991, p. 125), this research has demonstrated the value of also considering TPACK as (a) knowledge that is developed in community and shared across a community of practitioners and (b) knowledge that appears to exist as current and as in development or under construction. Consequently, this study suggests that TPACK may be considered as both an individually acquired and aspirational point, but also as a communal epistemology and an epistemology of practice (Cook and Brown 1999) that is always in the making. The challenge for future researchers is to ascertain whether this character of an epistemology of practice is able to be incorporated in studies examining teacher's TPACK development and enactment across different contexts.

3. **The development of TPACK may be enhanced by the creation of 'different learning teams'.**

In addition to the support more experienced teachers may provide to less experienced teachers, TPACK enactment may be enhanced by teaming teachers with similar trajectories yet different TPACK practices. Findings from this study indicate that such combinations of near-peers, such as the pairing of Anna and Jake in their CoP, can develop relationships of reciprocity, which enhance the TPACK enactment of both individuals. This finding has implications for those developing staff teams and professional development or mentoring programmes in schools. In contrast to simply pairing a master old-timer with an apprentice newcomer, school leaders seeking to develop effective teams of teachers might also consider the potentially valuable role of near-peers and the mix of TPACK expertise in forming those teams. This would be an area that would benefit from future research.

Concluding Statements

This chapter has addressed gaps in the current research literature. In particular, it has suggested six main theoretical propositions which have three implications for teachers' TPACK enactment in their workplaces. On this basis, the study adds to the theoretical understanding of teachers' TPACK development from a situated learning perspective, in particular the ways in which practice and identity development can be understood as the contextual factors which influence in-service teachers' TPACK enactment. As the mounting policy imperatives to use digital technologies across the curriculum continue, such knowledge contributes to the ways in which teachers, school leaders and policy makers may confront the wicked problem of teachers' technology use.

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Notes

(i) Please note: The acronym CoP will be used in this book as an abbreviation both a singular Community of Practice and multiple Communications of Practice. This is done to avoid textual complexity and confusion with the additional acronym CoP's which refers to a belonging to a Community or Communities of Practice.

(ii) The quotations form the participants were taken from interviews conducted on the following dates:

Anna: 23/02/2012 and 06/09/2012
John: 01/06/2012 and 30/10/2012
Nick: 16/03/2012 and 18/07/2012
Felicity: 17/02/2012, 07/03/2012 and 06/07/2012
Simon: 17/05/2012
Jake: 22/11/2012
Joanne: 24/05/2012
David: 30/05/2012
Margaret: 23/05/2012
Alicia: 30/05/2012

(iii) Each of the participants in this case were provided with an individual A4 copy of the TPACK diagram. Each of the participants marked a place on the TPACK diagram to represent where they believed Anna's TPACK was positioned.

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