In this edition of Australian Educational Computing, research continues to focus on the use of the TPACK (Technology Pedagogy and Content Knowledge) framework, the subject of an AEC special edition, 27(3).

The first paper, by Michael Phillips, explores preservice teacher understanding of the technologies that can be used in their future teaching, and how to acquire this understanding. Reviewing the dominant theories in workplace learning as they relate to TPACK provides a useful counterpoint to research focusing on preservice teacher engagement with the framework.

The second TPACK focused investigation, by Kathy Jordan, delves into the gender influences on how teachers engage with the framework. Findings suggest that male preservice teachers self rating their technology knowledge more highly while female preservice teachers self rating their pedagogical knowledge higher.

Finally, Michael Henderson, Ilana Snyder, and Denise Beale review the literature on the use of social media for collaborative learning. They present a set of design principles for educators, highlighting that social media is not redundant to current practices but offers something new, that strategies can be put in place to help students learn how to work collaboratively, and the importance of setting appropriate tasks.

Through various ACCE national initiatives, and in the activities of each state association, there is an increasing focus on the implementation of the Digital Technologies curriculum. The national ACEC2013 conference in Adelaide next year will provide a national forum in which to share and discuss how various states and educational sectors are progressing towards this implementation. I look forward to meeting many of you at the conference and further sharing your initiatives through Australian Educational Computing.

Dr Jason Zagami
Editor
Australian Educational Computing

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In addition there are many educators who are exploring new ideas about the use of computers in education and who are writing articles of national interest. The journal may also contain reprinted articles from international organisations such as ISTE and IFIP; however the majority of articles are of Australian content.

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Associations
Greetings, I hope the teaching year has been successful and that all the members of ACCE’s state associations have a restful, relaxing and well deserved holiday.

The last 3 months for ACCE has been extremely busy and rewarding. I would like to thank all Board members for their commitment to the national association’s activities.

In November I was very pleased to announce that a number of state and territory associations had been awarded grants to help with the implementation of the Digital Technologies Curriculum. The total funding for the grants was $35,000, which for an association the size of ACCE is a large sum of money and does demonstrate our commitment to the implementation process for Digital Technologies.
The resources produced will be shared with all states and territories at the beginning of term 2 next year.

November also saw the election of ACCE past president and Fellow, Ralph Leonard, as Director of the Australian Computer Society’s Computer Education Committee. As an existing member of the ACCE Council this appointment further strengthens the ties between the two organisations. It is also pleasing to note there have been a number of successful engagements between ACS State Committee and ACCE State affiliates; this can only be helpful for education in Australia.

In the past few weeks I have represented ACCE at the Google Education Summit and at the National Group X committee meeting. I do believe that there are many people who are working extremely hard to ensure Australian education and especially the Digital Technologies Curriculum and the ICT General Capability are well resourced and well supported.

As we enter 2014 please note in your diary two major ACCE events. The ISTE Study Tour and ACEC2014, our biennial conference. The tour leaves on June the 17th and returns early July. This is a fantastic opportunity to visit many exciting education destinations. There are still places available. The conference, Now It’s Personnel, begins on September the 30 and runs through to October 3rd. Further information is on the ACCE website at acce.edu.au.

Finally, don’t forget to listen and watch the ACCELN (Learning network). This is a weekly series of 30 minute live education broadcasts hosted by Amanda Rablin (Queensland) and Roland Gesthuizen (Victoria). Google ACCELN or check the website.

Enjoy your break, live long and prosper.

Tony Brandenburg
President ACCE
There have been many professional development opportunities in the Sydney area for computing studies teachers in particular during the latter half of the secondary school year:

• Sydney University offered a free 3 day course for computing teachers during the July holidays which was highly successful and sponsored by Google (CS4HS)

• Macquarie Uni offered a two day course on Augmented reality which again was sponsored by Google

• Oracle ran workshops on: Alice 3D, Greenfoot and a “Girls in Technology” day.

• The latest ‘Fundamentals of Java Programming’ course was run fully online.
Adobe ran a 5 week course on being creative with Photoshop, 300 active participants mostly in Australia and New Zealand met once a week online, facilitators were located in Scotland; they used Moodle as the LMS and Adobe Connect. This series was an excellent example of course delivery and learning for the sake of learning.

Promethean had hoped to run with something in the Sydney area but that did not come to fruition.

Many TeachMeets have been taking place in the Sydney area. They seem to becoming specialized, for example, one was run with English as the focus.

The Google Summit on Digital Technologies was scheduled to take place on Nov.7 and 8th and ICTENSW was successful in getting a couple of people accepted.

The ICTENSW October workshop evening was a success with 65 participants involved in a late afternoon through evening workshops.

The ICTENSW March 15, 16 week end conference is almost organised. Venue: Sydney Uni

- Jason Zagami: keynote speaker and will run a workshop on Digital Technologies on the Sunday
- Higher School Certificate solutions have been organised.
- Peter Thompson, Inspector for the Board of Studies NSW, seems to have been active in things related to ACARA attending various meetings at various levels.
- At the time of this writing, one person has nominated for Leader of the Year and no one has nominated for Educator of the Year for NSW.

Steve Madsen, Vice President ICTENSW
In my previous QSITE report (for AEC Vol 28 No 1), I wrote of the plans for our forthcoming state conference. I am now delighted to report that the conference has been held on Monday, September 30 and October 1 at Siena College, Sippy Downs, Sunshine Coast. Our theme was Finding your W@y and we dedicated the first of the two days to an investigation of Digital Technologies.

The conference was a terrific success. One delegate included the following in an email: “Congrats once again on a great conference - friendly, quality presentations and full of dedicated people.” The feedback on the QSITE Facebook site was also positive.
Thanks QSITE for yet another amazing conference. So many wonderful presentations and so much knowledge and information shared.

Thank you to everyone involved in organizing the wonderful QSITE conference at the Sunny Coast. Fantastic venue! Loved the food. Wonderful people to meet. Sessions were very good too. Lots of new ideas to inflict on my colleagues and charges starting next Tuesday! I really was full of wonder the whole time.

The conference reminded me of what a “broad church” that the state and territory computer education teacher professional associations are. The conference drew delegates from many locations across the state and from all sectors of schooling – from the very youngest to tertiary students. Those from the secondary years tended to be teachers of specialist senior secondary computing subjects. Those from primary classrooms were teachers of many subject areas.

Having this range amongst our delegates makes planning a conference somewhat difficult – we need to meet many needs. One of our solutions was, as noted in my last report, to have a number of targeted mini-keynotes followed by one hour “chat” sessions which allowed more in-depth conversations. This allowed everyone to have a glimpse of what is happening in “other” schooling sectors while allowing those with a specific interest in that area to engage in more personal ways with the keynote speakers. It asks quite a lot of our keynotes but all seemed to be energised – rather than exhausted – by the process. It certainly made the task more interactive than anyone might have expected.

This “glimpsing” is going to be an important part of every teacher’s professional life in the very near future. The Australian Curriculum learning areas and their embedded subjects are progressive and sequential. It will soon be critical for Year 10 teachers to know and understand what skills and dispositions their students have been developing since their Foundation Year. It is also important for primary teachers to be aware of where their students are heading. The delegates at the QSITE 2013 Conference came to understand this with many commenting that this was going to be an emerging challenge for them.

The field of ICT in education is also a broad church and the Finding Your W@y conference gave us the chance to listen to and talk with everyone from an international academic through to some young teachers delivering their first conference presentations. Because the QSITE conference coincided with the ACCE Board Meeting, we were also fortunate to have with us members of our “sister” associations. Tony Brandenburg, the ACCE President, gave the opening address. He spoke of the importance of teacher professional associations and the value of face-to-face events like conferences. These ideas, prompted by followup conversations at the conference, led to an email to the oz-teachers list in which Tony said:

I had the great fortune to attend the Qsite conference recently in Queensland. I enjoyed the two days and learnt a great deal.

He went on to say – and this can be extended to an observation of what happened at the QSITE conference – that:

What I really think, though, is that ACCE (and in turn, many of the other professional associations in Australia) are much more than a conference
and are very relevant for many reasons. The conference, in ACCE’s case, is a time when Australian Educators meet and celebrate what has happened in the past two years from a variety of perspectives. Yes they listen to keynotes, they go to workshops, they present refereed and non-refereed papers, but what they also do is they network and celebrate achievements and are connected to all that is happening.

Lastly, he said that:

… Australian Professional Teacher Associations, not just ACCE, are important as they give teachers an opportunity to share across state borders, they allow teachers to have a focused input into national initiatives and a chance to influence national policy; and I think they give teachers an opportunity to belong and be supported, outside the jurisdictional structures. In fact, I think they provide an opportunity to belong!

So, the QSITE State Conference is over for another year. I can only hope that the knowledge and friendships developed continue into the future. I would like to end this report by sincerely thanking everyone involved from the speakers to the delegates, to the sponsors and exhibitors, to the QSITE Board members who contributed so positively to the success of the event. It was about professional learning, but, above all, it was about “belonging”!
The last 4 months have been busy ones for the members of the EdTechSA and ACEC2014 committees, with a focus on how to best continue the developing momentum for ACEC2014 while also maintaining our efforts for our local membership base for EdTechSA.

EdTechSA

Our annual state conference was held on July 17-18, 2013 at Unley High School. The theme was “Connecting People - Sharing Learning”. The keynotes were Nick Jackson, Mark Sparvell and Professor Chris Pilgrim, in addition to an online keynote address by Dr. Alec Couros which was very well received and demonstrated the effectiveness of online communication.

The EdTechSA Management Committee has decided not to hold the annual 2-day State Conference in 2014 due to our commitments to ACEC2014. Instead, a half-day Saturday PD
event is planned for Term 1 and Term 2. The first of these events is tentatively booked at St Andrew’s school, Walkerville on Saturday 1 March and will focus on ICT as a general capability across four learning areas. There will be four concurrent workshops, which will be repeated to allow delegates to attend two of the four sessions held on the day. These events and other planned PD for 2014 will have some focus on encouraging and supporting members to develop their use of social media in the lead up to ACEC2014.

On 15 and 17 August, a successful Spotlight session and full-day Masterclass were held with Dr. Alec Couros. These were well attended with Alec’s “in-person” facilitation an added benefit after his well-received online keynote at the state conference.

EdTechSA has also recently hosted two other PD events. The first of these being our introduction to iPads workshop, facilitated by two Apple Distinguished Educators, which was attended by 27 predominantly new members on 14 September. We have also recently held our regular SACE IT Examination Revision Workshops, which has again attracted similar numbers as previous years from this specialised teaching area.

ACEC2014

During the last four months, a great deal of progress has been made in the planning for ACEC2014.

The website at http://acec2014.acce.edu.au/ is fully operational and looks fantastic with similar functionality to the sites of ACEC2010 and ACEC2012. We will be opening up registrations on the website very shortly, allowing delegates to benefit from the Early Bird pricing rates which will be available until 14 February 2014.

The Trade and Sponsorship prospectus is available on the website and a silver sponsor has been secured. However, as outlined in the prospectus, there are still currently other opportunities available for trade and sponsorship to become involved with ACEC2014.

Most recently we have announced the first 3 keynote speakers that all delegates will attend.

- Alec Couros (confirmed) - Opening keynote
- Kathy Schrock (confirmed) - with a focus on practical strategies for classroom implementation.
- Toni Downes (confirmed) – plenary speaker to pull the main messages at conference together.
There are still more keynote opportunities available and the ACEC2014 committee is seeking recommendations from delegates through the “Select You Own Keynote” suggestions, as well as providing further opportunities for the possible sponsorship of other inspirational keynotes.

The conference strands are:

**Strand 1: Inspirational Leadership**

Inspirational leadership is about empowerment, working with and walking together. It is about performance, not supervision. It is personal, not institutional; inspiring not constraining; liberating, not coercing. It is a culture, not a state. It is transparent, not secretive. People do the right thing because they want to, not because they have to.

**Strand 2: Innovative Learning**

Students have ever-increasing expectations of being able to work, play and learn via cloud-based services and apps across their mobile devices, whenever they want and wherever they may be. Innovative learning is about possibilities. It is limited only by imagination. It is open, free and wide-ranging. It is not constrained by past thinking. It is personal. It is about choice, connection and reflection. It challenges the learner to be responsible, not reliant. To lead, not follow. To create, not copy.

**Strand 3: Redefining Education**

The importance of personal knowledge management and the blurring of the boundaries between formal and informal learning is redefining education. No longer is education constrained by set parameters. It is not limited to time or place. It is free to explore. It
offers choices, not constraints. It presents challenges, not solutions. It asks questions.

The Program Committee is determined to adopt a modern conference program for ACEC2014 that focuses on personalising the conference experience for delegates. For this reason we have decided to try to promote social interaction and shared meaning between delegates in the lead up to, during and after the conference.

• Plans are being finalised to arrange a Tweet Chat and webinar with the keynotes in the 6 months leading up to the conference and after the conference.

• For each keynote, delegates will be seated in a cabaret style layout and participate in 20 minutes of guided dialogue led by ‘thought leaders’ who will record and share conversations using social media.

• Delegates will be encouraged to record and share their thinking and learning using Twitter via #ACEC2014

• Student-leaders and unconference sessions will also be a feature of the conference. There are also plans to support an un-conference program, including such events as a TeachMeet prior to the Welcome Reception.

The social program is also well into the initial stages of planning and some of the formal events will include:

o Welcome Reception
  5:30 - 7:30pm, Tuesday 30 September

o Breakfast with the Keynotes
  7:30 - 8:30am, Thursday 2 October, Stamford Plaza, North Terrace

o ACCE President’s dinner
  Invitation only event

o Conference dinner
  7:30 - 11:30pm, Thursday 2 October (to be held at the convention centre)

In addition to these more formal events, the social committee is dedicated to upholding the “Now It’s Personal” theme, in providing many other opportunities for delegates to meet, network and share ideas and learning in more informal settings.

To be kept up to date with all the latest from ACEC2014 sign up to the website http://acec2014.acce.edu.au/ to personalise your learning experience and receive regular updates about topics which interest you.
ICT in Education Victoria has had a very successful year offering members a broad range of opportunities for professional learning and networking. We started the year hosting a TeachMeet @ the Pub, where we were entertained and informed by a great selection of Educators sharing their experiences in this informal setting.

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Immediate Past President - Dr Nick Reynolds, University of Melbourne
Executive Officer - Joedy Wallis, ICT in Education Victoria
2013 State Conference

The 2013 State Conference was a sellout event (450 delegates) featuring over 100 presentations. The day’s hashtag #ictev13 was the highest trending in Australia throughout the day and tweeted over 3000 times by people from all over the world. The Storify of the event can be viewed at storify.com/ictev13-it-takes-a-village

Free Webinar Series

We have run 10 free webinar events throughout the year. These one hour webinars provide great practical tips and resources as well as the opportunity to extend teachers’ professional learning networks through a fun and friendly open forum. Topics included: Teaching the 5 P’s of Digital Ethics (Greg Gebhart), Teaching The Social Media Generation (Rebecca Spink), A Collaborative Strategy For Integrating ICT (Bianca Cumine Groza), A Rearvision View Of The Future (John Pearce), Trending Tools and Apps - From A Village perspective (Anne Mirtschin), ICTEV2013: IT Takes A Village Conference Preview (Daniel Donahoo).

Study Tours

We've run successful study tours visiting 18 primary and secondary schools across the state. These have been very popular with participating teaching enjoying the experience of visiting three schools in one day and networking with teachers both at these schools and within the bustour.

ICTEV YouTube

Our YouTube Channel has 177 subscribers. Our featured 58 videos have been viewed a combined 10,019 times

Social Networking - FaceBook and Twitter

ICTEV has an active Facebook page and 4,479 twitter followers

ICTEV Merger with VITTA

After many months of meetings, the members of ICTEV and the Victorian Information Technology Teachers Association (VITTA) have unanimously voted to merge the two associations to form one single Victorian teachers association for all educators from pre-service teachers to principals, from the early years to careers from 1st January 2014.

The new association Digital Learning and Teaching Victoria (DLTV) will be the Victorian Affiliate of Australian Council for Computers in Education.

Become a Foundation Member of Digital Learning and Teaching Victoria. Sign up online at ICTEV or VITTA. All memberships will roll into DLTV on 1 January 2014.

Contact the office

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Research
Investigating In-service Teachers' Workplace TPACK Development

Michael Phillips
Monash University

Abstract

Technological, pedagogical and content knowledge (TPACK) provides a theoretical lens which attempts to identify the nature of knowledge required by teachers for technology integration in their teaching. While there have been hundreds of studies that have used TPACK to examine what teachers need to know about technology as part of their classroom practice, there has been little research specifically investigating how we acquire this knowledge, especially in relation to in-service secondary teachers. This paper investigates workplace learning literature in an attempt to provide a theoretical grounding that will enable future investigations to examine the complex context in which professional educators develop individual knowledge within a socially mediated, participatory workplace culture.
A quest to understand teachers’ professional knowledge.

The quest to determine what knowledge distinguishes teachers from content experts has long been an area of academic investigation (for example, see: Kayser, 1916). Of particular note in this field of research is Shulman’s (1986) delineation of teachers’ professional knowledge as pedagogical content knowledge (PCK). The PCK framework differentiates teachers from content experts as expert teachers have a balanced blend of pedagogical knowledge (PK) and content knowledge (CK) collectively labelled pedagogical content knowledge (PCK) in contrast to content experts’ deference to CK. Shulman’s (1986) conception of PCK has been utilised in different educational contexts (for example, see: Bennett & Dewar, 2012; Benson & Brack, 2009; Berliner, 1988), particularly in the education of Science teachers (for example, see: Loughran, Mulhall, & Berry, 2004) and has contributed to our understanding of teachers’ professional knowledge.

More recently, Koehler and Mishra (2005) re-considered Shulman’s PCK framework in an attempt to understand how the increasing use of digital technologies in schools might impact on the development of teachers professional knowledge. In doing so, they proposed two questions:

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

In an attempt to answer their first question, Mishra and Koehler (2006) expanded the PCK framework through the addition of technological knowledge (TK). In doing so, Mishra and Koehler (2006) proposed that good teaching with technology involves a balanced combination of technological, pedagogical and content knowledge 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 is the context in which teachers’ acquire and exhibit their knowledge as shown in Figure 1.

Figure 1 The TPACK framework from http://tpack.org/
The impact of the TPACK model has been profound and has been used in hundreds of studies examining teachers’ professional knowledge (Graham, 2011), with the majority of these using surveys to measure the extent of teachers’ TPACK (Jordan & Dinh, 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 international examinations of the TPACK development of pre-service teachers (for example, see: Albion, Jamieson-Proctor, & Finger, 2010), distance educators (for example, see: Archambault & Crippen, 2009) and primary teachers (for example, see: Chai, Ling Koh, Tsai, & Lee Wee Tan, 2011). In Australia the most recent, large-scale use of TPACK was in the nationally funded Teaching Teachers for the Future (TTF) project. While these investigations have made valuable contributions to our understanding of the interplay between forms of professional knowledge in a variety of settings, in-service teachers’ TPACK acquisition in their workplaces remains an under-explored context (for example, see: Jordan & Dinh, 2012).

One reason why TPACK acquisition and development (and PCK before it) has proven so difficult to measure is that knowledge must be acquired and exhibited in a specific context. Given the multifarious settings in which secondary school teachers’ work, TPACK may look different in each instance. Included in the idea of context are such things 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 and the preferred instructional methods of the teacher (Kelly, 2008). The effect of context is that TPACK is “unique, temporary, situated, idiosyncratic, adaptive, and specific and will be different for each teacher in each situation” (Cox, 2008). The complexity involved in investigating TPACK acquisition in such changeable environments may explain why researchers have shied away from examining in-service teachers’ TPACK development in their workplaces.

The remainder of this paper explores the suitability of a range of workplace learning theories that could be used to investigate the situated contexts in which in-service teachers develop TPACK.

**Understanding teachers’ workplaces as the context for TPACK development.**

The workplace context in which in-service teachers continue to develop and refine their TPACK remains under-represented in research literature (for example, see: Jordan & Dinh, 2012). To better understand teachers’ workplaces as the context for TPACK development, it is necessary to have a detailed understanding of workplace learning theories. Hager’s (2005) extensive critical assessment focuses on workplace learning in educational settings and, as such, is particularly relevant when assessing the suitability of theoretical frameworks to understand how in-service teachers’ acquire TPACK in their workplace. Finalising his critique of workplace learning theories, Hager (2005) concludes that there are:

Four major criteria for assessing workplace learning theories are 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. (Hager, 2005, p.843)

In order to apply these criteria to current theories of workplace learning in a meaningful way, it is valuable to understand the similarities and differences between workplace learning theories relevant to in-service teachers’ TPACK development. The following review highlights two research traditions that dominate the workplace learning literature with theorists generally subscribing to learning in a workplace via an acquisitional or participatory perspective.

Providing a sense of the development of the history of academic investigations into workplace learning, Hager (2005) highlights the continuously growing body of workplace learning literature from the 1970’s which he positions in two categories. Hager (2005) argues that early accounts of workplace learning “were strongly influenced by the [concept of] learning as a product…” (p.829) in which knowledge was considered as an individually acquired novel attribute. In contrast, more recent accounts of workplace learning focus “more on learners developing [knowledge] 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) argued underpin much educational thought. While both the acquisition and participation categories of workplace learning have contributed to understandings of workplace learning, to better understand in-service teachers’ TPACK development in their workplaces requires both the acquisition and participation collections to be examined in greater detail to allow for evaluation against Hager’s (2005) four criteria outlined above.

Many of the early theories of workplace learning focused 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 (for example, Argyris and Schön (1974, 1978); Schön (1983, 1987); Marsick and Watkins (1990)). Despite variations in these early workplace learning theories, Hager (2005) claims that these concepts have a range of common features:

They centre [on] individual learners.

They focus mainly on the rational, cognitive aspects of work performance

Work performance tends to be conceived as thinking or reflection followed by application– this is especially evident in Schön’s work.

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.

The social, organisational and cultural factors in workplace learning and performance are downplayed. (Hager, 2005, pp. 832-833)

If one accepts Hager’s (2005) summary of early workplace learning theories and examines their range of common features it becomes clear that those that adopt knowledge development from an acquisitional perspective “do not fare well against most of the
criteria” (Hager, 2005, p. 843). The individual, rational and cognitive aspects of work performance common to these theories takes little account of the social, cultural and political dimensions that may be argued as important aspects of workplace learning. As such, it can be suggested that early workplace learning theories may be of little assistance when trying to understand the socially mediated contexts in which in-service teachers’ develop TPACK in their school workplaces. It is worthy to note that the majority of investigations into TPACK take little account of the workplace setting in which in-service teachers continue to develop and refine their professional knowledge; however, research studies too often consider TPACK as an individual attribute or possession. This approach has attracted criticism from researchers such Bereiter (2002) who argued that many forms of research investigating learning too often carry with them unreflective assumptions about what such learning is like, instead rely on the ‘common-sense’ or ‘folk theory’ perspective of learning dominated by the acquisition perspective.

In contrast to these acquisitional theories of workplace learning another conception of workplace learning theories is evident in the literature. These theories broadly recognise that workplace learning and performance are embodied phenomena that are shaped by social organisational and cultural factors that extend beyond individuals. Key theorists from this perspective include Lave and Wenger (1991), Engestrom (2001; 1999), Billett (2001) and Eraut (2000). Given the body of research indicating the growing importance of collaborative knowledge development in schools (for example, see: Butler, Lauscher, Jarvis-Selinger, & Beckingham, 2004; Feldman, 1994; Garmston & Wellman, 2013; Krajcik, Blumenfeld, Marx, & Soloway, 1994; Musanti & Pence, 2010; Wilson & Berne, 1999; Zottmann et al., 2013) it is not surprising to find “that the participation [theorists] have been extremely influential” (Hager, 2005, p. 844).

Lave and Wenger (1991) and Wenger (1998) have made important contributions to the conception of participatory workplace learning through their development of notions such as legitimate peripheral participation and Communities of Practice (CoP). These concepts provide a stark contrast to the view of learning as acquisition and emphasise learning through relationships:

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 comprised of a range of components including items such as workplace rules, the division of labour and mediating artifacts (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. 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 & 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.

While it might be questioned whether all learning at work occurs from the contradictions and tensions within an activity system or CoP, this participatory 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 and thus provides an alternative framework through which in-service teachers’ workplace TPACK development can be considered. Despite this caveat, when using Hager’s (2005) four criteria to assess these participatory theories of workplace learning, their strength arguably lies in the first two standards that accounts for learning as a process while also taking the social, cultural and political dimensions of the workplace into consideration.

It is open to interpretation, for example how well the CoP notion and the legitimate peripheral participation framework that preceded it is in accord with the (re)construction metaphor. While the transition of legitimately peripheral new-comers 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 others, 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). Therefore, the participatory conception underpinning these theoretical frameworks provides an alternative perspective to teachers’ workplace TPACK development; however, this perspective in isolation still presents challenges to researchers wishing to examine professional knowledge development in this context.

Billett’s 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. (Billett, 2001, p.432)
In developing his account of workplace learning, Billett (2001) problematizes the notion that expertise is a capacity of an individual and locates it instead in particular domains of knowledge and social practice. In relation to in-service teachers’ TPACK development, this could translate to an individually held, possibly tacit understanding about the subtle interplay between TK, PK and CK; however, the exhibition of this knowledge occurs in a socially mediated, participatory workplace culture in which growing importance of collaborative knowledge development is recognised. The interplay between individual acquisition and communal participation influencing knowledge development in workplaces has been argued from a theoretical perspective.

Eraut (2000) provided such a theoretical justification when arguing 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) point out, “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). Similarly, Beckett and Hager (2002) indicated that while some aspects of workplace learning can be understood at the level of the individual, but other elements of the same learning is inherently at the level of the group or community of practitioners and they argue that both perspectives should be kept in sight in attempts to examine workplace learning.

The above discussion has located workplace learning in traditions which either construct learning as acquisitional in nature or as socially mediated as a process. While the differences between these traditions have been highlighted, it has also been pointed out that a third group of researchers including Billett (2001), Beckett and Hager (2002), Eraut (2000) and Hager (2005), suggest that nuanced investigations into workplace learning should take both theoretical traditions into account.

To make further sense of these matters and to contextualise these themes in this investigation, the focus will move to a more detailed investigation of the suggestions made by those who advocate for researchers to consider both individual and communal considerations of workplace knowledge development.

Individual and communal considerations of workplace learning theories: implications for research.

This paper seeks to develop an understanding of the ways in which workplace learning theories might help to illuminate the contexts and processes in which in-service teachers’ develop TPACK. The preceding review of workplace learning theories has identified different traditions within the literature. This review has indicated that while there are advantages associated with theories that privilege participation and the social construction of knowledge over acquisitional perspectives, it may be short sighted for one perspective to jettison the other (Eraut, 2000).

Schoenfield’s (1999) perspective adds 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” (p.6).
As Winch (1998) claims, there are many, diverse cases of workplace learning each subject to “constraints in a variety of contexts and cultures” (p.85). This level of constraint therefore prohibits both context and culture from being considered in a general way.

It is noteworthy for this investigation examining TPACK development in school workplaces that Winch’s (1998) conceptualisation of ‘contexts and cultures’ is at a micro level. While it may be the case that the majority of school 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.

Indeed, Hager (2005) suggests, it might not only be a mistake to think about workplace learning in terms that are too closely linked to learning in formal classrooms, “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, which contends that individual cognitive and tacit forms of knowledge are always deployed in a situated way thereby highlighting the need for researchers to not only consider the macro – micro context in which research is conducted but also the balance between examinations of individually acquired knowledge and the knowledge developed through social participation in workplaces.

**Conclusion**

Examinations of teachers’ professional knowledge have been ongoing and have recently reflected the increasing prevalence of digital technologies in teachers’ practice. The TPACK framework has provided a valuable lens through which researchers have been able to examine teachers’ knowledge. Despite the proliferation of empirical research using TPACK, in-service teachers’ development of TPACK in the context of their workplace remains under represented in the research literature. Highlighting the complex context in which professional educators work and learn, this paper has provided a review of the dominant theories in workplace learning to provide a backdrop against which in-service teachers’ TPACK development can be more clearly comprehended. Further research incorporating acquisitional, participatory and (re)construction perspectives outlined in this paper is required to understand how teachers’ acquire TPACK in their workplaces.
References


The influence of gender on beginning teachers’ perceptions of their Technological Pedagogical Content Knowledge (TPACK)

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Abstract

TPACK is emerging as an influential framework for conceptualising teacher knowledge in regards to integrating ICT and is generating considerable international research interest. To date, the question of whether gender plays a role in how teachers self-assess their TPACK knowledge has not figured greatly in this research. This paper seeks to explore this possible role by using an adapted form of the Schmidt et al (2009b) instrument to survey two cohorts of beginning teachers (64 in the first cohort and 142 in the second) from Victoria, Australia. It suggests that, while both genders rate their knowledge highly, especially Content Knowledge, there are significant differences in how male and female beginning teachers rated their knowledge, with males rating their knowledge higher in both years of this study.
Introduction

The development of the TPACK framework by Mishra and Koehler (2006) has met with considerable interest by the educational technology research community, particularly in the United States, but also in Australia, the U.K, Singapore and Taiwan (Abbitt, 2011; Baran et al, 2011; Harris, Mishra & Koehler, 2009; Thompson & Schmidt, 2010; Unwin, 2007). In 2013, some 463 papers could be referenced from the TPACK organisation website (see http://tpack.org/). Researchers have had a particular interest in developing a tool to measure TPACK knowledge and a number of instruments have been developed for this purpose. However, little attention has been given to the possible influence of gender on assessment of TPACK knowledge. This gap is of concern, given that research around gender and ICT generally has suggested that it can play a significant role. This paper aims to address this gap in the literature by focusing on the influence of gender in survey findings from two cohorts of beginning teachers.

The TPACK framework builds on Shulman’s (1986) premise that Content Knowledge (what to teach) and Pedagogical Knowledge (how to teach) are interconnected, and together they form Pedagogical Content Knowledge (PCK). Mishra and Koehler (2006) argue that, because of the increasing number of technologies that are being appropriated in the classroom, teachers also require explicit Technology Knowledge (TK). Their resulting framework then is built on the notion of the connection between Pedagogical Knowledge (PK), Content Knowledge (CK) and Technological Knowledge (TK) and the resulting intersecting three pairs of knowledge, Pedagogical Content Knowledge (PCK), Technological Content Knowledge (TCK), and Technological Pedagogical Knowledge (TPK). Where all three knowledges (PK, CK, and TK) intersect is referred to as Technological Pedagogical Content Knowledge (TPACK).

Measuring TPACK

A lot of research activity around the TPACK framework has focused on developing and administering a valid and reliable tool to measure teachers’ TPACK (Abbitt, 2011; Jordan, 2012; Voogt et al., 2012). Such a tool would be useful for teacher professional development as well as the future design and evaluation of teacher education programs (Baran et al., 2011; Albion, Jamieson-Proctor, & Finger, 2010). To date though, there is no common agreement around such an instrument and “throughout efforts to further define and measure the multiple domains of the TPACK framework, several persistent challenges have remained” (Abbitt, 2011, p. 287). One of these challenges relates to issues in defining the constructs to be measured. Graham (2011), drawing on Cox’s (2008) doctoral research, argues that there have been some 89 different definitions of the central construct as well as other constructs including technology knowledge. Relating to this challenge is the issue around defining the boundaries of the domains (Archambault & Crippen, 2009; Angeli & Valanides, 2009). A further challenge relates to the lack of clarity in the operation of the framework, namely whether TPACK is an integrative form of knowledge, constructed by the integration of other domains of teacher knowledge, or whether it is transformative, and a unique knowledge constructed from other forms of teacher knowledge (Archambault & Barnett, 2010; Angeli & Valanides, 2009).
Abbitt’s (2011) review of TPACK instruments, conducted within the context of pre-service teacher education, argues that there have been two parallel approaches to this research. One approach he argues uses performance-based measures, such as artefacts produced by preservice teachers as evidence of TPACK. He cites the study of Graham, Burgoyne and Borup (2010) as an example of this approach. In that study, 133 early childhood and elementary teachers were asked to state how and why they would integrate ICT into three content-based design tasks (literacy, maths, science or social studies). Using the themes that emerged from these planning and decision-making explanations, the researchers then mapped them against the coding categories of TK, TPK and TPACK. The second approach which Abbitt argues involves the use of self-reporting measures, which preservice teachers use to self-assess their knowledge of particular TPACK domains. In this discussion, he highlights the development and use of The Survey of Preservice Teachers’ Knowledge of Teaching and Technology (Schmidt et al., 2009b), describing it as “among the more mature tools” (p. 290) as “straightforward and useful” and “a valuable instrument in terms of reliability and efficiency” (p. 292). Initially designed as a self-assessment tool for Pk-6 pre-service teachers majoring in elementary and early childhood education, the instrument used 4 subscales within Content Knowledge (social studies, science, literacy and mathematics) to reflect their need to teach in several disciplines. The survey instrument included demographic information and some open-ended questions, around the effectiveness of the teacher education program, as well as some 47 items to measure the knowledge domains in the framework: TK (7 items), CK (12 items), PK (7 items), PCK (4 items), TCK (4 items), TPK (5 items), TPCK (8 items). For each of these items participants were asked to indicate their level of agreement using a five-point Likert scale, Strongly Agree, Neither Agree or Disagree, Disagree and Strongly Disagree. Each item in the survey was scored and then each construct was scored by averaging item scores.

This instrument has been used by a number of other researchers, particularly international researchers who have adapted the instrument to suit their particular context. A recent search of titles of papers available on the TPACK organisation website (using the term ‘TPACK’ or ‘TPCK’ or ‘pedagogy’ or ‘pedagogical’, as well as ‘content’, ‘technology’, or ‘technological’ and ‘knowledge’) located some 12 papers which used this instrument. These are listed in Appendix 2. Two of these papers were produced by the survey designers, as part of their efforts to use the tool in other contexts. In one of these studies, the designers used this instrument to evaluate the TPACK of 87 pre-service teachers enrolled in an introductory technology course (Schmidt et al., 2009a) and, in the other (Shin et al., 2009), they investigated the effect of a summer course on 17 teacher’s TPACK. The instrument has been adapted for use in both smaller scale surveys, such as the 17 participants in Shin et al. (2009), to larger-scale surveys involving 1185 participants, as in Koh, Chai and Tsai (2010). It has been used both as a single test and a pre-test and post-test design.

Often the process of adapting the instrument for particular use involved removing the initial focus on 4 content areas, and replacing them with items reflecting the particular context. For example, Koh, Chai and Tsai (2010) wanted their adapted instrument to reflect the primary and secondary teaching context in Singapore, and so included the item, ‘I know how to select effective teaching to guide student thinking in my curriculum
subject’. Chai, Koh and Tsai (2010), to reflect the teaching subjects of secondary teachers in Singapore, replaced the four items with the items, ‘Curriculum Study 1’ and ‘Curriculum Study 2’. Often as well, adaptations to the instrument involved redefining the constructs. Koh, Chai and Tsai (2010) reduced the number of constructs from 7 to 5: Technology Knowledge, Content Knowledge, and Knowledge of Pedagogy, Knowledge of Teaching with Technology, and Knowledge from Critical Reflection, and some 29 items. Chai, Koh and Tsai (2010) reduced the number of constructs further to 4: Technology Knowledge, Pedagogy Knowledge, Content Knowledge and TPACK. Adaptations also involved the number of levels in the agreement scale. Several, namely Koh, Chai and Tsai (2010), Chai, Koh and Tsai (2010) and Chai, Koh and Tsai (2011) increased the number of levels to 7, in the belief that this aided reliability.

**TPACK and gender**

Investigating the role that gender may have on the assessment of TPACK knowledge is important, given that research around gender and educational computing per se has shown that there are significant gender differences in relation to attitudes to ICT, ICT skills and ICT use (Kay, 1992; 2006). The literature around the latter two areas, relating to skills and use is particularly relevant given their synergies with technology knowledge, defined as knowledge of technologies and how to apply this knowledge productively (Harris, Mishra & Koehler, 2009). Given the operational premise of the TPACK framework that teachers interconnect their knowledge, how teachers assess their technology knowledge has a flow on effect on the interconnected domains of TPK, TCK and ultimately TPACK.

In relation to computer use, Kay (2006) reviewed some 42 studies and concluded that 51% showed higher use by males. In relation to computer ability, he concluded that males reporting higher ability in 8 studies, females in 1, and no difference reported in 7 studies. Markauskaite (2006) also argues that males and females had significant differences in ICT capabilities, with males scoring higher than females. Likewise, the earlier study by Jamieson-Proctor et al. (2006), indicated that female teachers were less confident to use ICT for teaching and learning, being more likely to indicate Very Little or Some confidence (on a four point scale) relating to listed ICT applications compared to male teachers. It is to be noted that, more recently, the literature suggests that these gender gaps may be lessening. Koh and Chai (2011), for example, argue that, as more and more computers become prevalent in schools, this may have the effect of equalising difference in use between males and females. This sentiment is supported by Koh, Chai and Tsai, (2010).

To date though, the question of whether gender impacts on measuring TPACK knowledge has largely not been asked. In part, this could be because researchers have been concerned with questions around defining the constructs to be measured and the validity and reliability of the instrument itself. The few studies which have considered this question have concluded mixed results. Koh, Chai and Tsai (2010) in their study of 1185 pre-service teachers in Singapore, concluded gender differences in Technology Knowledge, Content Knowledge and Knowledge of Teaching with Technology, yet also suggested that this gap may reduce as computers become more common place in schools. In contrast, Koh and Chai (2011) in their study of 214 pre-service teachers, reported no significant differences by gender. The purpose of this paper is to offer further research on this question.
Aims of the study

Using an adapted form of the Schmidt et al. (2009b) instrument, this study compares male and female beginning teachers’ self-assessments of their TPACK knowledge. These beginning teachers were in their first year of teaching in P-12 schools across the state of Victoria, Australia. Two cohorts of teachers, one cohort in 2010 and the other in 2011 make up this study, with Cohort 1 comprising 64 beginning teachers and Cohort 2 comprising 142 beginning teachers. Findings from Cohort 1 have been reported elsewhere (Jordan, 2011). This study draws on this data set as well as that by the second cohort.

The study’s aim is guided by several questions: How do male and female self-assessments compare? What are the differences and similarities in how they self-assess their domain knowledge? How do they self-assess multiple items in a given domain? What are the similarities and differences in how they self-assess these multiple items? Does this self-assessment remain constant in the two years of the study?

Method

The Schmidt et al. instrument (2009b) commonly used by other researchers was adapted for use in this study (see Appendix 1). This adaptation involved the practice used by other researchers of removing the focus on the 4 content areas in the initial instrument, and replacing them with items related to the particular context. Thus, the items, ‘I have sufficient knowledge about the content I am teaching’ and ‘I have various ways and strategies of developing my understanding of the content I teach’ were used. Other adaptations made to PCK and TCK are shown in Appendix 1.

The 5 point scale asking participants to indicate level of agreement (Strongly Agree, Agree, Neither Agree nor disagree, Disagree, Strongly Disagree) remained constant. The adapted survey was then administered online via Survey Monkey.

The participants

The participants in this study are part of a larger Victorian education department initiative, the Supporting New Teacher’s Practice program, which aims to support beginning teachers in their first year of teaching as they face the challenges of being new to the profession (DEECD, 2010). Costing over $1 million, this three year program involves separate cohorts of beginning teachers from P-12 schools.

This program uses a blended approach to professional learning and includes a two day face-to-face program and is then followed by an extended online program of around 6 months. The face-to-face component aims to provide beginning teachers with opportunities to share their first year experiences as well as discuss some challenges to their practice. It also serves to orientate them to online technologies and prepare them to be able to participate in subsequent online elements. The online component of the program followed the face-to-face component. It essentially has two functions, to provide beginning teachers with further knowledge about issues affecting their practice and to provide a space for them as a community to share experiences and develop shared practice (Wenger, 1998).

The 206 beginning teachers involved in the first two years of this program teach in primary schools, secondary schools, across both these sectors (such as P-10 settings) or in specialist schools (such as
special development schools or language schools for new arrivals). The vast majority had completed their teacher education program the year before at a range of institutions across the state. For some this was a four year bachelor qualification, for others it was a one year or two year post graduate qualification. There are around 4000 graduate teachers each year in Victoria. As such, this study provides a snapshot of how beginning teachers teaching in this state self-assess their TPACK knowledge.

Data collection and analyses

As part of this program, the beginning teachers completed a pre-program survey, with a section which sought information about their TPACK, which forms the basis of this paper. In 2010 (Cohort 1), 64 beginning teachers completed this survey, with 52 female and 12 male respondents. In 2011 (Cohort 2), 142 beginning teachers completed the survey, with 112 female and 30 male respondents. This proportion of males and females is consistent with national statistics for teaching.

The survey findings were then analysed to examine how the beginning teachers rated their knowledge in each of the domains of the framework, but no test of significance was chosen to be conducted, given the small number of males in 2010. In keeping with the initial survey designed by Schmidt et al. (2009b), an average or mean result for each item was calculated, by assigning a numerical score of 1 to 5 to the level of agreement scale. Thus a score of 5 was calculated for Strongly Agree, 4 for Agree, 3 for Neither agree or disagree, 2 for Disagree and 1 for Strongly Disagree. In the following section, a more detailed commentary on the beginning teachers’ self-assessments is provided. Each cohort of beginning teachers is considered, and these are often referred to as ‘All Participants’, as well as each gender (male and female).

Results

1. Analysis of domain knowledge

As shown in Table 1 below, the two cohorts of beginning teachers revealed similar trends in how they rated their knowledge of each of the domains. In both years, they rated their knowledge of CK highest (3.98 in 2010, 4.04 in 2011), and those around technology, including TK, TCK, TPK and TPACK lower. Males rated their knowledge higher than females in most domains (6 domains in 2011, 5 domains in 2011), but males rated their PK knowledge lower than females in both years.

<table>
<thead>
<tr>
<th>Table 1 Domain Knowledge</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DOMAINS</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>TK</td>
</tr>
<tr>
<td>CK</td>
</tr>
<tr>
<td>PK</td>
</tr>
<tr>
<td>PCK</td>
</tr>
<tr>
<td>TCK</td>
</tr>
<tr>
<td>TPK</td>
</tr>
<tr>
<td>TPACK</td>
</tr>
</tbody>
</table>

2. Analysis of domain knowledge – individual survey items

In the following section, how the beginning teachers rated individual items within each of the domains, are analysed.
a. Technology Knowledge

Technology Knowledge (TK) is knowledge about technologies and having the knowledge to use them and to learn new ones. Some four items were used to measure the beginning teachers’ knowledge in this domain.

Table 2 Technology Knowledge

<table>
<thead>
<tr>
<th>TK ITEM</th>
<th>2010</th>
<th></th>
<th></th>
<th>2011</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Solve my technical problems</td>
<td>ALL(64)</td>
<td>FEMALE(52)</td>
<td>MALE(12)</td>
<td>ALL(142)</td>
<td>FEMALE(112)</td>
<td>MALE(30)</td>
</tr>
<tr>
<td>3.54</td>
<td>3.53</td>
<td>3.71</td>
<td>3.45</td>
<td>3.39</td>
<td>3.83</td>
<td></td>
</tr>
<tr>
<td>Learn technology easily</td>
<td>4.07</td>
<td>4.01</td>
<td>4.21</td>
<td>4.06</td>
<td>4.01</td>
<td>4.13</td>
</tr>
<tr>
<td>Keep up with new technologies</td>
<td>3.89</td>
<td>3.82</td>
<td>3.97</td>
<td>3.80</td>
<td>3.82</td>
<td>3.93</td>
</tr>
<tr>
<td>Have the technical skills</td>
<td>4.01</td>
<td>3.97</td>
<td>4.17</td>
<td>4.00</td>
<td>3.99</td>
<td>4.14</td>
</tr>
</tbody>
</table>

In 2010, the beginning teachers varied somewhat in how they rated their knowledge of the 4 items, from a mean score of 4.07 for ‘Learn technology easily’ to 3.54 for ‘Solve my technical problems’. This pattern was repeated in 2011. When gender is considered, male beginning teachers in both years rated their knowledge higher in each item compared to females.

b. Content Knowledge

Content Knowledge (CK) is knowledge of the content to be learned or taught and how this content knowledge is different in other subject areas. Two items were used to measure Content Knowledge.

Table 3 Content Knowledge

<table>
<thead>
<tr>
<th>CK ITEM</th>
<th>2010</th>
<th></th>
<th></th>
<th>2011</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge about the content</td>
<td>ALL(64)</td>
<td>FEMALE(52)</td>
<td>MALE(12)</td>
<td>ALL(142)</td>
<td>FEMALE(112)</td>
<td>MALE(30)</td>
</tr>
<tr>
<td>3.97</td>
<td>3.90</td>
<td>4.21</td>
<td>4.06</td>
<td>4.05</td>
<td>4.10</td>
<td></td>
</tr>
<tr>
<td>How to develop content knowledge</td>
<td>4.04</td>
<td>4.07</td>
<td>4.80</td>
<td>4.08</td>
<td>4.09</td>
<td>4.04</td>
</tr>
</tbody>
</table>

The two cohorts similarly rated their knowledge of these two items. Females, however, rated their knowledge of one item, ‘How to develop content knowledge’ higher than males in both years, and their knowledge in the other item, ‘Knowledge about the content’ less.

c. Pedagogical Knowledge

Pedagogical Knowledge (PK) is knowledge about the methods of teaching and learning, such as knowledge of lesson planning and knowledge of learning theories. Beginning teachers self-assessed their Pedagogical Knowledge in relation to seven items.

Table 4 Pedagogical Knowledge

<table>
<thead>
<tr>
<th>PK ITEM</th>
<th>2010</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Assess student performance</td>
<td>ALL(64)</td>
<td>FEMALE(52)</td>
<td>MALE(12)</td>
<td>ALL(142)</td>
<td>FEMALE(112)</td>
<td>MALE(30)</td>
</tr>
<tr>
<td>3.86</td>
<td>3.88</td>
<td>3.83</td>
<td>3.89</td>
<td>3.85</td>
<td>3.77</td>
<td></td>
</tr>
<tr>
<td>Adapt teaching</td>
<td>4.04</td>
<td>4.11</td>
<td>3.75</td>
<td>3.87</td>
<td>3.99</td>
<td>3.63</td>
</tr>
<tr>
<td>Different learners</td>
<td>3.97</td>
<td>3.97</td>
<td>3.91</td>
<td>4.04</td>
<td>4.04</td>
<td>4.06</td>
</tr>
<tr>
<td>Assess in multiple ways</td>
<td>3.91</td>
<td>3.91</td>
<td>3.66</td>
<td>3.94</td>
<td>3.99</td>
<td>3.83</td>
</tr>
<tr>
<td>Range of teaching approaches</td>
<td>3.96</td>
<td>4.01</td>
<td>4.63</td>
<td>3.94</td>
<td>3.98</td>
<td>3.87</td>
</tr>
<tr>
<td>Understandings and misconceptions</td>
<td>2.57</td>
<td>3.59</td>
<td>3.57</td>
<td>3.68</td>
<td>3.65</td>
<td>3.57</td>
</tr>
<tr>
<td>Classroom management</td>
<td>3.78</td>
<td>3.82</td>
<td>3.57</td>
<td>3.84</td>
<td>3.87</td>
<td>3.70</td>
</tr>
</tbody>
</table>

While the male beginning teachers assessed their knowledge higher in CK and TK than females did, this pattern was reversed in this domain, with females rating their knowledge higher in all items in 2010, and in 6 of the 7 items in 2011. In both years, both males and females rated the same two items ‘Understandings and misconceptions’ and ‘Classroom management’ lower than the other items. However, there was a shift in how they rated their knowledge of ‘Adapt teaching’, rating this highest in 2010, but behind 4 other items in 2011.
d. Pedagogical Content Knowledge

Pedagogical Content Knowledge (PCK) is knowledge of particular pedagogy (methods or practices of teaching and learning) to use in relation to particular content knowledge. Only one item was used to gauge Pedagogical Content Knowledge.

**Table 5 Pedagogical Content Knowledge**

<table>
<thead>
<tr>
<th>ITEM</th>
<th>2010 ALL(64)</th>
<th>FEMALE(52)</th>
<th>MALE(12)</th>
<th>2011 ALL(142)</th>
<th>FEMALE(112)</th>
<th>MALE(30)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Select effective teaching approaches</td>
<td>3.81</td>
<td>3.84</td>
<td>3.96</td>
<td>3.90</td>
<td>3.95</td>
<td>3.83</td>
</tr>
</tbody>
</table>

Beginning teachers expressed high levels of agreed knowledge in relation to the one item in this domain in both 2010 and 2011. While males indicated higher rates in 2010, this was not the case in 2011.

e. Technological Content Knowledge

Technological Content Knowledge (TCK) is knowledge about the relationship between content and technology and how technologies both constrain and enable new representations of content. Only one item was also used to assess Technological Content Knowledge.

**Table 6 Technological Content Knowledge**

<table>
<thead>
<tr>
<th>ITEM</th>
<th>2010 ALL(64)</th>
<th>FEMALE(52)</th>
<th>MALE(12)</th>
<th>2011 ALL(142)</th>
<th>FEMALE(112)</th>
<th>MALE(30)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Know about technologies</td>
<td>3.83</td>
<td>3.79</td>
<td>4.00</td>
<td>3.84</td>
<td>3.83</td>
<td>3.83</td>
</tr>
</tbody>
</table>

Beginning teachers self-assessed their agreed knowledge similarly in both years. Males indicated higher rates in 2010, and these were similar to the data for females in 2011.

f. Technological Pedagogical Knowledge

Technological Pedagogical Knowledge (TPK) is knowledge of technologies and of their capabilities or affordances in teaching and learning settings and knowledge that teaching may change as a result of their application. Nine items were used to measure knowledge in this domain.

**Table 7 Technological Pedagogical Knowledge**

<table>
<thead>
<tr>
<th>ITEM</th>
<th>2010 ALL(64)</th>
<th>FEMALE(52)</th>
<th>MALE(12)</th>
<th>2011 ALL(142)</th>
<th>FEMALE(112)</th>
<th>MALE(30)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Choose technologies to enhance teaching</td>
<td>3.94</td>
<td>3.86</td>
<td>4.21</td>
<td>3.83</td>
<td>3.83</td>
<td>3.96</td>
</tr>
<tr>
<td>Choose technologies to enhance learning</td>
<td>3.83</td>
<td>3.80</td>
<td>4.17</td>
<td>3.81</td>
<td>3.82</td>
<td>3.94</td>
</tr>
<tr>
<td>Influence of teacher preparation on thinking about deeply</td>
<td>3.86</td>
<td>3.78</td>
<td>4.09</td>
<td>3.88</td>
<td>3.89</td>
<td>3.94</td>
</tr>
<tr>
<td>Think critically about use of technology</td>
<td>3.86</td>
<td>3.78</td>
<td>4.09</td>
<td>3.86</td>
<td>3.80</td>
<td>3.94</td>
</tr>
<tr>
<td>Adapt technologies to teaching activities</td>
<td>3.82</td>
<td>3.79</td>
<td>4.04</td>
<td>3.81</td>
<td>3.80</td>
<td>3.83</td>
</tr>
<tr>
<td>Select to enhance teaching/learning</td>
<td>4.01</td>
<td>3.93</td>
<td>4.17</td>
<td>3.77</td>
<td>3.78</td>
<td>3.74</td>
</tr>
<tr>
<td>Use strategies from teacher preparation</td>
<td>3.78</td>
<td>3.69</td>
<td>3.96</td>
<td>3.73</td>
<td>3.71</td>
<td>3.77</td>
</tr>
<tr>
<td>Provide leadership</td>
<td>3.49</td>
<td>3.45</td>
<td>3.84</td>
<td>3.34</td>
<td>3.22</td>
<td>3.63</td>
</tr>
<tr>
<td>Choose technologies to enhance content</td>
<td>3.92</td>
<td>3.87</td>
<td>4.08</td>
<td>3.84</td>
<td>3.85</td>
<td>3.77</td>
</tr>
</tbody>
</table>

The beginning teachers varied in how they rated their knowledge in these 9 items, ranging from 3.49 to 4.01 in 2010 and 3.34 to 3.88 in 2011. One item, relating to ‘provide leadership’ they rated lower in both years. Males rated their knowledge higher in this domain. In 2010, they rated all items higher, while in 2011 they rated some 7 items higher, but these rates were less than in 2010.
g. TPACK

Technological Pedagogical Content Knowledge (TPACK) is emergent knowledge of good teaching with technology involving understanding of three sources of knowledge; namely, pedagogy, content and technology knowledge. Only one item was used to measure TPACK.

Table 8 TPACK

<table>
<thead>
<tr>
<th>ITEM</th>
<th>2010 ALL (64)</th>
<th>2010 FEMALE (52)</th>
<th>2010 MALE (12)</th>
<th>2011 ALL (142)</th>
<th>2011 FEMALE (112)</th>
<th>2011 MALE (30)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teach lessons</td>
<td>3.84</td>
<td>3.75</td>
<td>4.08</td>
<td>3.76</td>
<td>3.81</td>
<td>3.87</td>
</tr>
</tbody>
</table>

The beginning teachers similarly assessed their knowledge in both years, with males rating their knowledge higher than females.

Discussion

This paper reports on how 206 beginning teachers from P-12 schools across Victoria, self-assessed their TPACK using an instrument adapted from Schmidt et al. (2009b). This survey instrument was administered to one cohort in 2010, and the other cohort in 2011. Using the findings from both surveyed years, this paper seeks to better understand the possible role that gender has on teacher self-assessment of TPACK knowledge.

In this section, I discuss the results of this study in relation to previous research which has also measured teacher’s TPACK. As stated earlier, however, multiple instruments have been developed to do so, in part because researchers have wanted to measure the TPACK of particular participants, in particular contexts, and sometimes, when using particular technologies. However, researchers such as Graham (2011) and Angeli and Valanides (2009) also suggest that multiple instruments abound as researchers face considerable challenges in designing them, as defining the domains to be measured and the boundaries between them is difficult. In an effort to provide more of a like-minded comparison of results, this discussion concentrates on research which also used the Schmidt et al. (2009b) instrument as well as mean findings to report on domain knowledge. Thus, only 5 of the papers included in Appendix 2 (those in bold text) are utilised; that is, Bos and Lee (2012), Chai, Koh and Tsai (2010), Koh, Chai and Tsai (2010), Koh and Chai (2011), and Schmidt et al. (2009a). It is to be noted that when doing so, while a paper may report on pre- and post- survey findings (such as Bos & Lee, 2012; Chai, Koh & Tsai, 2010; and Schmidt et al., 2009a) only pre-test results are discussed.

Beginning teacher domain knowledge

Findings have suggested that, in both years of this study, male and female beginning teachers rated their knowledge highly in all domains, recording mean data of 3.80 in the first year and 3.98 in the second. This finding is confirmed by other studies, although these studies used a different scale and constructs. For example, Chai, Koh and Tsai (2010), reported means scores of 4.39 to 4.95, from their study using a 7 point scale and 4 constructs and likewise Koh, Chai and Tsai (2010) reported scores of 4.71 to 5.45, also using a 7 point scale, but 5 constructs.

A closer analysis of how the beginning teachers rated their knowledge in each of the domains revealed higher mean ratings in Content Knowledge in both years (3.98 in 2010 and 4.04 in 2011). Only one other study, that by Koh and Chai (2011), reported likewise, and this was for only one of the two content areas being measured, while two studies (Bos & Lee, 2012; Koh, Chai & Tsai, 2010) scored CK lowest. Other studies reported higher ratings in
other domains. In two of these, PK was reported highest (Bos & Lee, 2012; Chai, Koh & Tsai, 2010), while in another (Koh, Chai and Tsai (2010), Knowledge from Critical Reflection (KCR) was rated the highest, with TPK rated highest in the study by Schmidt et al. (2009a).

Of particular interest was how they assessed their Technology Knowledge, given that research around gender and educational computing generally has suggested that males rate their ICT skills more highly than females. Beginning teachers in this present study also assessed their knowledge around technology, including TK, TCK, TPK and TPACK lower than Pedagogy Knowledge and Content Knowledge. This finding was not evident in other studies to any great degree. Thus, research around the self-assessment of domain knowledge has revealed different conclusions.

Male and female domain knowledge
The main objective of this study was to compare how male and female beginning teachers rated their domain knowledge. It suggests that there were considerable differences in the self-assessment patterns of males and females, with males consistently rating their domain knowledge higher than females. However, they rated PK lower in both years, as well as PCK in 2011.

There were similarities in the way that male and female beginning teachers self-assessed multiple items in domains. Both males and females similarly assessed items in CK and TK, with both rating less knowledge in relation to solving technical problems. In relation to PK, both males and females rated their knowledge lower in two items, ‘I am familiar with common student understandings and misconceptions’ and ‘I know how to organize and maintain classroom management’. In relation to TPK, both genders rated their knowledge lower around providing leadership.

Of the studies selected for inclusion in this discussion, only two explicitly examined findings in relation to gender and these reported conflicting findings. In one of these studies, Koh, Chai and Tsai (2010), surveyed 1185 primary and secondary pre-service teachers (809 females and 376 males) in Singapore, using an instrument with 5 constructs, a 7 point scale and some 29 items. The researchers used T-tests to consider the influence of gender as well as age, and teaching level. The results showed gender differences in relation to TK, CK, and Knowledge of Teaching with Technology (KTT), with male pre-service teachers rating their knowledge higher. While these differences were small in relation to CK and KTT, they were largest for TK. The researchers, when commenting on these findings, suggested that females needed more TK support, however added that this was probably only needed in the short-term, as the increased use of computers in schools would likely increase female ICT experiences in the future.

In the other study, Koh and Chai (2011) measured 214 preservice teachers (149 female and 65 male), also in Singapore. They used the TPACK for Meaningful Learning Survey, an instrument underpinned by constructivist learning (also used by Chai, Koh and Tsai, 2011), which had 7 constructs, a 7 point scale and some 33 items. The researchers considered the possible relationship between gender and the domains through independent sample T-tests, concluding however that there were no significant gender differences.

This present study also considered whether or not the patterns in self-assessment by gender were consistent in both years. Findings
suggest that female patterns were more constant, with male patterns in the second year indicating some decline in knowledge of some domains (PCK, TCK, TPK and TPACK). This finding cannot be verified, as the studies by Koh, Chai and Tsai (2010), and Koh and Chai (2011) were not conducted over the same period.

**Implications for pre-service teacher education**

This study suggests that the beginning teachers studied generally rate their TPACK knowledge highly, particularly in relation to their CK. This finding, however, is not consistent with other research which concluded higher rates of knowledge in a range of domains. Given that the TPACK framework is underpinned by the notion of interconnecting knowledge, pre-service teacher education providers could pay closer attention to undertaking similar studies of their teacher education students and monitoring findings over time to inform their programs of study.

This study also suggests that there are considerable differences in how male and female beginning teachers self-assess their domain knowledge, with males consistently self-assessing their knowledge higher than females. Pre-service teacher programs could consider giving more attention to increasing knowledge levels of females. Further research could consider the possible role that female confidence levels have on these findings. Both genders revealed some similarities in how they rated individual items within knowledge domains. Their similar rating of the item around ‘having the knowledge to solve technical problems’ suggests this is a possible area that could be attended to in education programs.

**Future directions**

The findings from this study suggest that there are major differences in how male and female beginning teachers assess their knowledge of the TPACK framework. Previous research has not really focused on the influence of gender, and the few studies which have, have reported inconsistent findings. Further studies are therefore warranted, so that we can gain a much clearer understanding of its possible role. These studies could focus on pre-service and in-service teachers, and consider possible similarities and differences in how both rate their knowledge. Further studies might also examine age and gender.

Further research could examine the possible connections between measurement of TPACK knowledge and subsequent practice. Is there a relationship, and if so, what is it? For example, if male beginning teachers are more likely to rate their TPACK knowledge highly than females, will this higher rating be carried over to their practice? Related to this question around connections of knowledge to practice, is the question of to what extent could this knowledge be used as a predictor of practice.

This study examined beginning teachers, those in their first year of teaching. It would be interesting to examine their TPACK knowledge over time and to consider the influence of various factors on their ratings. For example, this research could consider the role of a teacher mentor in schools, the school leadership team, and professional development in influencing teacher assessment of knowledge.
Conclusion

There is a growing body of research interest in measuring teachers’ TPACK, evident in a considerable body of research involving a multitude of instruments. The Schmidt et al. instrument (2009b) initially devised as a self-report instrument for Pk-6 preservice teachers, has been one of the most adapted instruments, particularly outside the United States. A number of researchers such as Graham (2011) and Angeli and Valanides (2009) have urged caution in drawing too many conclusions from research reporting to measure TPACK knowledge, arguing that there are a number of theoretical issues that need to be addressed. To date though, this research has not focused much on the possible influence of gender on teacher self-assessment and this gap is significant, given that research around gender and educational computing in general has suggested that males rate their ICT skills more highly than females.

This study has aimed to add to this gap in research by examining how two cohorts of male and female beginning teachers (64 in Cohort 1 and 142 in Cohort 2) rate their TPACK knowledge. It has suggested that while male and female beginning teachers rate their domain knowledge highly, particularly around Content Knowledge, they rate their knowledge around technology lower, including their capacity to interconnect this knowledge to form TCK, TPK and TPACK. It has suggested there are significant differences in how male and female beginning teachers rated their knowledge with males consistently rating their domain knowledge higher. Females however rated their knowledge higher than males in one domain, Pedagogy Knowledge. This study has also made numerous recommendations for future research, particularly around examining the possible connection between measurement of TPACK knowledge and practice.

References


### Appendix 1: Adapted Schmidt et al (2009b) instrument

<table>
<thead>
<tr>
<th>Schmidt et al (2009b) survey instrument</th>
<th>Adapted version</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TK Technology Knowledge</strong></td>
<td><strong>TK Technology Knowledge</strong></td>
</tr>
<tr>
<td>1. I know how to solve my own technical problems.</td>
<td>1. I know how to solve my own technical problems.</td>
</tr>
<tr>
<td>2. I can learn technology easily.</td>
<td>2. I can learn technology easily.</td>
</tr>
<tr>
<td>3. I keep up with important new technologies.</td>
<td>3. I keep up with important new technologies.</td>
</tr>
<tr>
<td>4. I frequently play around the technology.</td>
<td>4. I have the technical skills I need to use technology.</td>
</tr>
<tr>
<td>5. I know about a lot of different technologies.</td>
<td></td>
</tr>
<tr>
<td>6. I have the technical skills I need to use technology.</td>
<td></td>
</tr>
<tr>
<td><strong>CK (Content Knowledge)</strong></td>
<td><strong>CK (Content Knowledge)</strong></td>
</tr>
<tr>
<td><strong>Mathematics</strong></td>
<td>5. I have sufficient knowledge about the content I am teaching.</td>
</tr>
<tr>
<td>7. I have sufficient knowledge about mathematics.</td>
<td></td>
</tr>
<tr>
<td>8. I can use a mathematical way of thinking.</td>
<td></td>
</tr>
<tr>
<td>9. I have various ways and strategies of developing my understanding of mathematics.</td>
<td></td>
</tr>
<tr>
<td><strong>Social Studies</strong></td>
<td>6. I have various ways and strategies of developing my understanding of the content I teach.</td>
</tr>
<tr>
<td>10. I have sufficient knowledge about social studies.</td>
<td></td>
</tr>
<tr>
<td>11. I can use a historical way of thinking.</td>
<td></td>
</tr>
<tr>
<td>12. I have various ways and strategies of developing my understanding of social studies.</td>
<td></td>
</tr>
<tr>
<td><strong>Science</strong></td>
<td></td>
</tr>
<tr>
<td>13. I have sufficient knowledge about science.</td>
<td></td>
</tr>
<tr>
<td>14. I can use a scientific way of thinking.</td>
<td></td>
</tr>
<tr>
<td>15. I have various ways and strategies of developing my understanding of science.</td>
<td></td>
</tr>
<tr>
<td><strong>Literacy</strong></td>
<td></td>
</tr>
<tr>
<td>16. I have sufficient knowledge about literacy.</td>
<td></td>
</tr>
<tr>
<td>17. I can use a literary way of thinking.</td>
<td></td>
</tr>
<tr>
<td>18. I have various ways and strategies of developing my understanding of literacy.</td>
<td></td>
</tr>
<tr>
<td><strong>PK (Pedagogical Knowledge)</strong></td>
<td><strong>PK (Pedagogical Knowledge)</strong></td>
</tr>
<tr>
<td>19. I know how to assess student performance in a classroom.</td>
<td>Nil adaptions</td>
</tr>
<tr>
<td>20. I can adapt my teaching based-upon what students currently understand or do not understand.</td>
<td></td>
</tr>
<tr>
<td>21. I can adapt my teaching style to different learners.</td>
<td></td>
</tr>
<tr>
<td>22. I can assess student learning in multiple ways.</td>
<td></td>
</tr>
<tr>
<td>23. I can use a wide range of teaching approaches in a classroom setting.</td>
<td></td>
</tr>
<tr>
<td>24. I am familiar with common student understandings and misconceptions.</td>
<td></td>
</tr>
<tr>
<td>25. I know how to organise and maintain classroom management.</td>
<td></td>
</tr>
</tbody>
</table>
## Appendix 1 continued: Adapted Schmidt et al (2009b) instrument

<table>
<thead>
<tr>
<th>Schmidt et al (2009b) survey instrument</th>
<th>Adapted version</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PCK (Pedagogical Content Knowledge)</strong></td>
<td></td>
</tr>
<tr>
<td>26. I can select effective teaching approaches to guide student thinking and learning in mathematics.</td>
<td><strong>PCK (Pedagogical Content Knowledge)</strong></td>
</tr>
<tr>
<td>27. I can select effective teaching approaches to guide student thinking and learning in literacy.</td>
<td>14. I can select effective teaching approaches to guide student thinking and learning in the content areas I teach.</td>
</tr>
<tr>
<td>28. I can select effective teaching approaches to guide student thinking and learning in science.</td>
<td></td>
</tr>
<tr>
<td>29. I can select effective teaching approaches to guide student thinking and learning in social studies.</td>
<td></td>
</tr>
<tr>
<td><strong>TCK (Technological Content Knowledge)</strong></td>
<td></td>
</tr>
<tr>
<td>30. I know about technologies that I can use for understanding and doing mathematics.</td>
<td><strong>TCK (Technological Content Knowledge)</strong></td>
</tr>
<tr>
<td>31. I know about technologies that I can use for understanding and doing literacy.</td>
<td>15. I know about technologies that I can use for understanding and doing what I teach.</td>
</tr>
<tr>
<td>32. I know about technologies that I can use for understanding and doing science.</td>
<td></td>
</tr>
<tr>
<td>33. I know about technologies that I can use for understanding and doing social studies.</td>
<td></td>
</tr>
<tr>
<td><strong>TPK (Technological Pedagogical Knowledge)</strong></td>
<td><strong>TPK (Technological Pedagogical Knowledge)</strong></td>
</tr>
<tr>
<td>34. I can choose technologies that enhance the teaching approaches for a lesson.</td>
<td>34. I can choose technologies that enhance the teaching approaches for a lesson.</td>
</tr>
<tr>
<td>35. I can choose technologies that enhance students' learning for a lesson.</td>
<td>35. I can choose technologies that enhance students' learning for a lesson.</td>
</tr>
<tr>
<td>36. My teacher education program has caused me to think more deeply about how technology could influence the teaching approaches I use in my classroom.</td>
<td>36. My teacher education program has caused me to think more deeply about how technology could influence the teaching approaches I use in my classroom.</td>
</tr>
<tr>
<td>37. I am thinking critically about how to use technology in my classroom.</td>
<td>37. I am thinking critically about how to use technology in my classroom.</td>
</tr>
<tr>
<td>38. I can adapt the use of the technologies that I am learning about to different teaching activities.</td>
<td>38. I can adapt the use of the technologies that I am learning about to different teaching activities.</td>
</tr>
<tr>
<td>39. I can select technologies to use in my classroom that enhance what I teach, how I teach and what students learn.</td>
<td>39. I can select technologies to use in my classroom that enhance what I teach, how I teach and what students learn.</td>
</tr>
<tr>
<td>40. I can use strategies that combine content, technologies and teaching approaches that I learned about in my coursework in my classroom.</td>
<td>40. I can use strategies that combine content, technologies and teaching approaches that I learned about in my coursework in my classroom.</td>
</tr>
<tr>
<td>41. I can provide leadership in helping others to coordinate the use of content, technologies and teaching approaches at my school and/or district.</td>
<td>41. I can provide leadership in helping others to coordinate the use of content, technologies and teaching approaches at my school and/or district.</td>
</tr>
<tr>
<td>42. I can choose technologies that enhance the content for a lesson.</td>
<td>42. I can choose technologies that enhance the content for a lesson.</td>
</tr>
<tr>
<td><strong>TPACK (Technology Pedagogy and Content Knowledge)</strong></td>
<td><strong>TPACK (Technology Pedagogy and Content Knowledge)</strong></td>
</tr>
<tr>
<td>43. I can teach lessons that appropriately combine mathematics, technologies and teaching approaches.</td>
<td>25. I can teach lessons that appropriately combine content knowledge, technologies and teaching approaches.</td>
</tr>
<tr>
<td>44. I can teach lessons that appropriately combine literacy, technologies and teaching approaches.</td>
<td></td>
</tr>
<tr>
<td>45. I can teach lessons that appropriately combine science, technologies and teaching approaches.</td>
<td></td>
</tr>
<tr>
<td>46. I can teach lessons that appropriately combine social studies, technologies and teaching approaches.</td>
<td></td>
</tr>
</tbody>
</table>
## Appendix 2: Studies which adapted the Schmidt et al (2009b) instrument

Note: Studies in bold text are included in the discussion section.

<table>
<thead>
<tr>
<th>NAME</th>
<th>YEAR</th>
<th>PARTICIPANTS</th>
<th>CONSTRUCTS</th>
<th>ONE TEST OR PRE-TEST AND POST-TEST</th>
<th>FINDINGS (mean)</th>
<th>FOCUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bos &amp; Lee</td>
<td>2012</td>
<td>43 (7% M and 93% F)</td>
<td>7 constructs: TK, Mathematical Content Knowledge, PK, PCK, TPK, TCK and TPCK</td>
<td>Pre-test and post-test and year later</td>
<td>From pre-test: TK: 3.55 CK: 3.53 PK: 3.91 PCK: 3.87 TPK: 3.65 TPCK: 3.60</td>
<td>To analyse mathematics teachers' TPACK knowledge at various points and their integration of TPACK knowledge into their lesson plans</td>
</tr>
<tr>
<td>Chuang &amp; Ho</td>
<td>2011</td>
<td>335</td>
<td>unclear</td>
<td>One test</td>
<td>Significant correlation between five modelled uses and TPACK knowledge. Use of CMC and digital materials/software are predictors of TPACK.</td>
<td>Effects of modelling on in-service early childhood teachers' TPACK knowledge</td>
</tr>
<tr>
<td>Jordan</td>
<td>2011</td>
<td>64</td>
<td>7 constructs: CK (2 items), TK (4 items), PK (7 items), TPK (9 items), PCK (1 items), TCK (1 item) and TPACK (1 item)</td>
<td>One test</td>
<td>TK: M 4.04, F 3.82 CK: M 4.04, F 3.99 PK: M 3.71, F 3.90 PCK: M 4.00, F 3.81 TCK: M 4.00, F 3.75 TPK: M 4.07, F 3.77 TPACK: M 4.08, F 3.81</td>
<td>To analyse beginning teachers' TPACK knowledge</td>
</tr>
<tr>
<td>Shin et al</td>
<td>2009</td>
<td>17</td>
<td>7 constructs: TK (7 items), CK (12 items), PK (7 items), PCK (6 items), TCK (4 items), TPK (8 items), TPCK (8 items)</td>
<td>Pre-test and post-test</td>
<td>Reports on matched-pairs means</td>
<td>To analyse how in-service teachers developed TPACK knowledge after participation in an educational technology course</td>
</tr>
<tr>
<td>Chai, Koh &amp; Tsai</td>
<td>2010</td>
<td>889 (208 M and 248 F in pre-test)</td>
<td>4 constructs: TK (4 items), PK (5 items), CK (4 items) and TPACK (5 items)</td>
<td>Pre-test and post-test</td>
<td>From pre-test: TK: 4.39 CK: 4.39 PK: 4.95 TPACK: 4.91</td>
<td>To analyse a TPACK-focused ICT program, “ICT for Meaningful Learning”</td>
</tr>
<tr>
<td>Chai, Koh and Tsai</td>
<td>2011</td>
<td>214</td>
<td>7 constructs: TK (6 items), CK (6 items), PK (6 items), TCK (4 items), TPK (3 items), PCK (4 items), TPCK (5 items)</td>
<td>One test</td>
<td>Results report on the constructs</td>
<td>To design an instrument to measure Singapore pre-service teachers' TPACK knowledge, underpinned by a constructivist orientation</td>
</tr>
<tr>
<td>Galstaun, Kennedy-Clark &amp; Hu</td>
<td>2011</td>
<td>216 pre-test (48 M and 168 F), and 172 post-test</td>
<td>3 constructs: TK, TPK, TPACK</td>
<td>Pre-test and post-test</td>
<td>Presented pre and post test results as percentages</td>
<td>To analyse pre-service teachers' confidence to integrate ICT into their practice by measuring TPACK knowledge</td>
</tr>
<tr>
<td>Hu &amp; Fyfe</td>
<td>2010</td>
<td>172</td>
<td>3 constructs: TK, TPK, TPACK</td>
<td>Pre-test and post-test</td>
<td>Presented pre and post test results as percentages</td>
<td>To measure impact of new curriculum on pre-service teachers' TPACK knowledge</td>
</tr>
</tbody>
</table>
### Appendix 2 continued: Studies which adapted the Schmidt et al (2009b) instrument

Note: Studies in bold text are included in the discussion section.

<table>
<thead>
<tr>
<th>NAME</th>
<th>YEAR</th>
<th>PARTICIPANTS</th>
<th>CONSTRUCTS</th>
<th>ONE TEST OR PRE-TEST AND POST-TEST</th>
<th>FINDINGS (mean)</th>
<th>FOCUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Koh, Chai &amp; Tsai</td>
<td>2010</td>
<td>1185 (F 809, M 376)</td>
<td>5 constructs: TK (3 items), CK (6 items), Knowledge of Pedagogy (7 items), Knowledge of Teaching with Technology (9 items), Knowledge from Critical Reflection (2 items)</td>
<td>One test</td>
<td>From one test: TK: 4.84 CK: 4.71 KP: 5.00 KTT: 4.89 KCR: 5.45 Gender differences in relation to TK, CK, KTT, with males scoring higher especially TK</td>
<td>To examine TPACK perceptions of pre-service teachers in Singapore</td>
</tr>
<tr>
<td>Koh &amp; Sing</td>
<td>2011</td>
<td>214 (149 F and 65 M)</td>
<td>7 constructs: TK (6 items), CK (6 items), PK (6 items), TCK (2 items), TPK (4 items), PCK (4 items), TPCK (5 items)</td>
<td>One test</td>
<td>TK 5.10 PK 5.01 CK(1) 4.13 CK(2) 4.72 TPK 4.72 TCK 4.41 PCK 4.62 TPCK 4.76 No significant gender differences</td>
<td>To analyse Singapore pre-service teachers’ TPACK perceptions with consideration of demographics (gender and age)</td>
</tr>
<tr>
<td>Liu</td>
<td>2011</td>
<td>401 (136 M and 265 F)</td>
<td>3 constructs: TCK (3 items), PCK (3 items), TPK (3 items), TPACK (3 items)</td>
<td>One test</td>
<td>Compares those enrolled in course and those not enrolled</td>
<td>Influence of an integrated course on pre-service teachers’ TPACK knowledge</td>
</tr>
<tr>
<td>Schmidt et al</td>
<td>2009a</td>
<td>87 (F 71 and M 16)</td>
<td>7 constructs: TK (7 items), CK (12 items), PK (7 items), PCK (4 items), TCK (4 items), TPK (5 items), TPCK (8 items)</td>
<td>Pre-test and post-test</td>
<td>From pre-test TCK 3.18 TPACK 3.62 TK 3.43 PK 3.74 TPK 3.96 CK-Literacy 3.82 CK Math 3.50 CK Science 3.52 CK Social Studies 3.67 PCK 3.62</td>
<td>To analyse pre-service teachers’ TPACK knowledge following participation in instructional technology course</td>
</tr>
<tr>
<td>Schmidt et al</td>
<td>2009b</td>
<td>124</td>
<td>7 constructs: TK (7 items), CK (12 items), PK (7 items), PCK (4 items), TCK (4 items), TPK (5 items), TPCK (8 items)</td>
<td>One test</td>
<td>Describes the development of the instrument and pilot study</td>
<td>To analyse pre-service teachers’ TPACK knowledge</td>
</tr>
</tbody>
</table>
Social media for collaborative
A review of school literature

Michael Henderson, Ilana Snyder, Denise Beale
Monash University

Abstract
Social media are widely seen as having transformational potential in school education. However, there is a surprising lack of empirical research in schools about pedagogical designs using social media and particularly the factors that facilitate or hinder desirable outcomes. Consequently, this article offers a review of the limited empirical research literature, and is unique because it not only focuses on school contexts, when the literature is dominated by the tertiary sector, but also because it carefully excludes uses of social media that do not leverage its particular affordances, that is, social interactivity. A synthesis of the literature resulted in a series of design principles for educators, including three broad conclusions that social media for collaborative purposes is best utilised when: (a) social media is not redundant to current practices but offer something new, (b) strategies are in place to help students learn how to work collaboratively, and (c) the tasks are appropriate.
Introduction

The potential of social media to increase interactivity and collaboration to benefit learning was recognised early (e.g., Desilets & Paquet, 2005; Knobel & Lankshear, 2006; Richardson, 2006) and considerable research to date has been conducted in higher education (for systematic reviews, see Greenhow, Robelia & Hughes, 2009; Minocha, 2009). However, in the schooling sector, empirical research literature is more limited, despite scholarly interest in the benefits of social media applications (e.g., Bryant, 2007; Burnett & Merchant, 2011; Lankshear & Knobel, 2011). In addition, the relatively small amount of literature available inconsistently refers to other research from the sector, which is perhaps a consequence of being spread thinly across a gamut of educational disciplines (e.g., literacy, mathematics, child development) as well as drawing on different methodologies and different theoretical standpoints (and in many cases without theory). The result is a poorly defined body of literature which cannot easily be leveraged by practitioners to help in their design of educational experiences, or used by researchers in further refining our understanding of the issues. Consequently, this review provides a much needed consolidation of empirical research findings into the uses of social media in school settings. This review helps to discern the shape and focus of research conducted to date and, drawing on the approach of Hew, Cheung and Ng (2010), to reveal possible future research trajectories by considering the factors that facilitate or hinder effective use of social media for teaching and learning purposes in schools.

1. Defining social media

There is no universally agreed definition of social media, nor uniform terminology, consistent with rapid technological developments and evolving conventions and uses (Burnett & Merchant, 2011). Often researchers use terms such as Web 2.0 (Greenhow, Robelia & Hughes, 2009), social networking (Livingstone & Brake, 2010), social software (Owen, Grant, Sayers & Facer, 2006; Minocha, 2009) or simply the internet. Web 2.0 is the most frequently used term in relation to social media, however its meaning has changed over time, and is often mistakenly used by teachers and academics to refer to any dynamic website regardless if it involves social, cooperative or collaborative interactivity. In recognition of this confusion in the literature, this review uses the term ‘social media’ because it emphasises social interaction, reflecting the authors’ interest in leveraging the unique affordances of the technology in facilitating students, teachers and others working with each other for a variety of purposes.

We have adopted Kaplan and Haenlein’s (2010) definition of social media as ‘a group of Internet-based applications that build on the ideological and technological foundations of Web 2.0, and that allow the creation and exchange of User Generated Content’ (p. 61). These interactive applications encompass, amongst others, social networking services (eg. Facebook), blogs (eg. Blogspot), microblogs (eg. twitter), wikis (eg. wiktionary.org), forums (eg. minecraftforum.net), video sharing (eg. YouTube), and image sharing (eg. Flickr) enabling people to connect for purposes of ‘collaboration, contribution and community’ (Anderson, 2007, p.
14). The definition also includes virtual worlds (eg. SecondLife) and massive multiplayer online role playing games (eg. World of Warcraft) however these have been excluded from this review due to their diversity and complexity which require a more detailed response than can be given here.

It is important to recognise that wikis, blogs and other social media can be used in ways that take no advantage of the technology’s social affordances. For instance the researchers have noted the use of Facebook by teachers to inform students of upcoming assessments. However, the same task could be accomplished by email, and does not leverage the networked environment beyond the fact that a network exists. As a consequence, this review carefully excludes or otherwise considers critically those studies where social media are used essentially as one-way publication or broadcast sites. We recognise that such usage may be highly valuable (eg. the use of a blogging tool to create a portfolio of learning for self-reflection and assessment), however, as we sought to understand the particular opportunities and implications arising from the social interactivity afforded by social media, for the purposes of this review they are not included. The focus then of this article is not the use of social media for just communication, but rather the use of social media for meaningful interactions, particularly characterised by cooperation or even collaboration.

**Method**

We sought to identify studies which investigated the use of social media in schools in order to understand the opportunities and implications which arise from the social interactivity afforded by social media. The review included research studies in journals that focus on teachers and classrooms, conference proceedings (national and international including ACEC, ASCILITE, SITE, EdMedia, etc.) and reports on empirical research or horizon scans (e.g. Educause, The New Media Consortium). Seventeen popular education electronic databases were surveyed.\(^1\) Results were limited to a date range of 2005 to 2012. A variety of search terms was used with the most useful Boolean construct being: (social media OR web 2.0 OR social network*) AND (education OR school OR teach* OR learn* OR child*). In addition to the databases, twenty four key journals were surveyed by using their own online search functions or by sighting each issue from 2005 to 2012.\(^2\) Finally the bibliographies of all articles selected from these searches were then scanned in a ‘snowball’ method and further studies located for consideration.

Identifying articles that specifically focussed on children and young people was not easy. The majority of articles returned during the search were from the higher education sector. Eventually 135 articles dealing with children or young people or the school sector in general were retrieved, of which 47 were overviews, conceptual papers and suggestions for practice which considered the role of social media in learning, but did not report on research and were not included in the review. Fifteen research reports which investigated technology use more broadly and in which social media were not the focus were discarded, as were fifteen studies which considered social media, although not for collaborative learning purposes. For instance, where a blog was used to simply publish a student’s work, but which did not leverage any of the social media affordances such as using the comment fields for others to comment on the blog. Another fifteen research reports were excluded, either because they were preliminary findings, lacked detail or did not further
understanding. Ultimately forty-three 43 reports of research were included in the review offering insights into the factors that facilitate or hinder effective leveraging of social media for teaching and learning purposes.

In the first stage of analysis, the findings of the articles were extracted and thematically organised by one of the authors. A second author did the same task for 20 of the articles, strengthening reliability of interpretation and thematic organisation. A second stage of analysis included all three authors who iteratively refined the themes from the first stage and synthesised the findings, with constant reference to the original source files. This process led to identifying three broad themes in the research literature surrounding the use of social media in school contexts. First, young people cannot be assumed to know how to use social media for learning. Second, effective use of social media is characterised by (a) extending learning through offering new opportunities that could not be achieved with other media, (b) preparing students to work collaboratively before and during the use of social media, and (c) employing the media for appropriate tasks. The third theme revealed the central role of teachers in the successful use of social media for learning. These themes and their related conclusions and recommendations are discussed in turn below.

2. Young people cannot be assumed to know how to use social media for learning

As we conducted the review it became clear that the field is awash with optimistic but poorly substantiated claims of the potential for social media in education. In many of the articles this potential seems to be founded on students’ affinity for social media in their personal lives. However our review also revealed that such affinity or even frequent use should not be assumed to mean that young people know how to use social media in educational contexts, or for learning purposes.

Children and young people’s frequent use of social media is not in question. In the US, social media were used by 73 per cent of teenagers in 2008 (Lenhart, Purcell, Smith & Zickuhr, 2010). In 2009, social media were used by 90 per cent of Australian young people between 12 and 17 and by 51 per cent of those between eight and 11 (ACMA, 2009). In 2011, 65 per cent of Australian internet-using young people between the ages of 9 and 16 were reported to have a profile on a social media site (Green, Brady, Olafsson, Hartley & Lumby, 2011) and social media had been used by 94.9 per cent of 1004 Victorian students in Years 7 to 10 (de Zwart et al., 2011). Similar findings have been reported in the US, the UK and Europe. However, as Livingstone and Haddon (2009) attest, there is a risk that children and young people’s frequent use of digital technologies and social media is conflated with proficiency and effectiveness.

Studies that have explored young people’s use of technologies in their everyday lives as well as in educational settings draw a more nuanced picture, contesting the assumption of uniform skill (Barron, Walter, Martin & Schatz, 2010; Calvani, Fini, Ranieri & Picci, 2012; Eynon & Malmberg, 2011; Ito, et al., 2008; Sweeney & Geer, 2010; van den Beemt, Akkerman & Simons, 2010, 2011). The findings from these studies mean that a first consideration for policy regarding social media use in educational settings should be based on the assumption that not all students are familiar with a range of different media, that they use them all equally or that they
are proficient users. Within schools, studies suggest that students used social media mostly to upload photos and to keep in touch with friends, and Google and Wikipedia for searching. Researchers noted that few students wrote blogs or participated in online forums (e.g. Clark, Logan, Luckin, Mee & Oliver, 2009; Luckin, Clark, Graber, Logan, Mee & Oliver, 2008, 2009). The majority of students were engaged in ‘consuming’ rather than ‘producing and publishing’ (Luckin et al., 2009: p. 94), consistent with the findings of other studies (e.g. Barron et al., 2010; van den Beemt et al., 2010) social media were not considered to be learning technologies.

Young people’s orientations to social media as leisure, communication and informal information-gathering applications create inherent ‘tensions’ in adopting these media for learning purposes (Crook, et al., 2008, p. 33). It is evident that the re-envisioning of social media as educational needs to take account of these orientations and work actively to legitimise new uses that build on students’ existing learning but also develop learning with applications that may be unfamiliar.

**3. Effective use of social media**

The review clearly demonstrated instances where social media had a valuable role in facilitating the cooperative or collaborative engagement of teachers, students and others in the learning process. For instance, connections with teachers can be made between different physical locations and outside specified class times (Chandra & Watters, 2012; DeGennaro, 2008), with groups outside the class such as other students at different levels of education (Gomez, Schieble, Curwood & Hassett, 2010; Maher 2009, 2010), with external experts (Hastie, Casey & Tarter, 2010) and with the wider community (Valk, et al., 2011). Within the classroom, social media can be employed to enhance students’ collaboration on group tasks (Liu, Liu, Chen, Lin & Chen, 2011; Pifarre & Fisher, 2011), as well as to draw on the knowledge and skills of others to enhance their own (Zhang, Scardamalia, Lamon, Messina & Reeve, 2007). Students can use the media to provide feedback and support to peers, and also share work with an audience beyond their teacher (Duncan-Howell & Lloyd, 2008; Hastie et al., 2010). These same affordances enable teachers to monitor students’ progress more closely as well as to provide timely guidance and feedback (Hastie et al., 2010; Zywica, Richards & Gomez, 2011).

By contrast, there are other studies which have investigated the use of social media for learning by school students and have reported disappointing results. Students can be reluctant to comment on each other’s work when using social media. They may complete to a required minimum level or not engage with the work of others (Grant, 2009; Joubert & Wishart, 2011). When completing a joint task, such as wiki writing, students have been shown to be hesitant to alter others’ work and protective of their own (Liu et al., 2011). When working with students outside of school, contact is often confined to expressions of support or to the coordination of their activities, rather than extending their learning through higher level exchanges (Duncan-Howell & Lloyd, 2008). When opportunities have been provided for students to communicate with strangers via social media, for learning purposes such as in an English as a Foreign Language context, or with unknown students in other schools, students have been found to engage in what teachers can regard as distracting exchanges (Maher, 2009), or to engage only when their teacher requires it (De Almeida Soares, 2008). Interaction between students within the same class or school or
with others outside it can be inappropriate or abusive (Geer & Sweeney, 2010; Maher, 2010).

Disappointing results have also been noted when social media are used within a task where face to face collaboration is already high, and consequently social media are automatically redundant (Heafner & Friedman, 2008). Also, where social media are used for tasks which are unrelated to the curriculum or not obviously linked to learning purposes, successful use is unlikely (Tan, 2009; Wishart & Triggs, 2010).

The above provides a glimpse into the diversity of findings from the research literature. A synthesis of those findings suggests that effective use of social media for collaborative learning requires clear pedagogical designs and purposes which: (a) extend learning through offering new opportunities (b) prepare students to work collaboratively with social media and (c) employ social media for tasks which are appropriate. The following sections address each of these conditions.

3.1 Extending learning through offering new opportunities;

Studies which capitalise on the new opportunities that social media afford demonstrate the potential for learning, in particular through providing:

1. contact with outside experts;

2. an audience beyond the teacher;

3. meaningful contact between teachers and students working on the same activity out of school;

4. ways for students to view and build on the work of others in their group or class;

5. purposeful interaction between students in different schools, levels or classes across time frames and distance;

6. a means to enhance the participation of all students;

7. a facility for timely feedback from teachers and peers.

Examples from the review are provided below to illustrate some of the ways these opportunities have been utilised.

Social media permit students to make contact with other people beyond their classroom teacher in ways which add expert knowledge of the subject matter. Students can be motivated by such contact to test and extend their ideas as in Hastie et al.’s (2010) study of a class of Years 10 and 11 British secondary school students. In a group wiki writing task, an American professor, a games expert, and his graduate students provided expertise and an external audience for the class. The researchers reported that students were excited by the outside audience and resulted in a high degree of participation. An audience beyond the teacher was provided through the medium of the wiki, one which would not otherwise have been available to them. As well, students showed considerable interest in the wiki task, posting comments on it outside school hours, and benefiting from comparing their work with others after class. Similarly, in Mak and Coniam’s (2008) study of Year 7 students in Hong Kong it was reported that the knowledge that parents were to be the audience for their group wiki writing task rather than simply the teacher added to students’ motivation.
Contact between teachers and students or amongst students outside of school hours and from different locations makes new learning connections achievable. A study (Chandra & Watters, 2012) in an Australian secondary school investigated whether Year 12 students’ learning in Physics could be improved by incorporating social media through after school chat session as one component in a series of lessons designed around a website, Getsmart. Analysis of student chat demonstrated that they focused on extending their conceptual understanding through reflecting on their answers and learning from others. Interaction between teachers and students allows for different types of learning opportunities which can also take place outside class contact hours.

Students can view and build on the work of others in their group or class as they develop and extend new ideas. Zhang et al.’s 2007 study of a class of Grade 4 children in Canada using the group workspace called Knowledge Forum (Zhang et al., 2007), informed by Scardamalia and Bereiter’s (2006) knowledge building principles, showed the students recording ideas, uploading material and commenting on each other’s work. Students’ post-tests showed significant gains in their scientific knowledge. Through building on each other’s ideas in the interactive space, the children gained new understandings. Pifarre and Fisher (2011) in a study in Spain with 9-10 year olds writing in a wiki concluded that the collaborative process and the ongoing discussion during the writing phase enhanced the students’ understanding of the nature of a writing task, as they learned from the comments and changes made by others.

Interaction amongst students can occur within the same class but can also be extended to students in other classes and physical locations, as in the study of the Dissolving Boundaries program which connected teachers and students across 150 schools in Northern Ireland and the Republic of Ireland, using social media within Moodle, over time moving from coordination to collaboration (Austin, Smyth, Rickard, Quirk-Bolt & Metcalfe, 2010). In a study of secondary and primary school students communicating with each other via social media in a transition program, Maher (2010) found that the shared exchanges facilitated understanding of new norms and supported other transition activities.

In these studies, new opportunities for interaction could be afforded through interactive sessions in which the teacher’s participation was crucial. His or her authoritative knowledge enhanced the importance of exchanges between students and teachers and also legitimised the social media spaces as a site of educational practice designed to enhance content knowledge (Chandra & Watters, 2012). Different forms of social media offer a means to enhance the participation of all students. Hastie et al. (2010) found that the wiki enabled less athletic boys to participate more positively in a game activity than they may have been able to otherwise. Chandra and Watters (2012) noted that the interactions through the chat facility between teachers and students in their homes enabled the participation of those who might not normally do so in the classroom, although collaboration between students was more limited.
Timely feedback from both teachers and peers is another benefit. Hastie et al. (2010) found that students modified their wikis after hours and the teacher could monitor these and provide feedback. Pifarre and Fisher (2011) also investigating wikis, noted that the ability to review each student’s changes to the wiki meant that the teacher was able to judge students’ individual participation and progress. The chat facility employed by Chandra and Watters (2012) meant that the teacher could give positive feedback immediately which motivated students to prepare more actively for the session. Zhang et al.’s (2007) study found that the teacher’s online feedback suggested new lines of inquiry and posed questions which stimulated the children’s higher-order thinking. Students could also view the ideas of their peers and build on the work of others.

3.2 Preparing students to work collaboratively

Social interaction, cooperation or collaboration for learning do not simply follow the introduction of social media. Within schools, where it is the norm for individual work to be produced for assessment, students may not know how to collaborate for learning purposes (Grant, 2009; Lund, 2008).

Collaborative work is more likely to succeed when preceded by careful preparation. Effective preparation includes:

1. an explanation of the purpose of collaboration and how it benefits all students;
2. explicit processes developed for students to work together collaboratively;
3. collaboration through small group work to build trust;
4. teachers monitoring interaction to ensure that collaboration is inclusive and that behaviours within interaction are appropriate and not hurtful or damaging;
5. teachers allowing students to make more decisions about their learning;
6. teachers encouraging all students to participate.

An explanation of the purpose of collaboration and how it benefits all students is an important initial step in the use of social media. In a school environment, where students are used to working on individual tasks for assessment, collaboration may disturb existing understandings of the purposes of particular tasks (Lund, 2008). Lund (2008) noted that students, given the task of working together in a wiki, began by working in pairs moving to more collaborative work only when the initial task was completed. Drawing on Lund’s insight, researchers in Spain developed a three stage process designed to teach collaborative skills in preparation for a wiki writing task which aimed to enhance the writing processes of 9 to 10 year old children (Pifarre & Fisher, 2011). The first stage of the process involved the development of ‘collaborative talk’ (p. 455). In the second stage, students worked in pairs to construct a text. In the third stage, the teacher demonstrated the collaborative process of wiki writing and how it allowed students to discuss ideas and elaborate or modify them. Students’ understanding of the task was improved by the discussion embedded within it and the feedback from their peers. Clearly there is a need for explicit instructions on how to use the platform and how to work collaboratively. Wong and Hew (2010) confirmed this, but also found that there is a need for
explicit discussions that clarify the purpose or goal of the learning exercise. In their study of primary school students using blogs, they found that without these discussions the students corrected each others’ use of language rather than offering higher order comments on the narrative.

Where contact is with participants within the same group, as in Wong and Hew’s (2010) study, the teacher’s role in valuing the participation of all students and moderating participation is crucial to establishing new norms of social behaviour to instil trust in the medium and the participants (Chandra & Watters, 2012; Hastie et al., 2010; Zhang et al., 2011). Geer and Sweeney (2010) report on teachers’ experiences with online forums (Edublogs and forums within Moodle) in two primary schools. For each of the teachers, the process of introducing the applications into their classrooms involved changes in their pedagogy, with a greater emphasis on small group work and student decision-making. There was also a greater need to monitor students’ behaviour to ensure that their interactions were appropriate. Developing strategies to shape and monitor students’ behaviour in interactive spaces is a recurring theme in several of the studies (e.g. Geer & Sweeney, 2010; Liu et al., 2011; Maher, 2010) which note that new complexities between openness and flexibility need to be negotiated. Teacher moderation and small group work assist to build trust when the interaction occurs between participants who have not met face to face. Trust is a vital element in achieving high levels of collaboration for both teachers and students and can be achieved through an initial period of online socialising (Maher, 2009). In Maher’s (2009) study online chat sessions between primary and secondary students required more time allocated to social chat as students needed to establish their identities with strangers when there were no visual or auditory cues. Such social chat was necessary in the online learning environment for students to develop sufficient trust in each other before learning could proceed. The role of teachers in mediating these challenges through their knowledge of external participants is an important factor in building trust (e.g. de Almeida Soares, 2008; Hastie et al., 2010).

These studies share several important similarities. Successful collaborative work in which individual entries cannot readily be distinguished demands careful thought by educators about the social and cultural context, which varies across these studies, as does the age of the students. However, all students showed some degree of concern about the status of their own entries – about when they could be modified or removed by others. In addressing this concern several researchers (Mak & Coniam, 2008; Pifarre & Fisher, 2011; Wong & Hew, 2010) suggest the value of a staged process in which students move from individual or pair work to a collective process. In a different approach, Pifarre and Fisher’s (2011) study suggests that preparation for the collaborative nature of a task through ‘talk’ is a valuable precursor to such a task. Training in the particular social media application was provided in most of the studies reviewed, however careful preparation is also needed to support students’ collaborative skills in the peculiar and often unfamiliar environment of social media as a learning space.

3.3 Employing social media for appropriate tasks

Social media technologies need to be chosen carefully to suit the task and to fit the pedagogical design. The reviewed articles clearly demonstrate that careful design is critical for effective social media use. It should not be assumed that social media can be applied to existing tasks which are designed for other methods of
instruction. The kinds of tasks for which social media are to be used need to be appropriate and purposeful.

The literature reviewed revealed examples of tasks which facilitated effective use of social media for students by offering:

1. clear links with the curriculum and explicit guidelines about assessment;
2. a purposeful application of the technology to achieve a shared and meaningful goal;
3. opportunities for collaboration;
4. the preservation of students’ original work as this reduces their level of task anxiety and they will be more likely to interact with other students’ work;
5. the opportunity to track their changes and to consider their progress;
6. the opportunity for teachers to stimulate new lines of inquiry and provide feedback and encouragement;
7. extended time for an activity which can be developed in stages and extend over a number of sessions.

Tasks which have clear links with the curriculum in place in schools enable ready incorporation of social media. Wishart and Triggs (2010) review the implementation of a project across five European countries which aimed to connect 27 schools and their students with cultural artefacts in museums, art galleries and other similar institutions. While students worked together in groups and incorporated feedback from parents and friends, alignment with the curriculum was the most significant factor in the successful implementation of the project. Factors which work to impede successful implementation of social media initiatives for learning are demonstrated in Tan’s (2009) doctoral research, which investigated the use of a Web 2.0 learning platform dubbed the Student Media Centre in an Australian secondary school. The platform was selected by the school leadership but led and maintained by 30 senior students in Years 10, 11 and 12. Overall, the majority of students in the school did not use the digital centre, regarding it as ‘useful-in-principle but useless-in-practice’ (p. 291, emphasis in original). With no relationship to curricular learning and tightly controlled, it was an adjunct which seemed to have limited purposes to the majority of students.

The literature also revealed the need for the social media tasks to be purposeful and that purpose to be clearly communicated with the students. Joubert and Wishart (2011) concluded that it is necessary for participants to fully understand the nature and purpose of the task to be completed and to have a sense that their participation is important to achieve an outcome, that is, that the task is purposeful for them so that they have ‘shared goals’ (p. 9). A similar finding as to the relevance and appropriateness of the task is borne out in Grant’s (2009) study of three Year 9 ICT classes in a British secondary school using a wiki. In this study the wiki environment could afford the opportunity for both collaboration and an audience, but the type of task to which it was applied, editing each others’ work, did not invite collaboration. It also mirrored those required of the students for assessment, with no audience other than the teacher. In addition, it was found that if a task already incorporates high levels of face to face collaboration, the use of social media is likely to be redundant (Heafner &
Friedman, 2008; Marttunen & Laurinen, 2007). Even those tasks which require the use of social media to complete an assessment often result in a minimal level of participation if they have not been incorporated in a meaningful way (Joubert & Wishart, 2011).

The majority of studies are premised on the notion that collaboration is a key affordance of social media. The review indicated that a student-centred model is more likely to effectively facilitate collaborative learning with social media than a teacher-centred one. This is, in part, related to the fact that teachers are limited by the time they can provide to each student whether in class or online. In contrast, social media such as Blogs are well suited to providing students with a platform to write to a larger audience, soliciting feedback and discussion about postings, facilitating reflection, self-editing and setting new goals.

However the review indicates that while collaboration is an affordance of social media, the tasks also need to be carefully designed to leverage that affordance. Tasks utilising social media which elicited beliefs and opinions were found to be less likely to result in valuable discussions (Joubert & Wishart, 2011) than tasks which were focused on enhancing content knowledge (e.g. Chandra & Watters, 2011) or building social relationships as a prelude to interaction (Maher, 2009). Joubert and Wishart (2011) concluded that statements of belief or the construction of a vision were too individual to produce collaboratively. A different conclusion was drawn in Grant’s (2009) study where students chose topics to write in a wiki and were tasked with editing each others’ writing. Grant noted that the students rapidly developed a sense of ‘ownership’ of their individual pages (p. 109) and felt that their work was their own and did not see the task of editing as something positive. Only two students modified another’s entry and then only in minor ways. A conclusion was that editing of another’s assessment transgressed the norms of what is closely held to be individual work. As mentioned in the previous section a number of studies revealed that all of their student participants showed some degree of concern about when their entries could be modified or removed by others. While preparation of students to work collaboratively is one response, another approach is recommended by Liu et al. (2011) who found that preservation of students’ original work enabled some students to feel more comfortable with collaboration. In Liu et al.’s (2011) study students whose original stories were preserved, produced more episodes of collaboration with others, whereas those whose original stories were not preserved, were distracted by the effort to protect their own work and experienced more tension with less collaboration. In contrast Lund (2008) argues for the development of new forms of assessment as critical to collaborative work, arguing that existing assessments privilege individual work.

Tasks can be designed to take advantage of the opportunity to monitor or track student changes over time. This can facilitate students’ reflection on their own progress as well as aid teachers in providing feedback, including stimulating new lines of inquiry (eg. Zhang et al., 2007) and encouragement (eg. Chandra and Watters, 2012) throughout the task and not just after completion. Mak and Coniam (2008) provide a useful example in their study of year 7 students in a Hong Kong secondary school using a wiki as part of their beginning studies in an English-speaking environment. The researchers found that tracking revisions enabled both students and the teacher to explore the way they developed their ideas. In Hastie et al.’s (2010) study the teacher was able to monitor...
students’ progress through the emails he received when changes were made to the wiki and subsequently to provide feedback. In addition, students benefited from comparing their work with others after class as well as from the suggestions made by the external audience who commented on their work.

Extended time for an activity is also important to enable successful learning with social media as tasks can take longer due to the demands of technology, of the need to learn to use the technology appropriately, of scheduling across different spaces and times, and the need for more extended social chat as a means of developing relationships (Wishart & Triggs, 2010; Maher 2009, 2010). Most social media such as blogs, wikis and forums are asynchronous and as a consequence students need to take turns if they are to engage meaningfully with each other’s work. The opportunity for careful and deliberate response is commonly argued as an advantage of asynchronous social media however since the turn taking is not as fast as verbal interactions, and can take hours if not days for each response, activities may need to be extended over a period of time, particularly if the collaborators are in other schools or even overseas, when timetabling or different time zones mean that responses cannot be made speedily (Austin et al., 2010).

4. The central role of teachers

The articles reviewed clearly indicate that teachers are central to the effective implementation of social media, through their careful planning, task design, the exercise of their authority and their ability to deploy social media in ways which reconceptualise them as educational. In this way, they build on students’ leisure uses of social media to develop and enhance new practices for learning. However, the studies also point to factors which may inhibit teachers’ adoption of social media into their professional practice. Teachers’ beliefs about the greater workload required to incorporate social media into their practice can discourage them from doing so (Lai & Chen, 2011). Indeed, several of the studies reviewed attest to the greater workload involved in the early stages of social media use, particularly when teachers require new skills in specific applications and when they may need to interact with students or their colleagues out of school (Chandra & Watters, 2012; DeGennaro, 2008; Geer & Sweeney, 2010; Hastie et al., 2010).

Teachers also vary considerably in their skills and confidence with social media for educational uses and can often encounter technical difficulties working with new technologies and applications which can cause them to disengage (Wishart & Triggs, 2010). However, as Zhang et al. (2007) found, teachers are highly motivated by the desire to develop their students’ learning capacities and consequently will invest themselves if the advantages of using social media are made clear. In a later study Zhang et al. (2011), like many researchers in the field of professional learning, found that teachers can be particularly supported in engaging with social media through ongoing professional learning communities and effective leadership.

Conclusion

The review has revealed a limited research base, especially in terms of empirical studies focussed on school contexts. The studies that do exist illustrate the social complexity and pragmatic instrumentalism afforded by social media in the lives of students and for the purposes of learning. The majority of studies investigating the use of social media in classrooms are focused on first uses of social media by teachers or researchers in one or small
numbers of classrooms. There are very few studies that compare applications across contexts. Consequently, there is a need for future research to clarify the contextual issues of use, particularly for in-depth research which explores students’ learning (not just attitudinal change) in and out of classrooms with social media.

At the same time, the studies reviewed allow some conclusions to be drawn which can enhance the adoption of social media. In the majority of studies, students enjoyed working with social media in their schools even when teachers or researchers considered the outcomes to be unsuccessful. Students’ differing learning styles could be taken into account and learning could occur both within and outside the classroom which heightened students’ engagement with their content (DeGennaro, 2008; Hastie et al., 2010; Heafner & Friedman, 2008; Zhang et al., 2007). Their enjoyment and existing skill with some forms of social media provide a solid foundation on which to construct new learning opportunities. However, as noted earlier in the review, students must not be assumed to be skilful users of a variety of social media applications. Those most likely to be used in schools are blogs, microblogs and wikis, with which students are least likely to be familiar. Explicit teaching is necessary to provide skills in the particular application to be employed. Building understanding and experience with new applications in a careful pedagogical way will legitimise social media as learning technologies, contributing to a reshaping of students’ perceptions of social media as not simply affording leisure and communication.

The studies revealed that social media were utilised most effectively for learning purposes when pedagogical design considered: (a) how the media could extend learning through offering new opportunities such as working with outside experts and receiving timely feedback; (b) the need to carefully prepare for students’ collaborative use of social media such as developing explicit processes to support and educate students to work together collaboratively; (c) when it is appropriate to employ social media for tasks, such as when there are clear links with the curriculum and when strategies are used to facilitate collaboration, such as preserving students’ original contributions. The review also clearly indicated that teachers are central to the effective implementation of social media, through their careful planning, task design, the exercise of their authority and their ability to deploy social media in ways which reconceptualise them as educational.

References


ACMA (Australian Communications and Media Authority) (2009). Click and connect: Young Australians’ use of online social media (quantitative report). Canberra, Melbourne &
Sydney: Australian Communications and Media Authority.


