Beginning teacher knowledge: Results from a self-assessed TPACK survey

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ABSTRACT

For over twenty years teachers in Australia and internationally have been encouraged to use ICT in their practice. Various government policies have been implemented to provide the technical means for teachers to do so as well as numerous teacher professional learning programs, often skills based, short term and off site. Yet teacher uptake of technologies in their routine classroom practice continues to be slow and uneven, with pre-service teacher education sometimes bearing the brunt of blame. The TPACK framework developed by Mishra and Koehler (2006) has emerged as an influential tool for describing the knowledge teachers need to integrate technology into their practice. This paper reports on a survey which measured the TPACK knowledge of sixty-four beginning teachers in Victoria, Australia. This data was analysed to reveal how beginning teachers self-assessed their knowledge in each of the seven domains, as well as to explore patterns by gender. As a result of these findings several suggestions for pre-service teacher education are made.

Introduction

For some time now, national and state policies in Australia as internationally have advocated the use of ICT in schools. Usually this is argued on two grounds: that learners using ICT will reap benefits to their learning and that learners need ICT skills to be employed in the future high-tech workplace. In Australia, computing was first included in national school-education policy in 1989, as part of the National Goals for Schooling, and the more recent Digital Education Revolution policy introduced in 2010 continues this national policy commitment to the provision of ICT in schools, with over $2 billion being earmarked for this purpose. State policies in Victoria, Tasmania and Queensland (Lloyd, 2008) likewise have reflected this advocacy. Being able to use ICT in the classroom is now an expected part of a teacher's toolkit in Australia.

Despite this advocacy and expectation, teacher use of ICT has been slow and uneven (Brown and Warschauer, 2006). Studies in the United States, such as that by Becker (1999) show that teacher use of ICT has been 'disappointing' and rather than being used to transform learning and teaching practice, is often used to assist teachers do their job quicker and easier. However, while this expectation has been a constant for some time, there is greater recognition that meeting it is not as simple and straightforward as perhaps once thought. Research such as that by BECTA (2004) has shown that there are numerous barriers to teacher use of ICT including lack of time, resources and training, as well as teacher confidence and resistance to change. Other research has also shown that 'human factors' including teacher attitudes and beliefs have a large role to play (Gill and Dalgarno, 2008, Orlando, 2009).

Given the 'acceptance' of this advocacy and expectation for teachers to embed ICT into their practice, it is interesting then that the question of teacher knowledge (what teachers need to know to achieve this expectation) has not been so readily answered. In part this is because when it comes to thinking about embedding ICT into practice, it is 'the ICT bit' that is usually given emphasis. For example, stage- based models are commonly used in teacher professional learning around ICT (Lloyd, 2008, Jamieson-Proctor, Finger and Albion, 2010). These models, typically involve teachers self-assessing their ICT knowledge along a continuum. Often however ICT knowledge is defined as discrete ICT-skills and other knowledge such as pedagogical knowledge is downplayed or ignored. Another example is the use of discrete ICT-based courses in teacher education programs. In these courses, ICT knowledge is equated to knowing how to use particular software, and while this approach may encourage the development of ICT skills, it can have limited effect on capacity to integrate ICT into practice. Both stage-based models and ICT- based courses focus on technological knowledge. As a result, simplified notions of teacher knowledge have been fostered and the development of more complex notions has been hampered.

The development of the TPACK framework by Mishra and Koehler (2006) can be seen then as a serious attempt to 'answer' this question of what knowledge teachers should have to be able to integrate ICT into their practice. This framework builds on Shulman's (1986) view that Content Knowledge (what to teach) and Pedagogical Knowledge (how to teach) are interconnected, and when so form Pedagogical Content Knowledge or PCK. To this influential view, Mishra and Koehler (2006) 'add' Technological Knowledge. The 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)

and one triad, Technological Pedagogical Content Knowledge (TPACK). The writers argue that the framework represents the connections between the three areas of knowledge, described as "interweaving" (Mishra and Koehler, 2006: 1029), a "complex relationship" (Mishra and Koehler, 2006: 1029) and a "dynamic transactional relationship" (Mishra and Koehler, 2006: 1030).

Several survey instruments have been developed to measure teacher TPACK knowledge, including that devised by Schmidt et al (2009) which has been adapted and used in the study reported in this paper. However, it is important to note that how teachers self-assess their knowledge does not directly correlate with how they teach in practice. This survey instrument was designed as a self-assessment tool for Pk-6 pre-service teachers majoring in elementary and early childhood education, with a focus on the four content areas of Literacy, Mathematics, Social Studies and Science. The survey used a number of items in relation to each of the seven knowledge domains in the TPACK framework. For each of these items participants were then asked their level of agreement using a five-level Likert scale. Each item in the survey was scored and then each construct was scored by averaging item scores. This survey instrument has been adapted and used by Vaughan (2010), while other surveys using different participants and instruments have been developed by Graham et al (2009), Archambault and Crippen (2009) and Jamieson-Proctor, Finger and Albion (2010). This paper then aims to add to this growing body of research relating to the TPACK framework and the use of self-assessment surveys to measure this knowledge.

Aims of the study

This paper presents an analysis of the TPACK capabilities of sixty-four beginning teachers from P-12 schools in Victoria, Australia and is guided by these broad questions: How do beginning teachers self-assess their capabilities in each of the seven domains of the TPACK framework? Are there differences in teacher self-assessment of their TPACK capabilities based on gender? As a result of this self-assessment, what are some of the implications for pre-service teacher education programs?

Method

The Schmidt et al survey (2009), designed for elementary educators was adapted to suit P-12 educators. This involved removing the focus on four content areas and introducing one item relating to generic content knowledge and omitting some items in some domains (see Appendix 1). The five-point Likert scale asking participants to indicate level of agreement (strongly agree, agree, neutral, disagree, strongly disagree) remained constant. The adapted survey was then administered online via Survey Monkey. Resultant data was then calculated to reveal percentage figures in relation to each of the five levels of agreement for all participants and then by gender.

The participants

The sixty-four 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, to increase their self-efficacy and their confidence in their roles as teachers. It is a three year program involving separate cohorts of beginning teachers from Prep to Year 12 schools in each of these years. This program uses a blended approach to professional learning and includes face-to-face and online components.

Prior to commencing the program, participants are asked to complete an online survey about their teaching experiences, their preparedness to teach, and to self-assess their TPACK knowledge. Data for this paper is drawn from some sixty-four beginning teachers, fifty-two female and twelve male beginning teachers, of whom forty-two are primary teachers, fourteen are secondary teachers, and eight other teachers who teach in other settings such as specialised schools, or schools with both primary and secondary students.

Results

Using the percentage figures an analysis was then made in relation to each of the seven domains and then individual items in each domain. This analysis considered total participants, and then males and females. For reader ease I often choose to use abbreviations for these domains (such as CK instead of Content Knowledge and PK instead of Pedagogical Knowledge) as well as abbreviations for individual survey items.

1. Domain Knowledge

Data was initially analysed in relation to perceived knowledge in each of the seven domains of the TPACK framework. As shown in Table 1a the beginning teachers similarly self-assessed their capabilities in each of the seven domains, with a slight tendency to self-assess Content Knowledge higher.

Data relating to perceived competence in each of the seven domains was also analysed by gender, as shown in Table 1b. Male beginning teachers self-assessed their knowledge in six of the seven domains higher than females. Males and females similarly rated their Content Knowledge however males rated their Technological Pedagogical Knowledge higher than females, while females rated Pedagogical Knowledge higher than males.

Table 1a Knowledge in each domain

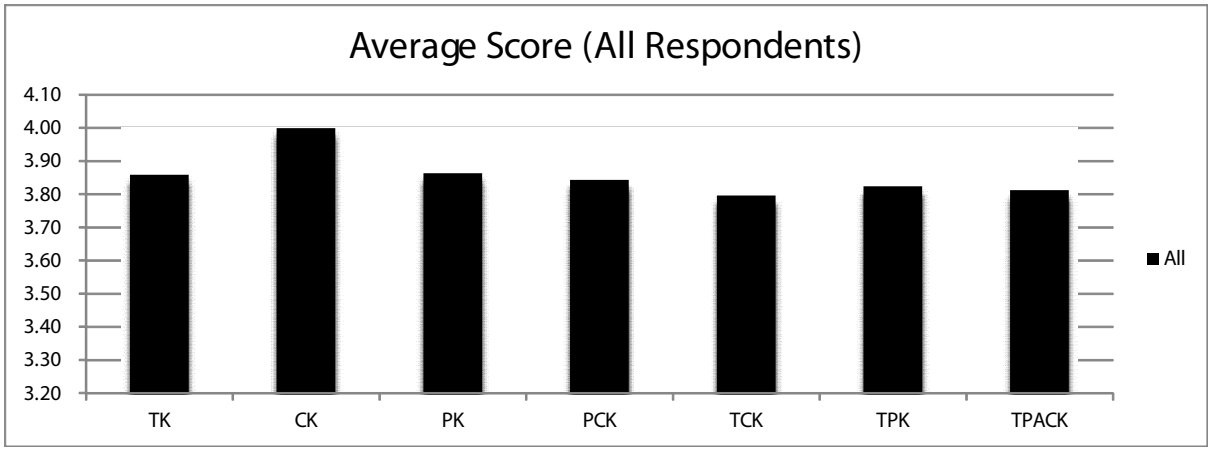
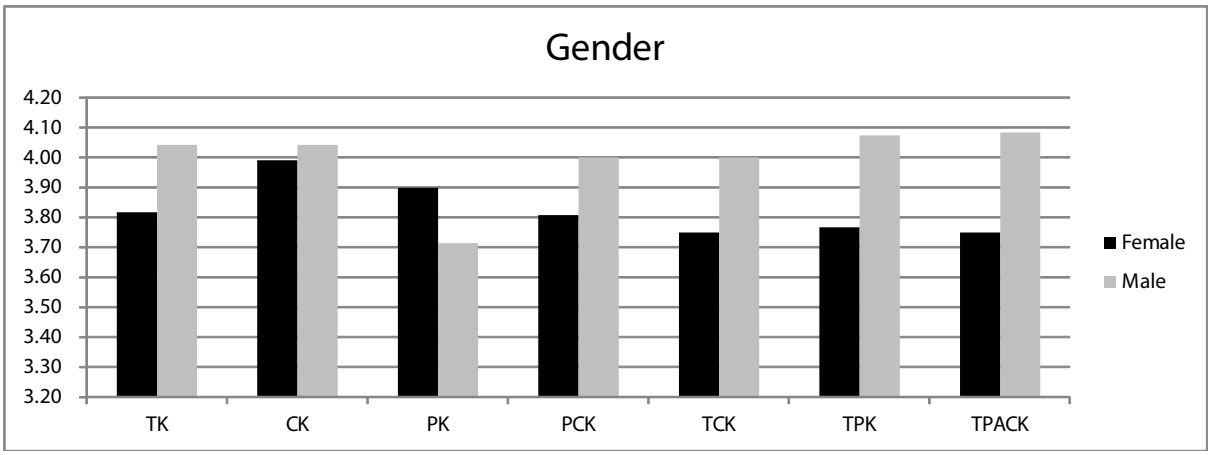


Table 1b Female and male Knowledge in each domain



2. Knowledge of items in each Domain

To self-assess their knowledge in a domain, beginning teachers were asked to rate their level of confidence to either a single item or multiple items. Multiple items were used in relation to four domains: Technology Knowledge, Content Knowledge, Pedagogical Knowledge and Technological Pedagogical Knowledge. I now turn to consider this data.

a. Technology Knowledge

Technology Knowledge (TK) is knowledge about technologies and having the knowledge to use them and to learn new ones.

Table 2: Technology Knowledge

All Participants	SA	A	N	D	SD
Solve my technical problems	9%	53%	23%	13%	2%
Learn technology easily	27%	58%	11%	2%	3%
Keep up with new technologies	22%	55%	13%	9%	2%
I have the technical skills	22%	63%	9%	5%	2%
Female	**SA**	**A**	**N**	**D**	**SD**
Solve my technical problems	10%	52%	21%	15%	2%
Learn technology easily	25%	58%	12%	2%	4%
Keep up with new technologies	21%	54%	13%	10%	2%
I have the technical skills	23%	58%	12%	6%	2%

Male	SA	A	N	D	SD
Solve my technical problems	8%	58%	33%	0%	0%
Learn technology easily	33%	58%	8%	0%	0%
Keep up with new technologies	25%	58%	8%	8%	0%
I have the technical skills	17%	83%	0%	0%	0%

Beginning teachers self-assessed their confidence in each of the four items in this domain at a similar high level, between 62% and 85% (Table 2). Perceived confidence in relation to the survey item, 'solving technical problems' received the lowest level of agreement. When we consider the influence of gender, female level of perceived confidence in each of the four items is less than males.

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.

Table 3: Content Knowledge

All Participants	SA	A	N	D	SD
Knowledge about the content	22%	59%	13%	6%	0%
How to develop content knowledge beginning teachers from prep to year 12 schools knowledge	16%	75%	6%	3%	0%
Female	**SA**	**A**	**N**	**D**	**SD**
Knowledge about the content	19%	60%	13%	8%	0%
How to develop content knowledge beginning teachers from prep to year 12 schools knowledge	17%	75%	6%	2%	0%
Male	**SA**	**A**	**N**	**D**	**SD**
Knowledge about the content	33%	58%	8%	0%	0%
How to develop content knowledge beginning teachers from prep to year 12 schools knowledge	8%	75%	8%	8%	0%

Beginning teachers expressed very high levels of confidence with both items in the Content Knowledge domain (81% and 91%), as shown in Table 3. Analysis by gender did not reveal major differences in how beginning teachers scored each item although there was some slight variation of around 10% in the way that males and females self-assessed their competence in each item.

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.

Table 4: Pedagogical Knowledge

All Participants	SA	A	N	D	SD
Assess student performance	11%	70%	13%	5%	2%
Adapt teaching	17%	72%	9%	2%	0%
Different learners	14%	72%	11%	3%	0%
Assess in multiple ways	13%	69%	14%	3%	2%
Range of teaching approaches	16%	67%	14%	3%	0%
Understandings and misconceptions	6%	61%	17%	16%	0%
Classroom management	16%	59%	14%	9%	2%

Female	SA	A	N	D	SD
Assess student performance	12%	71%	10%	6%	2%
Adapt teaching	21%	71%	6%	2%	0%
Different learners	15%	71%	10%	4%	0%
Assess in multiple ways	13%	73%	8%	4%	2%
Range of teaching approaches	17%	69%	12%	2%	0%
Understandings and misconceptions	6%	62%	17%	15%	0%
Classroom management	17%	60%	13%	8%	2%
Male	**SA**	**A**	**N**	**D**	**SD**
Assess student performance	8%	67%	25%	0%	0%
Adapt teaching	0%	75%	25%	0%	0%
Different learners	8%	75%	17%	0%	0%
Assess in multiple ways	8%	50%	42%	0%	0%
Range of teaching approaches	8%	58%	25%	8%	0%
Understandings and misconceptions	8%	58%	17%	17%	0%
Classroom management	8%	58%	17%	17%	0%

Beginning teachers self-assessed their Pedagogical Knowledge in relation to seven items. They self-assessed five of these items as around 80% but two items they assessed lower, 'I am familiar with common student understandings and misconceptions' (item six) and 'I know how to organize and maintain classroom management' (item seven). Higher levels of neutral responses were also scored for these two items (17% and 14% respectively).

In relation to gender a difference in pattern emerged, with males assessing their competence in all seven items lower than females. In most cases the variation was not great, around 15% for item two 'I can adapt my teaching based-upon what students currently understand or do not understand' and 30% for item four, 'I can assess student learning in multiple ways' and 20% for item five,' I can use a wide range of teaching approaches in a classroom setting'. Male teachers also indicated quite high levels of uncertainty as shown by neutral figures, with 42% being unsure in relation to item four, and 25% in relation to three items, item one, two and five.

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.

Table 5: Pedagogical Content Knowledge

All Participants	SA	A	N	D	SD
Select effective teaching approaches	6%	78%	9%	6%	0%
Female	**SA**	**A**	**N**	**D**	**SD**
Select effective teaching approaches	6%	77%	10%	8%	0%
Male	**SA**	**A**	**N**	**D**	**SD**
Select effective teaching approaches	8%	83%	8%	0%	0%

Only one item was used to gauge Pedagogical Content Knowledge. Beginning teachers expressed confidence with their knowledge, with males indicating a slightly higher level.

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.

Table 6: Technological Content Knowledge

All Participants	SA	A	N	D	SD
Know about technologies	8%	69%	19%	5%	0%
Female	**SA**	**A**	**N**	**D**	**SD**
Know about technologies	10%	62%	23%	6%	0%
Male	**SA**	**A**	**N**	**D**	**SD**
Know about technologies	0%	100%	0%	0%	0%

Only one item was also used to assess Technological Content Knowledge. Males reported more confidence with their knowledge than females in this one item.

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.

Table 7: Technological Pedagogical Knowledge

All Participants	SA	A	N	D	SD
Choose technologies to enhance teaching	16%	69%	8%	6%	2%
Choose technologies to enhance learning	11%	73%	6%	8%	2%
Influence of teacher preparation on thinking about deeply	20%	58%	13%	5%	5%
Think critically about use of technology	14%	64%	16%	5%	2%
Adapt technologies to teaching activities	8%	73%	14%	3%	2%
Select to enhance leaching/learning	16%	72%	9%	2%	2%
Use strategies from teacher preparation	5%	72%	19%	3%	2%
Provide leadership	9%	50%	27%	9%	5%
Choose technologies to enhance content	13%	73%	9%	3%	2%
Female	**SA**	**A**	**N**	**D**	**SD**
Choose technologies to enhance teaching	12%	71%	8%	8%	2%
Choose technologies to enhance learning	10%	71%	8%	10%	2%
Influence of teacher preparation on thinking about deeply	21%	54%	13%	6%	6%
Think critically about use of technology	13%	62%	17%	6%	2%
Adapt technologies to teaching activities	6%	75%	13%	4%	2%
Select to enhance leaching/learning	15%	69%	12%	2%	2%
Use strategies from teacher preparation	4%	69%	21%	4%	2%
Provide leadership	8%	50%	25%	12%	6%
Choose technologies to enhance content	13%	69%	12%	4%	2%

Male	SA	A	N	D	SD
Choose technologies to enhance teaching	33%	58%	8%	0%	0%
Choose technologies to enhance learning	17%	83%	0%	0%	0%
Influence of teacher preparation on thinking about deeply	17%	75%	8%	0%	0%
Think critically about use of technology	17%	75%	8%	0%	0%
Adapt technologies to teaching activities	17%	67%	17%	0%	0%
Select to enhance leaching/learning	17%	83%	0%	0%	0%
Use strategies from teacher preparation	8%	83%	8%	0%	0%
Provide leadership	17%	50%	33%	0%	0%
Choose technologies to enhance content	8%	92%	0%	0%	0%

Beginning teachers similarly rated items in this domain, indicating strong knowledge levels in relation to eight items (between 77% and 86%). The other item, item 8, relating to' provide leadership' was ranked lower, and also scored a higher neutral rank. When we consider gender, males expressed higher knowledge in each of the nine items than females, indeed not indicating any concern with their knowledge by the zero responses in the disagree column. This involved scores of 15% higher in relation to item two, three, four, six and nine and scores 20% higher in relation to item seven. Males expressed 100% agreement with three items, (item two, 'choosing technologies to enhance student learning', item six, 'selecting technologies to enhance teaching and learning' and item nine, 'choosing technologies to enhance content') and 90% or above agreement with seven items indicating not much range in their view of the items in this domain. Females similarly showed little range in their response to items, scoring some eight items between 73% and 84%.

g. TPACK

Technological Pedagogical Content Knowledge (TPACK) is emergent knowledge of good teaching with technology involving understanding of three sources of knowledge: pedagogy, content and technology knowledge.

Table 8: TPACK

All Participants	SA	A	N	D	SD
Teach lessons	13%	64%	17%	5%	2%
Female	**SA**	**A**	**N**	**D**	**SD**
Teach lessons	10%	65%	17%	6%	2%
Male	**SA**	**A**	**N**	**D**	**SD**
Teach lessons	25%	58%	17%	0%	0%

Only one item was used to self-assess TPACK knowledge. Beginning teachers expressed confidence with their knowledge in this domain, with males indicating some higher levels.

DISCUSSION

64 beginning teachers from P-12 schools across the state of Victoria self-assessed their TPACK knowledge using a survey instrument adapted from Schmidt et al (2009). Using this data, this paper seeks to explore how these teachers self-assess their capabilities in each of the seven domains, whether there are differences in their self-assessment based on gender, and as a result of these two findings, to suggest implications for pre-service teacher education programs. These questions are explored more fully in the discussion which follows.

Self-assessment in each domain

For the most part, beginning teachers similarly self-assessed their confidence in the seven domains, although they rated their confidence in Content Knowledge somewhat higher than others. This finding is different from Archambault and Crippen (2009) who concluded highest levels of confidence in relation to Pedagogical Knowledge. Possible reasons for this different finding are outside the scope of this paper, as both studies focused on self-assessing knowledge and did not examine reasons for this knowledge. Other researchers have also been interested in the way that in-service and pre-service

teachers assess their domain knowledge, but this interest has not always extended to all seven domains. Graham et al (2009) examined the four domains of Technology Knowledge (TK), Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK) and Technological Pedagogical Content Knowledge (TPACK) in their study of fifteen in-service teachers, while Jamieson-Proctor, Finger and Albion (2010), examined the two domains of Technology Knowledge (TK) and Technological Pedagogical Content Knowledge (TPACK) in their study of 345 final year pre-service teachers in two universities. While Vaughan (2010) did focus on all seven domains in his study of 25 pre-service teachers, he did not compare their ratings in these domains. Given that Mishra and Koehler (2006) argue that their TPACK framework is based on connecting knowledge, further studies that specifically examine perceived knowledge in all seven domain areas are warranted.

In the main beginning teachers also similarly self-assessed multiple items used to measure confidence in a given domain. For example, beginning teachers self-assessed their confidence between 62% and 85% in each of the four items in the Technology Knowledge (TK) domain and likewise either 81% or 91% in relation to the two items in the Content Knowledge domain. They also similarly rated items in the Technological Pedagogical Knowledge (TPK) domain, indicating strong knowledge levels in relation to eight items (between 77% and 86%). The other item, item 8, relating to 'provide leadership,' was ranked lower, and also scored a higher neutral rank. There were some differences however in the way they rated items in the Pedagogical Knowledge (PK) domain, self-assessing five of these items as around 80% but two items lower, item six, 'I am familiar with common student understandings and misconceptions' and item seven, 'I know how to organize and maintain classroom management'. Higher levels of neutral responses were also scored for these two items (17% and 14% respectively).

Thus it would seem that the beginning teachers in this study feel confident in each of the seven domains particularly Content Knowledge (CK), and when multiple items were used to gauge this confidence in relation to particular domains, there was little difference in their rating. However there was some variance in their confidence with items in relation to Pedagogical Knowledge.

Influence of gender on self-assessment

The role of gender in relation to perceived TPACK knowledge is unclear and under researched. Jamieson-Proctor and Finger (2008), for example in an earlier study of over 2000 teachers reported that males were much more confident in their ICT skills. Yet in their later study (Jamieson-Proctor, Finger and Albion 2010), in which they measured TPACK knowledge (drawing on data from existing instruments and adding a TK domain and TPACK domain),they reported a more positive trend with female level of confidence and no significant difference between males and females in relation to TPACK knowledge.

In this present study, male beginning teachers consistently assessed their knowledge higher in the domains than females with females only ranking their Pedagogy Knowledge higher than males. While male and female beginning teachers considered their Content Knowledge at a similar level (although this is the lowest domain score by males) when Technology and Pedagogy are added to form PCK, TCK, and TPK, male beginning teachers again self-assessed their knowledge somewhat higher than females.

There were similarities and differences in the way that male and female beginning teachers self-assessed multiple items in domains. They similarly assessed their knowledge in both items in the Content Knowledge domain, and the four items in the Technology Knowledge domain, with both males and females for example indicating concern with one item relating to having the knowledge to solve technical problems. This finding was also commented on by Vaughan (2010) and by Jamieson-Proctor, Finger and Albion (2010).

A different pattern emerged in relation to the way they self-assessed multiple items in relation to Pedagogical Knowledge. In the first instance females scored themselves higher in each of the seven items of this domain, rating themselves over 10 % higher in their knowledge of four individual items. Male beginning teachers were less confident in their knowledge around using a range of teaching strategies and assessment approaches. Both males and females considered their knowledge lower in two items in this domain, 'I am familiar with common student understandings and misconceptions' (68% for females and 66% for males) and 'I know how to organize and maintain classroom management' (77% for females and 66% for males). Concern from beginning teachers about classroom management has often reported in the research literature.

Another pattern was revealed in relation to Technological Pedagogical Knowledge, where nine items were used to self-assess this knowledge. In each of these nine items males scored themselves higher of around 10 % than females and rated 100% level of confidence in relation to three items: 'choosing technologies to enhance learning',' selecting technologies to enhance teaching and learning' and 'choosing technologies to enhance content', suggesting that males are very confident in this domain. Females while also expressing high levels of knowledge in this domain seemed less confident in regards to these items.

It would seem from this study that male beginning teachers are more confident in their domain knowledge than females. While both genders had considerable similarity in how they self-assessed multiple items in particular domains, including TK and CK, there were some differences. Females self-assessed their knowledge higher than males in all of the 7 items in the PK domain, while this pattern was reversed in relation to TPK with males self-assessing their knowledge higher in all nine items. Thus, while female beginning teachers generally feel more confident in their Pedagogical Knowledge, when technology is 'added' to form Technological Pedagogical Knowledge, males are more confident.

Implications for pre-service teacher education

The findings from this small-scale study suggest that beginning teachers are generally confident with their level of knowledge in each of the seven domains of the TPACK framework. Given that this level of confidence is desirable, pre-service teacher education programs which have had a role in the development of this knowledge should be pleased. Beginning teachers however tended to feel more confident in their Content Knowledge and if this finding was to be concluded by other subsequent research, particularly large scale research, this could suggest that pre-service teacher programs need to pay closer attention to the development of knowledge in other domains.

This study also suggests that there are considerable differences in the way that male and female beginning teachers self-assess their knowledge in the seven domains. Male beginning teachers consistently self-assessed their knowledge higher than females in all but one of the domains in the framework. This finding does suggest that pre-service teacher programs need to attend to increasing the confidence levels of females and to conduct further research which specifically examines ways that this outcome can be achieved.

This study has also suggested that there are similarities in the way that male and female self-assessed multiple items in a given domain, particularly in relation to Technology Knowledge and Content Knowledge. Both genders indicated concern with one item relating to 'having the knowledge to solve technical problems'. This finding suggests that pre-service programs could attend more to developing the knowledge and skills to use technology, including being able to address common problems associated with their use.

At the same time, this study has also suggested that there are dissimilarities in the way that male and female beginning teachers self-assessed multiple items. In relation to Pedagogical Knowledge (PK), female beginning teachers self-assessed their knowledge higher than males, with males expressing low levels of confidence relating to their knowledge around using a range of teaching strategies and assessment approaches. This finding suggests that pre-service teacher programs could perhaps attend more to encouraging the development of these skills. In relation to Technological Pedagogical Knowledge (TPK), male teachers self-assessed their knowledge in each of the nine items somewhat higher than females, scoring three items relating to choosing technologies to enhance learning, learning and teaching and content at 100%. Thus it would seem that males are much more confident in knowing how their teaching practice is interconnected with technology. This view is further enhanced when we also consider that when asked about the influence of their pre-service teacher education program on their thinking about how technology could influence teaching approaches and having strategies that combine content, technologies and teaching approaches, males self-assessed themselves higher. Taken together then these two findings suggest that pre-service teacher education programs could attend to increasing confidence levels of females relating to teaching with technology.

CONCLUSION

This study involved sixty-four beginning teachers from P-12 schools across the state of Victoria and their self-assessment of their TPACK knowledge through an online survey. This study suggests that beginning teachers have high levels of confidence to integrate ICT into their practice. It also suggests that male beginning teachers are more confident in this knowledge than female beginning teachers. Furthermore it suggests that there are some differences in the way that females and males assess their domain knowledge, with female beginning teachers most confident in relation to Pedagogical Knowledge whereas male beginning teachers are most confident in relation to Technological Pedagogical Knowledge. As a result of these findings, this study suggests that pre-service teacher education programs could pay more attention to possible gender differences in the way beginning teachers self-assess domain knowledge. Male beginning teachers could perhaps benefit from developing confidence in Pedagogical Knowledge and likewise female beginning teachers in relation to Technological Pedagogical Knowledge. Programs could also focus more on developing confidence to solve technical issues. As well, when developing Pedagogical Knowledge programs could give more priority to teaching how to cater for common student understandings and misconceptions, and developing and maintaining classroom management.

This study was a small-scale study and further study involving more beginning teachers is warranted in order to get a fuller picture of how they self-assess their knowledge, including studies which examine this knowledge by school type.

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Appendix 1

Schmidt et al (200) survey instrument	Adapted version
TK Technology Knowledge 1. I know how to solve my own technical problems. 2. I can learn technology easily. 3. I keep up with important new technologies. 4. I frequently play around the technology. 5. I know about a lot of different technologies. 6. I have the technical skills I need to use technology.	**TK Technology Knowledge** 1. I know how to solve my own technical problems. 2. I can learn technology easily. 3. I keep up with important new technologies. 4. I have the technical skills I need to use technology.
CK (Content Knowledge) **Mathematics** 7. I have sufficient knowledge about mathematics. 8. I can use a mathematical way of thinking. 9. I have various ways and strategies of developing my understanding of mathematics. **Social Studies** 10. I have sufficient knowledge about social studies. 11. I can use a historical way of thinking. 12. I have various ways and strategies of developing my understanding of social studies. **Science** 13. I have sufficient knowledge about science. 14. I can use a scientific way of thinking. 15. I have various ways and strategies of developing my understanding of science. **Literacy** 16. I have sufficient knowledge about literacy. 17. I can use a literary way of thinking. 18. I have various ways and strategies of developing my understanding of literacy.	**CK (Content Knowledge)** 5. I have sufficient knowledge about the content I am teaching.. 6. I have various ways and strategies of developing my understanding of the content I teach.

PK (Pedagogical Knowledge) 19. I know how to assess student performance in a classroom. 20. I can adapt my teaching based-upon what students currently understand or do not understand. 21. I can adapt my teaching style to different learners. 22. I can assess student learning in multiple ways. 23. I can use a wide range of teaching approaches in a classroom setting. 24. I am familiar with common student understandings and misconceptions. 25. I know how to organize and maintain classroom management.	**PK (Pedagogical Knowledge)** 7. I know how to assess student performance in a classroom. 8. I can adapt my teaching based-upon what students currently understand or do not understand. 9. I can adapt my teaching style to different learners. 10. I can assess student learning in multiple ways. 11. I can use a wide range of teaching approaches in a classroom setting. 12. I am familiar with common student understandings and misconceptions. 13. I know how to organize and maintain classroom management.
PCK (Pedagogical Content Knowledge) 26. I can select effective teaching approaches to guide student thinking and learning in mathematics. 27. I can select effective teaching approaches to guide student thinking and learning in literacy. 28. I can select effective teaching approaches to guide student thinking and learning in science. 29. I can select effective teaching approaches to guide student thinking and learning in social studies.	**PCK (Pedagogical Content Knowledge)** 14. I can select effective teaching approaches to guide student thinking and learning in the content areas I teach.
TCK (Technological Content Knowledge) 30. I know about technologies that I can use for understanding and doing mathematics. 31. I know about technologies that I can use for understanding and doing literacy. 32. I know about technologies that I can use for understanding and doing science. 33. I know about technologies that I can use for understanding and doing social studies.	**TCK (Technological Content Knowledge)** 15. I know about technologies that I can use for understanding and doing what I teach.
TPK (Technological Pedagogical Knowledge) 34. I can choose technologies that enhance the teaching approaches for a lesson. 35. I can choose technologies that enhance students' learning for a lesson. 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. 37. I am thinking critically about how to use technology in my classroom. 38. I can adapt the use of the technologies that I am learning about to different teaching activities. 39. I can select technologies to use in my classroom that enhance what I teach, how I teach and what students learn. 40. I can use strategies that combine content, technologies and teaching approaches that I learned about in my coursework in my classroom. 41. I can provide leadership in helping others to coordinate the use of content, technologies and teaching approaches at my school and/or district. 42. I can choose technologies that enhance the content for a lesson.	**TPK (Technological Pedagogical Knowledge)** 16. I can choose technologies that enhance the teaching approaches for a lesson. 17. I can choose technologies that enhance students' learning for a lesson. 18. My teacher education program has caused me to think more deeply about how technology could influence the teaching approaches I use in my classroom. 19. I am thinking critically about how to use technology in my classroom. 20. I can adapt the use of the technologies that I am learning about to different teaching activities. 21. I can select technologies to use in my classroom that enhance what I teach, how I teach and what students learn. 22. I can use strategies that combine content, technologies and teaching approaches that I learned about in my coursework in my classroom. 23. I can provide leadership in helping others to coordinate the use of content, technologies and teaching approaches at my school and/or district. 24. I can choose technologies that enhance the content for a lesson.
TPACK (Technology Pedagogy and Content Knowledge) 43. I can teach lessons that appropriately combine mathematics, technologies and teaching approaches. 44. I can teach lessons that appropriately combine literacy, technologies and teaching approaches. 45. I can teach lessons that appropriately combine science, technologies and teaching approaches. 46. I can teach lessons that appropriately combine social studies, technologies and teaching approaches.	**TPACK (Technology Pedagogy and Content Knowledge)** 25. I can teach lessons that appropriately combine content knowledge, technologies and teaching approaches.