TPACK: TRENDS IN CURRENT RESEARCH

Abstract

For some time school teachers have been encouraged to integrate ICT into their practice. Research has shown that a lot of factors can contribute to this uptake (Zhao et al, 2002; Groff and Mouza 2008; Harris, Mishra and Koehler 2009). The TPACK framework, by recognising the complexity in teacher knowledge required to integrate ICT, has been greeted with considerable interest. Developed by Mishra and Koehler (2006) this framework 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), Technological Pedagogical Knowledge (TPK) and one triad, Technological Pedagogical Content Knowledge (TPACK).

Considerable research relating to the TPACK framework is currently underway. This paper attempts to consolidate some of this research by reviewing a span of papers housed on the TPACK website. Specifically, it provides a meta-analysis of papers to identify trends in this research including: research focus, methodology, the participants, the researchers and the publishers. In doing so, the writers hope that this review will help other researchers understand current research around TPACK and to plan for future research.

Introduction

For some time now Australian teachers have been expected to embed ICT into their routine practice so that learners will be able to reap the anticipated benefits to their learning and as well gain the necessary skills to be employed in a future high-tech workplace (Bigum and Kenway 1998, Moyle 2005). National school-education policies have suggested that all teachers should be “competent users of information and communication technologies and able to apply these technologies to improve student learning” (EdNA 2000: 5). Yet this same policy suggests that teachers are not meeting this expectation as shown in the comment below:

“Progress is taking place, but not at the pace or depth required to effect major change. Teachers are developing basic ICT skills, but the main challenge of integrating new technologies into teaching practice still lies ahead for the bulk of the profession.” (EdNA 2000, p.5).

This discourse around teachers and their ‘failure’ to integrate ICT as expected is fairly common to the literature here in Australia as elsewhere. Research from the United States, including that by Becker (1999), Russell, O’Dwyer, Bebell and Tao (2007) and Culp, Honey and Mandinach (2003) have shown that rather than transforming learning and practice, teachers routinely use ICT to ‘value add’ to their current practice, that is, they choose to use technologies to make their job quicker and easier (Tyack and Cuban 2000; Harris, Mishra and Koehler 2009).

At the same time, there is greater international recognition that achieving this expectation is not so simple. Research such as that in England 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. In Australia, researchers including Gill and Dalgarno (2008) and...
Orlando (2009) have also shown that ‘human factors’ including teacher attitudes and beliefs have a large role to play. In the United States Zhao et al. (2002) argue that integrating technology is a messy process and that numerous factors impact on the success or otherwise of this integration. These factors they classify in three domains: the innovator (the teacher), the innovation and the context. Groff and Mouza (2008) argue there are six critical factors many of which overlap with Zhao et al. (2002): legislative factors, district/school level factors, factors associated with the teacher, factors associated with the project, factors associated with the students and factors inherent within the technology itself.

Yet the question: what do teachers need to know to integrate ICT into their practice, has largely remained unanswered. In part this is because of the way technology integration has been conceptualised (Harris, Mishra and Koehler 2009) with an emphasis placed on a techno-centric answer to the question. Often this is espoused through rhetoric around teachers needing to know how to use technologies, views that offer simplistic notions of what is needed and that then ignore or downplay the complexities in such as exercise – complexities such as the role of content and pedagogy to the question of ICT integration. The TPACK framework developed by Mishra and Koehler attempts to go beyond techno-centric approaches to an interrelated view of technology, pedagogy and content. The framework describes the knowledge required for teachers to integrate ICT, recognising that “teaching is a highly complex activity that draws on many kinds of knowledge and is complex” (Mishra and Koehler 2006: 1020).

The TPACK framework builds on Shulman’s notion (1986) of the connection between content knowledge (what to teach) and pedagogy knowledge (how to teach) by adding technological knowledge as another knowledge domain. This connection is much more explicit than in other research (Abbitt, 2011). 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 development of the TPACK framework has resulted in considerable interest (Harris, Mishra and Koehler 2009; Abbitt 2011; Thompson and Schmidt 2010). The broad aim of this paper is to more clearly understand how researchers are currently using the TPACK framework and to then suggest ways of moving this research agenda forward. Specifically, this review considers: Where is TPACK research being published? What is the focus of research around TPACK? What methodologies are being used to conduct this research? Who are the researchers researching TPACK?

**Research methods**

To achieve our broad aim, we reviewed papers housed on the TPACK organisation website (http://mkoehler.educ.msu.edu/tpack/), an open access repository which enables research relating to TPACK to be shared. We used a meta-analysis approach as it provides an effective way of synthesising results from multiple studies and in doing so identifying patterns in research. An initial search of the TPACK website in January, 2012, located some 286 papers from 2006 to 2011. The writers assumed these papers would refer to TPACK to varying degrees so refined their search to papers which included the term ‘TPACK’ or ‘TPCK’ or the words ‘pedagogy’ (pedagogical), ‘content’, ‘technology’ (technological), and ‘knowledge’ in the title. This method of selection is similar to that used by Kelly (2010) in her content analysis of peer reviewed journal articles between 2006 and 2009 and is the same as that used by Abbitt (2011) in his review of TPACK instruments used in pre-service teacher education. We further refined the search to include only conference papers and journal articles, discounting editorials (such as Bull and Bell 2009, Thompson & Schmidt 2000; and Niess 2006), symposiums and panels (such as Hofer, Harris, Blanchard, Grandgenett, Schmidt & Olpen 2009), conference posters (such as Figg and Burson 2010), books or book chapters (such as Jamieson-Proctor & Finger 2009) and dissertations (such as Hsueh 2008). In addition, we only included papers where full copies were accessible. This resulted in some 98 papers being selected for
inclusion in this review.

Both authors independently read the selected papers, and recorded information around the research questions into a spreadsheet. This data entry was then compared, discrepancies discussed and then resolved by mutual agreement. It is to be noted that categorising papers was not always straightforward, particularly in relation to determining whether papers were to be categorised as research or a discussion paper or report. For a paper to be categorised as research it needed to involve a research methodology and report results.

In summary, a paper was added to the sample if it met the following criteria:

- Included ‘TPACK’ or ‘TPCK’ or the words ‘pedagogy’ (pedagogical), ‘content’, ‘technology’ (technological), and ‘knowledge’ in the title,
- Was a conference paper or journal article
- A Full paper was available online

Findings

a. Publication type

Some 98 papers met the selection criteria and were included in this review. Of these slightly more than half (56) were conference papers, with the overwhelming majority, some 51 being published as proceedings of a Society for Information Technology and Teacher Education (SITE) conference (2 papers in 2006, 8 papers in 2007, 9 in 2008, 10 in 2009, and 22 in 2010). Only five papers stemmed from other conferences (Jamieson-Proctor, Finger & Albion 2010; Finger, Jamieson-Proctor & Albion 2010; Koehler and Mishra 2008; Stoilescu and McDougall 2009 and Hu and Frye 2010) with three being Australian conferences. Less than half of the papers (42) were published in journals. Of these 9 were published in Contemporary Issues In Technology and Teacher Education (CITE); 4 in Tecthtrends, 4 in the Journal of Research on Technology in Education (JRTE), and 3 in Computers and Education. 12 papers were published in some 12 other journals related to computers, technology or ICT, with a further 6 papers relating to mathematics and or science.

b. The focus of research around TPACK

As shown in Table 1: The Focus of TPACK papers, some 57 papers were categorised as research, that is, they included a research methodology and reported results while 41 papers were categorised as discussion or reports.

Table 1: The focus of papers

<table>
<thead>
<tr>
<th>Focus of papers</th>
<th>Number of papers (total 98)</th>
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<tr>
<td>Research based papers</td>
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<td>(total 57)</td>
<td></td>
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<tr>
<td>Research of TPACK in practice</td>
<td>27</td>
</tr>
<tr>
<td>(research around TPACK and its application in a particular setting and cohort)</td>
<td></td>
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<tr>
<td>Research measuring TPACK knowledge</td>
<td>19</td>
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<tr>
<td>– survey instruments</td>
<td></td>
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<tr>
<td>Other research linking TPACK with</td>
<td>11</td>
</tr>
<tr>
<td>other objectives</td>
<td></td>
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<tr>
<td>Non-research based papers</td>
<td>41</td>
</tr>
<tr>
<td>(total 41)</td>
<td></td>
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<tr>
<td>Discussion of TPACK framework</td>
<td></td>
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<tr>
<td>(non-research) or reporting on a</td>
<td></td>
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<tr>
<td>project (non-research) or</td>
<td></td>
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<tr>
<td>elaborations on the framework</td>
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Research papers focused on three aspects: Research on TPACK in practice (where researchers examined the development of TPACK within a particular context and with a particular cohort), Research measuring TPACK knowledge (where researchers developed and used self-assessed survey instruments to measure TPACK knowledge) and Other research (where researchers linked the TPACK framework to another research focus).

Some 27 papers related to Research on TPACK in practice. This included Hofer and Swan (2006), Lee and Hollebrands (2008), Jaipal and Figg (2010), Cavin and Fernandez (2007), Koehler, Mishra and Yahya (2007) and Doering et al 2009. Some 19 papers related to Research measuring TPACK knowledge. While it was typical for a range of instruments to be used, the instrument developed by Schmidt et al, (2009a; 2009b) was used by several projects including Shin et al (2009), Chai, Koh and Tsai (2010), Hu and Fyfe (2010), Abbitt (2011), and Chuang and Ho (2011). Some 11 papers involved Other research around TPACK. This included Hardy’s (2010) research of pre-service secondary maths teachers, Bannister and Reinhart’s (2010) study around social justice, Ozgun-koca, Meagher and Edwards’ (2010) study of maths pre-service teachers, Allan et al’s (2010) study of an ecology professional learning program, and Hughes’ (2009) research of pedagogical approaches to encourage technology integration.

In addition to these research-based papers, there were some 41 non-research based papers, which reported on or discussed the framework. For example, Nelson, Christopher and Mims (2009) explored TPACK in relation to Web 2.0 technologies, Angeli and Valanides (2009) explored epistemological issues with TPACK, Niess (2007; 2008) discussed issues around professional learning in maths and TPACK, and Priest (2007) discussed definitions of PCK and TPACK domains. Others focused more on discussing ways of elaborating the framework. For example Jaipal and Figg (2010) explored TPACK with socio-cultural theories of learning, Kelly (2008) discussed contextual elements as important additions to the TPACK framework, Cox and Graham (2009) explored difficulties in defining the TPACK domains and boundaries between them, Harris, Grandgenett, and Hofer (2009) discussed the development of a rubric around TPACK, Hofer and Harriss (2010) explored TPACK in relation to activity types, Marino, Sameshima and Beecher (2009) extended the model by promoting the inclusion of assistive technology for the disabled, Mishra, Koehler and Henriksen (2011) examined 7 cognitive tools and how they could be instantiated through the use of TPACK and Hammond and Manfra (2009) discussed a three-part pedagogical model to enhance the TPACK framework in the social science classroom.

As shown in Table 2: Year and type of publication, papers were published over the 6 year period of this review, 2006-2011. The number of papers in any one year generally increased over this time, with 5 papers published in 2006, 11 in 2007, 12 in 2008, 31 in 2009 and 33 in 2010, with only 7 papers published in 2011. When the type of paper is considered there is not the same trend. While the number of conference papers increased from 2 in 2006 to 25 in 2010, there was none reported in 2011. In relation to journal papers, there is an apparent spike of 20 papers in 2009, with a decline in 2010 and 2011. Interestingly, of the journal papers published in 2009, 7 were published by CITE (Marino, Sameshima and Beecher 2009; Groth et al, 2009; Guzey and Roehrig 2009; Archambault and Crippen 2009; Hammond and Manfra 2009; Richardson 2009; and Koehler and Mishra 2009) and 3 in TechTrends(Graham et al, 2009; Nelson, Christopher and Mims 2009; and Cox and Graham 2009) indicating considerable interest by these publications at this time.

Table 2: Year and type of publication

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of Papers in given year</th>
<th>Conference papers</th>
<th>Journal papers</th>
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<tbody>
<tr>
<td>2006</td>
<td>5</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>2007</td>
<td>10</td>
<td>8</td>
<td>2</td>
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To summarise, more conference papers than journal papers were published. The number of papers tended to increase over the time of the review, but there were varied patterns in the number of conference papers and journal articles in a given year over this period. There were slightly more research-based papers than non-research papers. Research-based papers focused on three areas: TPACK in practice, Research around measuring TPACK knowledge and Other research. Non-research papers explored or discussed TPACK, sometimes in relation to elaborating on the model.

c. The research methodology

Discussion now turns to examining how research-based papers classified in this review conducted their research. It begins by analysing the participants in this research, followed by the nature of this research (including length, and whether qualitative or quantitative), and then examines the particular data collection methods used in this research.

Research-based papers often involved a small number of participants. Some 30 involved between 1 and 30 thirty participants (14 involved 1 to 10 participants, 10 involved 11 to 20 participants, and 6 involved 21 to 30 participants). Some 12 involved over 300 participants. Of those research-based papers involving participants, 31 involved pre-service teachers, 22 in-service teachers and 5 higher education students and or faculty. Analysis also considered the teaching discipline (such as mathematics, science, or geography) and school sector (including elementary, primary and secondary) of participants. Of the 22 papers which specified the discipline of participants, some 11 involved maths teachers. This included, Bennett (2009), Lee et al (2006), Curaoglu et al (2010), Suhanwoto (2006), Richardson (2009) and Polly and Barbour (2009). Some 34 papers recorded participants as belonging to a particular sector. Of these 9 papers involved secondary, 6 elementary, and 3 middle school, with 9 involving participants from several sectors. For example, Graham et al (2009) involved elementary and secondary in-service teachers, Burgoine et al (2010) involved elementary and early childhood, and Archambault and Oh-Young (2009) K-12 online teachers.

The research period was often not reported, with only some 26 specifying a period. Half the research periods were around a semester (that is from 10 weeks to 16 weeks), 7 were under a semester, with three of these under a week (Williams, Foulger and Wetzel 2010; Hechter and Phyfe 2010 and Polly and Barbour 2009). 3 papers reported on a study of a year (Guzey and Roehrig 2009a; 2009b; and Suhanwoto 2006) and 1 of a three year period (Allan et al, 2010).

Of the 57 research-based papers, some 18 were quantitative, 25 were qualitative and 14 were mixed methodology. Survey was most commonly associated with quantitative papers, with all 18 employing this method. Qualitative and mixed methodology papers tended to select interview (used in 20 papers), observation (18 papers) and artefacts such as lesson plans or classroom resources (used in 21 papers). Reflective journals were also used, including by Hechter and Phyfe (2010), Lee at al (2006), Jang and Chen (2010) and Shah and Lee (2010).

d. The researcher

For the most part papers included in this review have been produced by American researchers. Some 22 papers were wholly or in part produced by researchers in institutions outside the United States. For example, three papers were produced by
Jamieson-Proctor, Finger and Albion, from the University of Southern Queensland, and Griffith University, Australia (Jamieson-Proctor, Finger and Albion 2010, Finger, Jamieson-Proctor and Albion 2010 and Albion, Jamieson-Proctor, and Finger 2010).

Some researchers produced several papers included in this review. Mishra and Koehler writing as a team produced 5 papers (Mishra and Koehler 2006; Mishra and Koehler 2007; Koehler, and Mishra 2008; Mishra and Koehler 2009; Koehler, and Mishra 2009) and with other researchers produced another 8 papers (Mishra, Peruski and Koehler 2007; Koehler, Mishra, and Yahya 2007; Harris, Mishra, and Koehler 2009; Kereluik, Mishra, and Koehler 2010; Kereluik, Mishra, and Koehler 2011; Mishra, Koehler, and Henriksen 2011; Schmidt, et al, 2009a and Schmidt et al, 2009b). Some other researchers have also produced or contributed to the production of multiple papers. This includes Niess (Nies 2008, Niess, 2007, Niess et al, 2009, Lee et al, 2006), Graham and Cox (Graham, Cox and Velasquez 2009; Cox and Graham 2009; Graham et al 2009), Kelly (Kelly 2007; Kelly 2008; Kelly 2010), and Archambault (Archambault and Barnett 2010; Archambault and Oh-Young 2009; Archambault and Crippen 2009; Archambault 2008) and Schmidt (Sahin, Akturk and Schmidt 2009; Schmidt et al, 2008; Shin et al, 2009; Schmidt et al, 2009a; 2009b) and Thompson (Shin et al, 2009; Schmidt et al, 2009a; 2009b).

Conclusions and Future Research Suggestions

The aim of this paper is to review current research relating to TPACK, using papers published on the TPACK website. So what broad conclusions can we make?

First, slightly more papers were published in conference proceedings than journals. Predominately, conference papers were published by the Society for Information Technology & Teacher Education (SITE) suggesting the influence of this organization on the direction of educational technology research. Journal articles were published in a range of journals, with several published by Contemporary Issues in Technology and Teacher Education (CITE) the print journal of SITE reinforcing further the influence of this organisation. The number of journals published in Mathematic journals (sometimes combined with ICT) suggests interest by this discipline more so than other disciplines.

Secondly, interest in the framework has generally increased over the review period. However, patterns in the number of papers published do suggest that a peak may have occurred in 2009 and 2010. This is indicated by the large number of conference papers in 2010, which constituted around half of the total number of conference papers, and the large number of journal papers in 2009, which also constituted around half of the total number of journal papers. As well it is indicated by the dip in number of publications in 2011.

Third, papers were more likely to be research-based rather than discussion papers or reports. In relation to research-based papers, three particular areas relating to TPACK were featured: TPACK in practice, Research measuring TPACK knowledge, and Other Research linking TPACK with other objectives. Non-research based papers discussed the TPACK framework in relation to a wide range of subjects, with a number focusing on exploring or elaborating the framework.

Fourth, most of this research has either been small scale involving both a relatively small number of participants and study period or large scale involving over 300 participants and quantitative survey data. Mathematics teachers have tended to feature more so in this research than other disciplines. Pre-service teachers, were more likely to figure in this research, followed by in-service teachers, and then higher education students or faculty. Qualitative or mixed method studies were more common than quantitative studies. Survey, interview, observation and the collection of artefacts were commonly used ways of collecting data.

Fifth, researchers are mainly from institutions in the United States, however almost a quarter are not. Several researchers have published multiple papers around TPACK including Mishra and Koehler, Niess, Graham and Cox, Kelly, Archambault,
Schmidt and Thompson, and Albion, Jamieson-Proctor and Finger.

A number of implications for consolidating current research and for suggesting future research emerge from this selected review of TPACK conference papers and journal papers from 2006-2011. Given the interest in TPACK by the Society for Information Technology & Teacher Education it could perhaps take a lead. Given the conclusions listed above, it would be opportune to consolidate research around Measuring TPACK and TPACK in practice, and as well to consolidate discussion around elaborating on the framework. The research agenda could be moved forward, by focusing more on gaps identified in research as a result of this review. For example the issue of gender is a notable gap in current research.

References

*Indicates a paper included in the sample


*Finger, G., Jamieson-Proctor, R., & Albion, P. (September, 2010). Beyond Pedagogical Content Knowledge: The Importance of TPACK for Informing Preservice Teacher Education in Australia. Paper presented at the Key Competencies in the Knowledge Society IFIP Advances in Information and Communication Technology, Brisbane.


*Guzey, S. S., & Roehrig, G. H. (2009a). Teaching science with technology: Case studies of


International Conference, San Diego.


Priest, W. C. (2007). *What is the common ground between tpck (technological pedagogical content knowledge) and learning objects?* Paper presented at the Society for Information Technology & Teacher Education International Conference, San Antonio.


pedagogical content knowledge on their vocational self-efficacy beliefs. Paper presented at the Society for Information Technology & Teacher Education International Conference, Charleston.


