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as Stakeholders in Higher Education**

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TEACHING TEACHERS FOR THE FUTURE PROJECT: BUILDING TPACK CONFIDENCE AND CAPABILITIES FOR ELEARNING

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ABSTRACT

In Australian Higher Education, the importance of initial teacher education (ITE) programs is evident through enrolments totalling 105 858 students in the broad field of Education in 2012 (DIISRTE, 2012) which represent 9.7% of the 1 094 672 students enrolled in higher education. This paper provides insights into the *Teaching Teachers for the Future (TTF) Project* involving all Higher Education Institutions (HEIs) which provide ITE programs in Australia. The 15 month long, \$8 million TTF Project, funded by the Australian Government's ICT Innovation Fund aimed to develop the ICT capabilities of future teachers. The design of ITE programs need to build the capabilities of future teachers to be effective within increasingly eLearning environments in schools. Central was the use of the Technological Pedagogical Content Knowledge (TPACK) conceptualisation (Mishra & Koehler, 2006) for teacher educators to build pre-service teachers' TPACK confidence and capabilities to enhance eLearning approaches with their students. Key findings from the TTF Project indicate that the TPACK conceptualisation and the Australian Institute for Teaching and School Leadership's *ICT Elaborations for Graduate Teacher Standards* (AITSL, 2011a) can inform the design of ITE programs in preparing future teachers for using ICT to support teaching and to support student learning.

KEYWORDS

Initial Teacher Education, TPACK, Capabilities, ICT, eLearning

1. INTRODUCTION – INITIAL TEACHER EDUCATION, TPACK CONFIDENCE, CAPABILITIES AND ELEARNING

Various approaches and conceptualisations of eLearning, blended learning, and online learning have been proposed and developed for use in all levels of schooling and education. Regardless of the approach or the conceptualisation which might be adopted, there is strong agreement that technological changes are requiring new capabilities of teachers to interface with and transform their existing pedagogical content knowledge (PCK). A central challenge is for teacher educators, referring here to those who teach the teachers in initial teacher education (ITE) programs, to build capabilities which can explore, harness, model and design eLearning environments which, in turn, help to build the capabilities of future teachers to design and implement effective eLearning with their students.

The importance and impact of designing initial teacher education (ITE) programs in Australian Higher Education Institutions (HEIs) is immense, given that enrolments in the broad field of Education totalled 105 858 students in 2012 (DIISRTE, 2012) which represented 9.7% of the 1 094 672 students enrolled in higher education. It is also worth noting that the remaining 90.3% of students study in HEIs would have been taught by teachers who were trained and educated in ITE programs. Put simply, ITE programs need to lead the design and implementation of eLearning approaches, enabling the development of future teachers with appropriate dispositions, values, beliefs, and capabilities to capitalise upon the potential of new and emerging technologies to enhance learning and teaching. As Tondeur et al. indicate, research (Agyei & Voogt, 2011; Drent & Meelissen, 2008) has established that a "crucial factor influencing new teachers"

adoption of technology is the quantity and quality of pre-service technology experiences included in their teacher education programmes” (Tondeur et al., 2011, p. 134). However, while this is well understood, they highlight that research findings (e.g. Sang et al., 2010; Tearle & Golder, 2008) report that “beginning teachers feel they are not well-prepared to effectively use technology in their classrooms” (Tondeur et al., 2012, p. 134).

This paper provides insights into the *Teaching Teachers for the Future (TTF) Project* involving all Higher Education Institutions (HEIs) which provide ITE programs in Australia. The 15 month long, \$8 million TTF Project, funded by the Australian Government’s ICT Innovation Fund aimed to develop the ICT capabilities of future teachers. The design of ITE programs need to build the capabilities of future teachers to be effective in designing and implementing eLearning in schools. Central to this project was the use of the Technological Pedagogical Content Knowledge (TPACK) conceptualisation (Mishra & Koehler, 2006) for teacher educators to design and model eLearning approaches with their students. This paper presents key findings which indicate that the TPACK conceptualisation and the *ICT Elaborations for Graduate Teacher Standards* (AITSL, 2011a) can inform the design of ITE programs in preparing future teachers for using ICT to support teaching and to support student learning.

2. TEACHING TEACHERS FOR THE FUTURE (TTF) PROJECT

The *TTF Project* focused on “systematic change in the ICT proficiency of graduate teachers in Australia by building the ICT capacity of teacher educators and developing resources to provide rich professional learning and digital exemplar packages” (Australian Government, 2010, p.1). The TTF Project involved all 39 Australian Higher Education ITE providers, with the lead agency being Education Services Australia (ESA) and partners being the Australian Council of Deans of Education (ACDE), the Australian Institute for Teaching and School Leadership (AITSL), and the Australian Council for Computers in Education (ACCE). Further details about the project are available elsewhere (<http://www.aitsl.edu.au/teachers/ttf/ttf-project.html>).

The TTF Project reflected an approach which respectfully understood the potential of capitalising upon the ‘collective wisdom’ of HEIs. As argued elsewhere (Finger, 2013a), the TTF Project adopted an *improvement* agenda rather than an *accountability* agenda. This collaborative approach, reflected through the establishment of the TTF National Support Network (NSN), the voluntary contributions of members of the TTF Research and Evaluation Working Group (REWG), and the collegial spirit of participants throughout the project. Central to the TTF Project was the Technological Pedagogical Content Knowledge (TPACK) conceptualisation (see Mishra & Koehler, 2006) which took into account the need for technological knowledge (TK) and well as pedagogical content knowledge (PCK). The *Australian Professional Standards for Teachers* (AITSL, 2011b) also interfaced with the TPACK conceptualisation, and a TTF Project outcome was the development of AITSL’s *ICT Elaborations for Graduate Teachers* (AITSL, 2011a) to complement and elaborate upon the standards.

3. TPACK AND PRE-SERVICE TEACHER EDUCATION LITERATURE REVIEW

A systematic literature review of TPACK undertaken by Voogt et al. (2013) examined 55 peer-reviewed publications between 2005 and 2011. That review found that there were different understandings of TPACK, and that teacher knowledge (TPACK) and their beliefs about pedagogy and technology determined whether or not a teacher might teach with technology. A search of the Association for the Advancement of Computing in Education (AACE) EdITLib publications, using ‘TPACK’ as the search term, resulted in 526 papers identified, with 232 papers published in 2012-2013. Mishra, in his December 2012 Newsletter lists 15 dissertations which utilised TPACK (Alshehri, 2012; Anderson, 2012; Benson, 2012; Bilici, 2012; Corey, 2012; Easter, 2012; Gillow-Wiles, 2012; Habowski, 2012; Hineman, 2011; Matherson, 2012; McBroom, 2012; Mishne, 2012; Mudzimiri, 2012; Rath sack, 2012; Unger, 2012). This provides evidence of an expanding body of TPACK research which is making a significant contribution to informing ITE, and the professional learning of practising teachers.

Tondeur et al. (2012) undertook a meta-ethnography through exploring qualitative evidence in relevant literature relating to pre-service teacher education. This review was useful in identifying 12 themes, as displayed in Table 1.

Table 1. Themes from a meta-ethnography of qualitative studies (Synthesised from Tondeur et al., 2012)

Key Themes relating to the preparation of pre-service teachers	
Themes and elaboration of the themes	Relevant Literature
1. Aligning theory and practice This relates to how well theory was embedded in practice.	Angeli & Valanides (2009); Goktas et al. (2008); Jang (2008); Lavonen et al. (2006)
2. Using teacher educators as role models The use of ICT needs to be modelled to pre-service teachers.	Angeli & Valanides (2009); Tearle & Golder (2008); Thompson et al. (2003); Clift et al. (2001)
3. Reflecting on attitudes about the role of technology in education It is important to reflect on the role of technology in education and to change attitudes.	Goktas et al. (2009); Tearle & Golder (2008)
4. Learning technology by design It is important for pre-service teachers to learn how to design and implement learning experiences which incorporate technology.	Angeli & Valanides (2009); Thompson et al. (2003); Sahin (2003)
5. Collaborating with peers Pre-service teachers need opportunities to discuss, share concerns and ideas with peers.	Jang (2008); Barton & Haydn (2006); Brush et al. (2003); Thompson et al. (2003)
6. Scaffolding authentic technology experiences Pre-service teachers acknowledged that it was important to be able to apply educational technology knowledge in authentic technology experiences	Goktas et al. (2009); Tearle & Golder (2008); Brush et al. (2003)
7. Moving from traditional assessment to continuous feedback Pre-service teachers felt that, while tests are important, there is a lack of relationship between the traditional tests and what is needed in order to make progress in using ICT in the classroom; e.g. such as developing ICT portfolios.	Lavonen et al. (2006); Barton & Haydn (2006); O'Reilly (2003); Sahin (2003)
Key Themes relating to the institutional level	
8. Technology planning and leadership It is important that leadership occurs at the programme planning and coordination level.	Goktas et al. (2009); Haydn & Barton (2007); Lavonen et al. (2006)
9. Co-operation within and between institutions Co-operation at the institutional level assists successful technology integration.	Thompson et al. (2003); Clift et al. (2001)
10. Staff development Many teacher educators were found to lack the knowledge, skills, and self-efficacy to teach or model technology integration to pre-service teachers, and, therefore, staff development is essential.	Goktas et al. (2009); Thompson et al. (2003); Seels et al. (2003)
11. Access to resources The research confirms the importance of access to resources, such as hardware, software, learning management systems)	Goktas et al. (2009); Haydn & Barton (2007); Thompson et al. (2003); Cuckle & Clark (2002)
12. Systematic and systemic change efforts The preparation of pre-service teachers to use technologies needs to be part of a systematic change process.	Goktas et al. (2009); Thompson et al. (2003); Seels et al. (2003)

Collectively, the themes identified by Tondeur et al. (2012), the literature review by Voogt et al. (2013), and the growing TPACK research base provides a context in which the TTF Project research and evaluation is located. The literature establishes the importance of pre-service teacher TPACK capabilities for successful eLearning.

4. TTF PROJECT RESEARCH AND EVALUATION DESIGN AND METHODOLOGY

Three major research and evaluation strategies were designed and implemented; namely, (1) the development and administration of a *TTF TPACK Survey*, (2) the implementation of Most Significant Change (MSC) methodology, and (3) the facilitation of and opportunities for institution-initiated TTF research and evaluation projects. This paper focuses on data analysis obtained through both parametric and Rasch analyses of the *TTF TPACK Online Survey*.

Jamieson-Proctor et al. (2013) outline the development of *TTF TPACK Survey* instrument which aimed to evaluate the change in pre-service teachers' TPACK as a result of their involvement in the TTF intervention conducted throughout 2011 at all participating Australian HEIs. The *TTF TPACK Survey* was administered

online pre- (T1) and post- (T2) the TTF intervention in each HEI to seek evidence of changes to the pre-service teachers' self-perceptions of their *confidence* to use ICT with a range of pedagogical strategies, and to support their future students' learning with ICT. Additionally, it aimed to measure the pre-service teachers' perceptions of *usefulness* of ICT for teaching and learning. Jamieson-Proctor et al. (2013) detail more fully the validity and reliability of the *TTF TPACK Survey*. However, this paper notes that a limitation of the data is that the online survey sought self report information from the pre-service teachers. This approach was justified according to limitations posed by the scale of the project and the design of the data collection needed to be logistically possible. Furthermore, it should be noted that the MSC methodology employed at each HEI, enabled the survey data to be complemented by the MSC stories.

The *TTF TPACK Online Survey* data collections were undertaken in mid-June and early November 2011. A total of 12881 participants completed the first survey (T1) and 5809 participants the second (T2). Participants tended to be female, Australian, spoke English at home, and tended not to identify as either Aboriginal Australians or Torres Strait Islanders. They ranged in age from 17-62 years with an average age of 29 years, and with secondary school as the most likely previous qualification for both participants and their parents.

5. TTF PROJECT SUMMARY OF SELECTED FINDINGS – PRE-SERVICE TEACHER CONFIDENCE

This paper presents a selection of findings related directly to future teachers' TPACK confidence and capabilities. TTF research and evaluation findings are provided elsewhere in the TTF Project final report (available at <http://www.acde.edu.au/pages/images/TTF%20Final%20Report.pdf>). Moreover, the TTF Project Special Edition of *Australian Educational Computing* provides further scholarly insights into TTF project outcomes and impact (Campbell, 2013; Chandler & Redman, 2013; Gronn et al., 2013; Heck & Sweeney, 2013; Henderson et al., 2013; Kearney & Maher, 2013; Lloyd & Mukherjee, 2013; Masters et al., 2013; Doyle & Reading, 2013; Reading & Doyle, 2013; Sweeney & Drummond, 2013; White & Geer, 2013; Williams & Sutton, 2013; Zagami, 2013). Specifically, in that journal issue, Finger et al. (2013b) provides a summary of key findings from the *TTF TPACK Online Survey*.

5.1 Pre-Service Teachers' Confidence about How ICT Supports Teaching

Pre-service teachers were asked to respond to items relating to their confidence, as a future teacher, about their use of ICT, to support teaching. In response to these items, means were calculated and the range of ratings extended from approximately 4.2, where a rating of 4 is equivalent to being moderately confident through to approximately 5.6, where a rating of 7 would be extremely confident and a rating of 6 would also reflect a high level of confidence. Growth in confidence was evident for all items between T1 and T2, as shown in Figure 1.

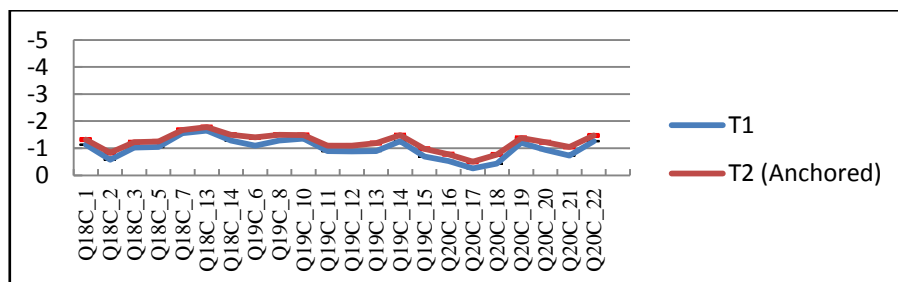


Figure 1. Confidence to use ICT, as a future teacher, to support teaching (*TTF Project TPACK Online Survey* Items 18C, 19C & 20C combined)

At the individual item level, as illustrated in Figure 2, participants were *most likely* to be confident that ICT would support teaching in relation to:¹

- engage with colleagues to improve professional practice;
- teach specific subject areas in creative ways;
- use ICT for reporting purposes such as reporting to parents/carers;
- select and organise digital content & resources;
- use a range of ICT resources and devices for professional purposes; and
- collaborate for professional purposes such as online professional communities.

However, they were *least likely* to be confident to use ICT to support teaching to:

- teach strategies to support students from Aboriginal and Torres Strait Islander backgrounds;
- manage challenging student behaviour by encouraging responsible use of ICT;
- develop digital citizenship to promote student demonstrate of rights and responsibilities in their use of digital resources;
- engage parents & families in child's school through ICT; and
- teach strategies responsive to diverse student backgrounds.

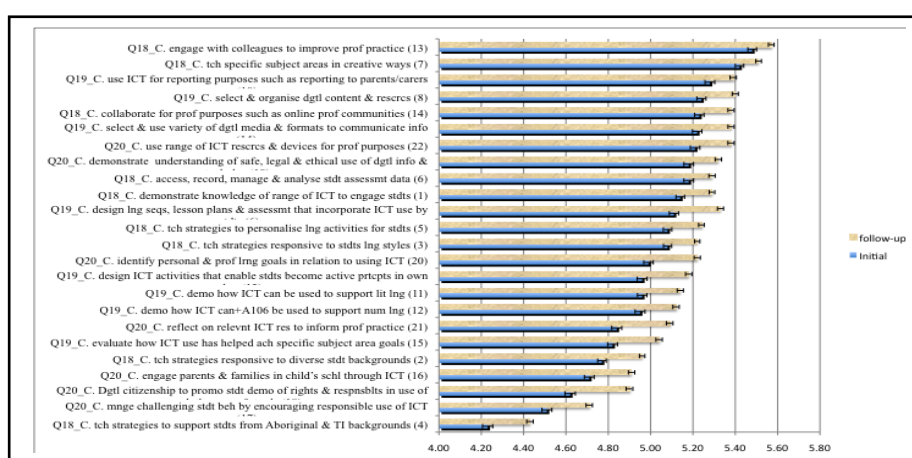


Figure 2. Average confidence of pre-service teachers to use ICT to support teaching (Q18-20 items arranged in ascending order; Scale 0-7 where 7 is the highest level of confidence)

Table 2 shows that the positivity of all responses increased significantly from the initial to the follow-up survey, with the threshold probability set at $p < .002$ (Bonferonni family-wise correction for 24 items).

Table 2. Nonparametric (Kruskal-Wallis) tests of initial vs. follow-up confidence ratings of 24 items about how confident pre-service teachers, as future teachers, would be to use ICT to support teaching²

Q18-20 Confidence ratings	Chi-Square	df	Asymp. Sig.
Q18_C. Demonstrate knowledge of range of ICT to engage students (1)	36.104	1	0.000
Q18_C. Teach strategies responsive to diverse student backgrounds (2)	67.906	1	0.000
Q18_C. Teach strategies responsive to students learning styles (3)	37.745	1	0.000
Q18_C. Teach strategies to support students from Aboriginal & TI backgrounds (4)	51.530	1	0.000
Q18_C. Teach strategies to personalise learning activities for students (5)	40.912	1	0.000
Q18_C. Access, record, manage & analyse student assessment data (6)	15.596	1	0.000
Q18_C. Teach specific subject areas in creative ways (7)	12.041	1	0.001
Q18_C. Engage with colleagues to improve professional practice (13)	12.133	1	0.000
Q18_C. Collaborate for professional purposes such as online professional communities (14)	32.801	1	0.000
Q19_C. Design learning sequences, lesson plans & assessment that incorporate ICT use by students (6)	68.341	1	0.000
Q19_C. Select & organise digital content & resources (8)	36.911	1	0.000
Q19_C. Use ICT for reporting purposes such as reporting to parents/carers (10)	14.861	1	0.000
Q19_C. Demonstrate how ICT can be used to support literacy learning (11)	43.356	1	0.000

¹ Highest and lowest groups to break in scores included: e.g., 5.1, 5.0, & 4.7 (only 5.1 & 5.0 included).

² Wording of items abbreviated in both figures and tables to accommodate available space on page.

Q19_C. Demonstrate how ICT can be used to support numeracy learning (12)	46.638	1	0.000
Q19_C. Design ICT activities that enable students become active participants in own learning (13)	66.427	1	0.000
Q19_C. Select & use variety of digital media & formats to communicate info (14)	38.768	1	0.000
Q19_C. Evaluate how ICT use has helped teach specific subject area goals (15)	68.665	1	0.000
Q20_C. Engage parents & families in child's school through ICT (16)	55.170	1	0.000
Q20_C. Manage challenging student behaviour by encouraging responsible use of ICT (17)	53.660	1	0.000
Q20_C. Digital citizenship to promote student demonstrate of rights & responsibilities in use of digital resources & tools (18)	89.908	1	0.000
Q20_C. Demonstrate understanding of safe, legal & ethical use of digital info & technology (19)	25.151	1	0.000
Q20_C. Identify personal & professional learning goals in relation to using ICT (20)	65.759	1	0.000
Q20_C. Reflect on relevant ICT research to inform professional practice (21)	77.940	1	0.000
Q20_C. Use range of ICT resources & devices for professional purposes (22)	34.948	1	0.000

5.2 Pre-Service Teachers' Confidence about How ICT Supports Student Learning

In response to items which sought pre-service teachers' perceptions of the confidence to use ICT to support student learning, growth in confidence was evident for all items between T1 and T2, as shown in Figure 3.

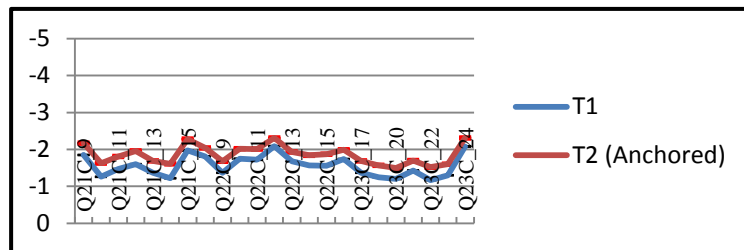


Figure 3. Confidence to facilitate student use (*TTF Project TPACK Online Survey Items 21C, 22C & 23C combined*)

In the initial survey, participants answered 24 items (Q21-23) using a 7-point Likert scale ranging from "Not at all confident" (1) to "Very confident" (7). Their responses from the initial survey were entered into an unconstrained factor analysis (PCA, Varimax rotation, .25 and above loadings visible, KMO shown). This factor analysis produced a single-component solution with all 24 items loading at .6 or above. A KMO of .951 and cumulative explained variance of 73% both supported the quality of this solution. Cronbach's Alpha was .985, a highly acceptable value. Responses from the follow-up survey were entered into a confirmatory factor analysis utilising Maximum Likelihood extraction of the single factor solution yielded a solution where all 24 items loaded at levels of .8 or above, KMO=.984 and 74% of variance was explained.

More generally, at the individual item level, the range of ratings extended from approximately 4.8, where a rating of 4 is equivalent to being moderately confident through to approximately 5.5, an average rating roughly equidistantly between ratings of moderate (4) vs. extreme confidence (7). As illustrated in Figure 3 below, participants were *most likely* to be confident that ICT would support student learning in relation to providing motivation for curriculum tasks, demonstrating what they have learned, developing understanding of world, gathering information and communicating with known audiences, and communicating with others locally and globally. In contrast, they were *least likely* to be confident that ICT would support student learning in relation to facilitate integration of curriculum areas to construct multidisciplinary knowledge, understand and participate in changing knowledge economy, synthesise their knowledge, acquire awareness of global implications of ICT-based technologies, and develop functional competencies in specified curriculum areas.

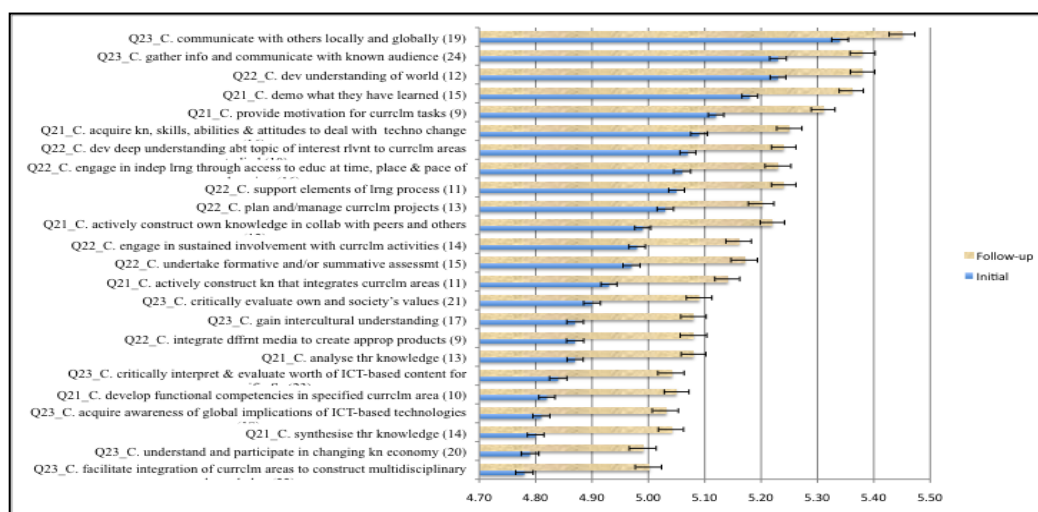


Figure 4. Average confidence of pre-service teachers to use ICT to support student learning (Q21-23 items arranged in ascending order; Scale 0-7 where 7 is the highest level of confidence)

As illustrated in Figure 4, when asked to rate 24 items for Questions 21-23, in terms of their confidence that each item would support ICT teaching, and with the average response per item plus standard error per occasion shown, the higher ratings on the occasion of the follow-up survey plus the non-overlapping error terms for initial vs. follow-up survey items are consistent with these differences being statistically significant. As further shown in Table 3, with the threshold probability set at $p < .002$ (Bonferonni family-wise correction for 24 items), the positivity of all responses increased significantly from the initial to the follow-up survey.

Table 3. Nonparametric (Kruskal-Wallis) tests of initial vs. follow-up confidence ratings of 24 items related to questions about how ICT can support student learning

Confidence ratings	Chi-Square	df	Asy mp. Sig.
Q21_C. Provide motivation for curriculum tasks (9)	62.024	1	0.000
Q21_C. Develop functional competencies in specified curriculum area (10)	82.94	1	0.000
Q21_C. Actively construct knowledge that integrates curriculum areas (11)	72.675	1	0.000
Q21_C. Actively construct own knowledge in collaboration with peers & others (12)	74.798	1	0.000
Q21_C. Analyse their knowledge (13)	61.48	1	0.000
Q21_C. Synthesise their knowledge (14)	85.774	1	0.000
Q21_C. Demonstrate what they have learned (15)	54.675	1	0.000
Q21_C. Acquire knowledge, skills, abilities & attitudes to deal with techno change (16)	32.813	1	0.000
Q22_C. Integrate different media to create appropriate products (9)	55.039	1	0.000
Q22_C. Develop deep understanding about topic of interest relevant to curriculum areas studied (10)	50.482	1	0.000
Q22_C. Support elements of learning process (11)	54.714	1	0.000
Q22_C. Develop understanding of world (12)	35.03	1	0.000
Q22_C. Plan & manage curriculum projects (13)	38.265	1	0.000
Q22_C. Engage in sustained involvement with curriculum activities (14)	47.502	1	0.000
Q22_C. Undertake formative and/or summative assessment (15)	48.953	1	0.000
Q22_C. Engage in independent learning through access to education at time, place & pace of own choosing (16)	37.033	1	0.000
Q23_C. Gain intercultural understanding (17)	57.781	1	0.000
Q23_C. Acquire awareness of global implications of ICT-based technologies (18)	58.654	1	0.000
Q23_C. Communicate with others locally and globally (19)	13.798	1	0.000
Q23_C. Understand and participate in changing knowledge economy (20)	47.853	1	0.000
Q23_C. Critically evaluate own and society's values (21)	45.995	1	0.000
Q23_C. Facilitate integration of curriculum areas to construct multidisciplinary knowledge (22)	58.494	1	0.000
Q23_C. Critically interpret & evaluate worth of ICT-based content for specific Ss (23)	47.116	1	0.000
Q23_C. Gather info and communicate with known audience (24)	27.494	1	0.000

The findings reported here showed that the TTF Project, focusing on a ‘collective wisdom’ approach, using TPACK as the guiding conceptualisation, and attention being paid to the *Australian Professional Standards for Teachers ICT Elaborations for Graduate Teachers* (AITSL, 2011a), resulted in gains in the overall confidence of pre-service teachers to use ICT to support teaching and to support student learning. Furthermore, this research has identified specific areas of strong confidence, such as using ICT to engage with colleagues to improve professional practice, teach specific subject areas in creative ways, use ICT for reporting purposes such as reporting to parents/carers, selecting and organising digital content and resources, using a range of ICT resources and devices for professional purposes, and collaborating for professional purposes through online professional communities

Given the expected technological changes of new and emerging technologies, the TTF Project research and evaluation has also identified ongoing areas needing attention. Strengthening capabilities in the use of ICT to support teaching is required in developing strategies to support students from Aboriginal and Torres Strait Islander backgrounds, managing challenging student behaviour by encouraging responsible use of ICT, promoting digital citizenship which enables student demonstration of digital rights and responsibilities in using digital resources, engaging parents and families in their children’s schooling through ICT use, and developing strategies which are responsive to diverse student backgrounds. In addition, strengthening capabilities is also required in supporting student learning, such as integrating curriculum areas to construct multidisciplinary knowledge, for future teachers to effectively understand and participate in changing knowledge economy, and to acquire awareness of global implications of ICT-based technologies.

6. CONCLUSION

This paper provided a summary of the TTF Project and established the importance of ITE programs in preparing future teachers to have the TPACK confidence and capabilities needed to support teaching and to support student learning. The literature review established the growing TPACK research base (e.g. Voogt et al., 2013) and the key themes (Tondeur et al., 2012) relating to teacher preparation for ICT use. Consistent with this literature, the TTF Project was guided by the TPACK conceptualisation. The TTF approach focusing on ITE programs and institutional leadership and collaboration within and between HEIs in Australia appropriately addressed key themes. themes identified at the teacher preparation programme level and at the institutional level.

Importantly, by adopting an *improvement* agenda, rather than responding to an *accountability* agenda, this paper has argued that the TTF Project research and evaluation findings have demonstrated that pre-service teachers’ TPACK confidence and capabilities, which both support teaching and support student learning, were enhanced. Given the central importance of teachers in eLearning, continuing attention needs to be focused on TPACK in ITE programs, and the TTF research provides evidence of measurable improvements, which can promote more effective teacher preparation and, consequently, this can result in more effective eLearning by students in schools.

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