Developing and validating a questionnaire for evaluating the EFL ‘Total PACKage’: Technological Pedagogical Content Knowledge (TPACK) for English as a Foreign Language (EFL)

This paper introduces a new self-report questionnaire for the assessment of TPACK for English language teaching which does not prescribe a particular approach to language teaching or the use of particular technologies. Development and validation of the questionnaire involved: (1) creation of an initial item pool based on a review of the literature on Pedagogical Content Knowledge (PCK) and the use of technology in EFL, (2) evaluation of the content validity of the initial items with a panel of 36 international experts in computer-assisted language learning, (3) exploration and validation of the underlying factor structure through the administration of the questionnaire to 542 EFL practitioners and Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA). A six-factor solution, comprising PCK, TK, CK, Technological Pedagogical Knowledge (TPK), Technological Content Knowledge (TCK), and Technological Pedagogical Content Knowledge (TPCK), emerged from the EFA and was subsequently confirmed through CFA. The results also provide further support for approaches to English language teacher education in which attempt to integrate TK, PK and CK, rather than introduce them separately, and which highlight the ways in which emerging and established technologies can be employed to represent language and provide opportunities for communication that are known to promote language acquisition.

EFL, ELT, Pedagogical Content Knowledge, Teacher Knowledge, Technology, TPACK,

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# Introduction

Investment in technology in schools and universities has increased in recent years. Moreover, the use of technology is now stipulated in curricula, including those specifically focusing on language learning and teaching ([Healey et al., 2008](#_ENREF_26); [Macaro, Handley, & Walter, 2012](#_ENREF_44)). These policies and the investment appear to be driven by a belief that the use of technology will inevitably improve educational outcomes ([Selwyn, 2012](#_ENREF_57)). Many educational technologists and Computer-Assisted Language Learning (CALL) researchers and experts, however, adopt a more critical stance to the use of technology in education, and believe that technology is only effective when its attributes and affordances align with the subject content and associated theories of learning and teaching practices (e.g. [Angeli & Valanides, 2009](#_ENREF_3); [Colpaert, 2006](#_ENREF_15); [Golonka, Bowles, Frank, Richardson, & Freynik, 2014](#_ENREF_21); [Mishra & Koehler, 2006](#_ENREF_47)). It has therefore been argued that it is essential to provide teachers training not only in how to use specific technologies generally, but also in how to select and adapt technologies for use in specific educational contexts to teach specific subject content ([Tondeur et al., 2012](#_ENREF_69)).

The knowledge that teachers require to make decisions about the potential use of technology in educational contexts has been referred to as Technological Pedagogical Content Knowledge or ‘Total PACKage’ (TPCK or TPACK; [Mishra & Koehler, 2006](#_ENREF_47); [A. D. Thompson & Mishra, 2007](#_ENREF_66)), and a number of self-assessment instruments have been developed to assess the impact of teacher training and continuing professional development on TPACK (e.g. [Angeli & Valanides, 2009](#_ENREF_3); [Jimoyannis, 2010](#_ENREF_30); [Koehler, Mishra, & Yahya, 2007](#_ENREF_33); [Koh & Chai, 2014](#_ENREF_34)). Initially, these instruments tended to be subject-independent (e.g. [Archambault & Barnett, 2010](#_ENREF_5); [Koh, Chai, & Tsai, 2010](#_ENREF_35); [Schmidt et al., 2009](#_ENREF_53)). It is, however, increasingly acknowledged that subject-dependent instruments might better capture teachers’ TPACK ([Voogt, Fisser, Roblin, Tondeur, & van Braak, 2012](#_ENREF_72)), and instruments have been developed for a number of specific curriculum areas including language learning ([Baser, Kopcha, & Ozden, 2016](#_ENREF_6); [Chai, Chin, Koh, & Tan, 2013](#_ENREF_12))

The approach which has been adopted to the development of instruments to assess the TPACK of language teachers is to be commended for its rigour. Emphasising the ability to facilitate collaborative and self-directed learning, Chai et al.’s (2013) instrument, however, appears to be influenced by social-constructivist and socio-cultural theories of learning, to the exclusion of other theories of Second Language Acquisition ([SLA; see Mitchell, Myles, & Marsden, 2013](#_ENREF_48)). Emphasising the communicative competence of the teacher, i.e. the teacher’s ability to use language to engage in successful communication ([Canale & Swain, 1980](#_ENREF_8)), to the neglect of other potential dimensions of Content Knowledge (CK), as well as the use of technologies to provide opportunities to learn through communication, Baser et al.’s (2016) instrument appears to be influenced by Communicative Language Teaching (CLT), to the neglect of other approaches to and methods of language learning and teaching ([see Larsen-Freeman & Anderson, 2011](#_ENREF_38)). These assumptions might be justified in their respective contexts (see below). Technology can, however, be employed to translate a range of different SLA theories into CALL designs (see Macaro et al., 2012), and it might be argued that language teachers ought to be able to critically select among these different pedagogical ideas ([Candlin & Widdowson, 1987](#_ENREF_10); [Kumaradivelu, 2001](#_ENREF_37)). It has also long been recognized that there is a need to complement the strong form of CLT which views communicative competence as the product of engaging in conversational interaction with the explicit teaching of language forms, skills and strategies and consequently for language teachers to possess ‘a sound understanding of the language systems knowledge base’ ([Andrews, 2001, p. 82](#_ENREF_2)), i.e. language awareness, as well as communicative competence ([Celce-Murcia, Dornyei, & Thurrell, 1997](#_ENREF_11)).

This paper therefore introduces a new instrument for measuring TPACK for English Language Teaching (ELT) which is theory and technology independent, that is does not prescribe a particular theory of second language acquisition and approach to language teaching or the use of particular technologies. Specifically, having defined TPACK and critically examined the instruments developed to date, we introduce our new instrument, English as a Foreign Language-TPACK (EFL-TPACK), and explore its validity and reliability through content validation involving CALL researchers and experts, and applying exploratory and confirmatory factor analyses to the responses of a large international sample of teachers to the survey. In other words, this paper addresses the following research questions:

* What is the content validity of EFL-TPACK items from the perspective of experts in the field of CALL?
* What is the underlying factor structure of EFL-TPACK?
* What is the construct validity of EFL-TPACK?
* How consistent and reliable is EFL-TPACK?

# Literature review

In order to develop a valid and reliable self-report instrument for the assessment of TPACK among English language teachers, it is essential to clearly define the construct to be measured. A review of the literature finds many attempts to develop instruments to measure TPACK. These may also shed light on the nature of the construct. Having defined TPACK, previous research on the development of instruments for the assessment of TPACK is therefore reviewed below.

## What is TPACK?

Technological Pedagogical Content Knowledge (TPACK) is a theory designed to account for teachers’ ability to integrate technology into the curriculum. TPACK builds on Shulman’s ([1986](#_ENREF_59)) concept of Pedagogical Content Knowledge (PCK). According to Shulman’s model of PCK, the effectiveness of an individual teacher depends not only on their Content Knowledge (CK) but also on their PCK. CK refers to teachers’ knowledge of the subject area, including how knowledge is structured within the discipline and how ‘truth’ is established ([Shulman, 1986](#_ENREF_59)). PCK, on the other hand, refers to teachers’ ‘knowledge [of the subject] *for* teaching’ (Shulman, 1986, p.9). It includes knowledge of the variety of ways in which the subject matter might be transformed into representations which promote understanding among learners and an awareness of the teachability and learnability of different areas of the subject matter (Shulman, 1986).

As for TPACK (seeFigure 1), it is claimed that the level of effectiveness of an individual teacher is determined by their Technology Knowledge (TK), Pedagogy Knowledge (PK), and Content Knowledge (CK), and the degree to which they are able to integrate these different areas of knowledge ([Mishra & Koehler, 2006](#_ENREF_47)). TK refers to teachers’ understanding of how to operate technologies which could be used in education; PK refers to teachers’ understanding of the conditions necessary for and processes involved in learning and common approaches to and methods of teaching; and, CK, as outlined by Shulman (1986), refers to teachers’ understanding of the subject matter and how different areas of the subject matter are related to one another ([Mishra & Koehler, 2006](#_ENREF_47)). With respect to the integration of these three different areas of knowledge, four further areas of knowledge are distinguished: Pedagogical Content Knowledge (PCK; *see* above), Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK), and Technological Pedagogical Content Knowledge (TPCK[[1]](#endnote-1); Mishra & Koehler, 2006). TCK refers to knowledge of how technology might be employed to transform subject matter into representations which promote understanding. For example, audio-visual speech synthesis or ‘talking heads’ might be used as an alternative to teacher demonstrations and vowel charts to demonstrate English pronunciation ([e.g. Wang, Chen, Li, & Meng, 2012](#_ENREF_74)). TPK refers to teachers’ understanding of how technology might be employed to create conditions and engage learners in processes which promote learning. For example, evidence suggests that learners might find computer-mediated communication and in particular text chat less anxiety inducing than face-to-face communication ([e.g. Satar & Özdener, 2008](#_ENREF_52)). TPCK refers to knowledge of how technology might be employed to represent content in pedagogically meaningful ways, as well as create conditions and engage learners in processes which promote learning (Mishra & Koehler, 2006). For example, in addition to permitting the demonstration of English pronunciation, it has been suggested that learners might find working with ‘talking heads’ less anxiety inducing than teacher led pronunciation instruction because they perceive ‘talking heads’ to be non-judgemental pronunciation tutors ([e.g. Handley, 2009](#_ENREF_25)). In addition to reducing learners’ anxiety, it has also been suggested that the slower pace of text chat might promote noticing and focus on form (e.g. Satar & Özdener, 2008).

[Figure 1 around here]

## Instruments for assessing TPACK

Driven by the need to assess the implementation of policies and curricula stipulating the use of technology, as well as the effectiveness of related training initiatives, a number of instruments have been developed to assess teachers’ TPACK. Perhaps the first and most frequently cited example is Schmidt et al.’s ([2009](#_ENREF_53)) self-assessment instrument for pre-service primary school (PK-6) teachers. Based on existing instruments for the assessment of technology use in educational settings, Schmidt and colleagues demonstrated the validity of the instrument through expert content validity analysis and factor analysis of the results of the administration of the survey to a cohort of students in instructional technology.

Researchers who have adapted Schmidt et al.’s (2009) instrument have, however, frequently failed to find all seven of the knowledge domains hypothesised to underpin TPACK when validating adaptations of Schmidt et al.’s (2009) survey (e.g. [Archambault, 2008](#_ENREF_4); [Chai, Koh, Tsai, & Tan, 2011](#_ENREF_14); [Koh et al., 2010](#_ENREF_35); [Liu, Zhang, & Wang, 2015](#_ENREF_41); [Shinas, Yilmaz-Ozden, Mouza, Karchmer-Klein, & Glutting, 2013](#_ENREF_58)). Of all the areas of knowledge that are hypothesised to underpin TPACK, PK is the one that studies frequently fail to identify as a separate construct (e.g. [Archambault & Barnett, 2010](#_ENREF_5); [Jang & Tsai, 2012](#_ENREF_29); [Koh et al., 2010](#_ENREF_35); [Shinas et al., 2013](#_ENREF_58)).

Broadly these findings have been attributed to the imprecision of construct definitions and consequently construct boundaries ([Angeli & Valanides, 2009](#_ENREF_3); [Cox, 2008](#_ENREF_17); [Graham, 2011](#_ENREF_22)). More specifically, it has been suggested that failure to identify PK as a separate factor from PCK, might be explained by the fact that PK and CK are intrinsically linked ([McEwan & Bull, 1991](#_ENREF_45); [Segall, 2004](#_ENREF_56)). As Segall (2004) explains, if we accept that pedagogy is not restricted to the classroom and refers broadly to process of transmitting and reproducing knowledge ([Simon, 1992](#_ENREF_62)), and that any expression of subject matter is an attempt to communicate understanding thereof (McEwan & Bull, 1991), then ‘pedagogy would be inherent in any message’ (Segall, 2004, p. 494). Similar reasons are proposed for the emergence of TPCK as a single factor combining TCK and/or TPK ([Archambault & Barnett, 2010](#_ENREF_5)).

The imprecision of constructs and their boundaries might also be attributed to the fact that in many studies TPACK is treated as if it were subject-independent (e.g. [Archambault & Barnett, 2010](#_ENREF_5); [Jang & Tsai, 2012](#_ENREF_29); [Koh et al., 2010](#_ENREF_35)) and consequently content knowledge has not been articulated with sufficient clarity ([Chai, Koh, & Tsai, 2013](#_ENREF_13); [Voogt et al., 2012](#_ENREF_72)) . This is a significant limitation given that it has long been acknowledged that PCK is subject-dependent ([Shulman, 1986](#_ENREF_59), [1987](#_ENREF_60)) – compare for example the teaching of a skill like multiplication with teaching the understanding and critical interpretation of complex writing materials (Shulman, 1987).A number of instruments have therefore been developed for the assessment of TPACK in specific curriculum areas. As predicted, some of these studies have succeeded in identifying all seven areas of knowledge hypothesised to underpin TPACK. These include Canbazoğlu-Bilici et al.’s ([2013](#_ENREF_9)) instrument for science teachers, and Su et al.’s ([in press](#_ENREF_64)) instrument for geography teachers, for example.

## Instruments for assessing TPACK for language teaching

Similarly, instruments have been developed for the specific assessment of TPACK for language teaching. As far as it is possible to establish, Chai et al. (2013) was the first such instrument. With the specific purposes of assessing TPACK among teachers of Chinese as a second language in Singapore, they adapted all of the content-related items (i.e. items designed to measure CK, PCK, TCK and TPCK) in Chai et al.’s (2011) subject-independent instrument for the assessment of TPACK among pre-service teachers to the specific context of Chinese language teaching. For example, ‘I can think about the content of my first teaching subject (CS1) like a subject matter expert’ in Chai et al. (2011, p. 600) became ‘I can think of the content of Chinese language like a subject matter expert’ in Chai et al. (2013, p. 661), and ‘Without using technology, I can help my students understand the content knowledge of first teaching subject (CS1) through various ways’ (Chai et al., 2011, p. 599) became ‘Without using technology, I can help my students understand the content knowledge of Chinese language through various ways’ (Chai et al., 2013, p. 661).

Baser et al. (2016), on the other hand, developed an entirely new instrument. With a view to assessing TPACK among pre-service English language teachers in Turkey, they consulted national and international standards focusing on the integration of educational technology and the use of technology to support English language teaching more specifically. On the basis of this review, they generated an item pool, which they subsequently asked a panel of experts to review. Finally, the resulting survey was administered to large sample of pre-service teachers and the results were subjected to factor analysis.

Both studies successfully identified all seven TPACK knowledge domains. A number of limitations of the two instruments, however, emerge if you examine the items on the surveys in depth. Focusing on the use of technology to support collaborative and self-directed learning in the TPCK domain, Chai et al.’s (2013) instrument appears to be influenced by a ‘uniform view of technology use led by enthusiasm for social-constructivist and socio-cultural theories of learning’ (Selwyn, 2012, p. 81). And, Baser et al.’s (2016) instrument appears to restrict itself to the use of technology to provide learners with opportunities to engage in communication in the target language in the TCK and TPACK domains, despite covering a wider range of technologies in the TK domain.

It is acknowledged that Chai et al.’s (2013) focus on uses of technology associated with socio-constructivist and socio-cultural theories of learning might be appropriate in the Singaporean context where there is currently an emphasis on collaborative and self-directed learning ([Teo & Ting, 2010](#_ENREF_65)) . Similarly, it is acknowledged that Baser et al.’s (2016) focus on the communicative competence of the teacher might be appropriate in the Turkish context, where the Turkish Ministry of National Education ([Seferoglu, 2004](#_ENREF_54), [2006](#_ENREF_55); [TMoNE, n.d.](#_ENREF_68) ) has relatively recently redesigned the national language teaching curriculum to focus on the development of Turkish citizens’ communicative competence, and is currently promoting a communicative approach to language teaching[[2]](#endnote-2).

Technology can, however, be employed to translate a range of different SLA theories (and associated approaches to and methods of language teaching) into CALL designs, including behaviourist (e.g. [Lu, 2008](#_ENREF_42); [Nakata, 2008](#_ENREF_50)), cognitivist ([e.g. Mirzaei, Meshgi, Akita, & Kawahara, 2017](#_ENREF_46)) and interactionist (e.g. [Montero-Perez, Paulussen, Macken, & Desmet, 2014](#_ENREF_49); [Smith, 2004](#_ENREF_63)) theories as well as socio-constructivist theories (e.g. [Lund, 2008](#_ENREF_43); [Simina & Hamel, 2005](#_ENREF_61)). And, just as it is claimed that in the current post-methods era, teachers ought to be equipped with the knowledge and skills required to permit them to select among ‘traditional’ non-technology methods and resources those which are most suited to their learners in their context (Candlin & Widdowson, 1987; Kumaravadivelu, 2001), it might be argued that teachers ought to be equipped with the knowledge and skills required to select among the different technologies and digital resources available those which are most suited to their own learners in their own particular context.

It is also widely accepted that there are a number of disadvantages to adopting a purely communicative approach to language teaching in its strong form (e.g. indirect instruction in which language knowledge is acquired inductively is far less efficient than direct instruction in which language knowledge is explicitly taught in the form of rules), and that indirect language instruction should be complemented with direct instruction, and consequently that the ‘good language teacher’ should not only be proficient in the target language, but also possesses and explicit knowledge about the language including its lexical, syntactic and phonetic systems, i.e. language awareness (Celce-Murcia et al., 1997).

In response to the limitations of these instruments for the assessment of TPACK for language teaching, this paper introduces and evaluates a new instrument for measuring TPACK for English language teaching which is theory and technology independent.

# Developing and validating EFL-TPACK

Development and validation of the EFL-TPACK questionnaire proceeded in three stages: 1) generation of the item pool, 2) content validation, and 3) construct validation.

## Generation of the item pool

Mishra and Koehler’s ([2006](#_ENREF_47)) definition of TPACK and its components, van Olphen’s ([2008](#_ENREF_71)) attempt to apply Mishra and Koehler’s framework to World Languages Teacher Education (WLTE), and Schmidt et al.’s (2009) attempt to translate Mishra and Koehler’s framework into an instrument for the assessment of TPACK among pre-service primary school teachers provided the foundation for the initial item pool (see Table 1).

[Table 1 around here]

Content Knowledge (CK): van Olphen’s (2008) articulation of CK which was based on the ACTFL ([2002](#_ENREF_1)) standards for the preparation of foreign language teachers was first checked against the syllabus for DELTA, the highest level on the Cambridge English Teaching Framework ([UCLES, 2010](#_ENREF_70)), for content validity. Then, it was translated into nine questionnaire items designed to tap a) language proficiency and communication skills, b) language awareness, and c) knowledge of culture.

Pedagogy Knowledge (PK): Schmidt et al.’s (2009) six items based on König et al. (2011) and Voss et al.’s (2011) articulation of general PK formed the foundation of the PK scale. Supplemented with nine novel items adapted from Newby et al. (2007) and designed to tap teachers’ ability to structure lessons and incorporate research, the resulting scale comprised seven sub-scales: a) knowledge of teaching methods, b) knowledge of classroom management, c) knowledge of assessment, d) knowledge of students, e) ability to adapt, f) lesson structuring and an understanding of curriculum and context, and g) incorporating research.

Technological Knowledge (TK): Schmidt et al.’s (2009) four items designed to tap an individual’s general technology self-efficacy were combined with three novel items designed to tap Mishra and Koehler’s (2006) definition of TK (i.e. knowledge about hardware and software), and supplemented with 10 novel items focusing on the individual technologies which researchers have proposed might be employed in CALL as identified in Levy ([2009](#_ENREF_40)) and Macaro et al.’s (2012) reviews.

Pedagogical Content Knowledge (PCK): van Olphen’s (2008) articulation of PCK was first checked against the DELTA syllabus for content validity, and then translated into eight questionnaire items. Supplemented with four items adapted from Newby et al. (2007) and designed to tap knowledge of students, self-evaluation, and structuring lessons around the language curriculum and context, the resulting scale comprised six sub-scales: a) knowledge of SLA theories, b) knowledge of students, c) lesson structuring and an understanding of curriculum and context, d) ability to adapt, e) ability to self-evaluate, and f) incorporating research.

Technological Content Knowledge (TCK): reflecting Mishra and Koehler’s (2006) definition of the domain and the TESOL Technology Standards ([Healey et al., 2008](#_ENREF_26)) as well as the construction of the CK and TK (see above), TCK items were designed to tap teachers’ awareness of how technology can be used to represent a) language knowledge, and b) culture, as well as c) provide opportunities for language use.

Technological Pedagogical Knowledge (TPK): Schmidt et al.’s (2009) four items based on a) evaluation of technologies, b) using technology to enhance teaching approaches, c) using technology to enhance student learning, and d) using technology to adapt teaching resources formed the foundation of the TPK scale. Validation of Schmidt et al.’s (2009) items against the American National Educational Technology Standards for Teachers ([ISTE, 2008](#_ENREF_28)) found that Schmidt et al.’s instrument failed to address teachers’ e) ability to structure lessons using technology and f) use it in assessment. Schmidt et al.’s (2009) items were therefore supplemented with four items designed to measure these areas of knowledge.

Technological Pedagogical Content Knowledge (TPCK): van Olphen’s (2008) definition of TPCK was checked against the American National Technology Standards for Teachers (ISTE, 2008) and TESOL Technology Standards (Healey et al., 2008) for content validity. Based on this analysis, two items from Schmidt et al.’s (2009) questionnaire were reworded to reflect the focus on English language teaching, namely those tapping teachers’ ability to a) combine technology and content in pedagogically sound ways and one item tapping teachers’ b) ability to select appropriate technologies was included in its original form. And, six novel items were added to tap teachers’ ability to c) develop technology enriched language learning environments, d) provide equitable access to digital language learning resources, e) model intercultural communication using technology, f) participate in digital language learning communities, and f) communicate relevant information to students and peers.

## Content validation

The resulting pool of 76 items (see Appendix A) was then subjected to content validation. Content validity was established through consultation of a panel of international CALL experts. The study was approved by the departmental ethics committee, and information sheets and consent forms were distributed to the editorial board of nine peer reviewed CALL journals[[3]](#endnote-3). 36 CALL experts volunteered to participate in the study.

The experts were presented the item pool, one scale at a time. Each scale was accompanied by a definition of the construct based on Mishra & Koehler’s work ([Koehler & Mishra, 2009](#_ENREF_32); [Mishra & Koehler, 2006](#_ENREF_47)). Their task was to rate the relevance of the items to the scales on the following three-point scale: ‘essential’, ‘useful but not essential’, and ‘not necessary’ ([Lawshe, 1975](#_ENREF_39)). Further to providing ratings, the experts were given the opportunity to provide open comments on each scale.

A comparison of the Content Validity Ratio (CVR; Lawshe, 1975) for the items with Wilson et al.’s ([2012](#_ENREF_75)) critical values (CV) suggested that 55 of the 76 items are representative of the EFL-TPACK construct (see Table 2 and Appendix A).The PKand CK scales had the highest mean CVR values (0.683 and 0.678 respectively), while the TKscale had the lowest mean CVR (0.099). Comments provided by the experts suggest that this was because TK was under-represented:

“Key components not addressed: knowledge of operating systems, computer hardware, how to install and remove peripheral devices, install and remove software programs, create and archive docs...you have only selected use of applications. Construct underrepresentation here is a real problem” (Anonymous CALL Researcher).

New items were therefore added to the TK scale to address the dimensions of ICT literacy mentioned by the CALL experts [e.g. “A15. I know about basic computer hardware (i.e. CD-ROM, mother-board, RAM) and their functions”]. Further to this: item A8, multimedia technologies, was deconstructed; items B4 and B5 were merged as B16 due to overlaps (see Appendix B); and, based on expert feedback, the following items were reworded: D9, F7, G5, and G8. The resulting questionnaire consisted of 65 items.

[Table 2 around here]

## Construct validation

The nature of the construct and validity of the instrument were investigated by applying Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) to the results of the administration of the survey to a large sample of teachers.

Information sheets and consent forms were distributed to teachers through a range of relevant special interest groups and online communities. Specifically, the administrators of all groups on Facebook and LinkedIn with more than fifty members which included ‘TESOL’, ‘EFL’, ‘ESL’, or ‘English’ in their title or description were contacted and asked to share a link and invitation to participate in the survey. On Twitter, the link and invitation to participate in the survey was accompanied with the hash tags ‘~~#~~EFLTPACK’, ‘~~#~~EFL’, ‘~~#~~TESOL’, and ‘~~#~~CALL’.

The final sample comprised 542 English language teachers (188 males and 351 females), including 144 native speakers of English and 391 non-native speakers located in 72 different countries across the world spanning the inner, outer and expanding circles ([see Table C.1 in Appendix C; Kachru, 1985](#_ENREF_31)). The participants’ teaching experience ranged from less than four years to over 20 years (seeTable C.2). Furthermore, teachers working at all levels of education were represented (seeTable C.3).

The survey was administered online using Google Docs. The teachers were presented the questionnaire items, one scale at a time, and their task was to rate the degree to which they agreed with the statements on a five-point Likert scale, where 1 = Strongly disagree and 5 = strongly agree.

### Consistency and reliability of the draft questionnaire

Following the entry of the 542 responses into SPSS, the internal consistency and reliability of the draft questionnaire was assessed. The internal consistency valued (Cronbach’s alpha) ranged from .82 to .89 suggesting that all subscales were internally consistent: technology knowledge (TK; .82), pedagogy knowledge (PK; .89), content knowledge (CK; .84), technological pedagogy knowledge (TPK; .87), technological content knowledge (TCK; .85), pedagogical content knowledge (PCK; .85), and technological pedagogical content knowledge (TPCK; .89).

### Exploratory factor analysis

Next, Exploratory Factor Analysis (EFA) was used to explore the underlying factor structure of the 65-item EFL-TPACK survey. The sample for this analysis consisted in a random sample of 322 participants in the online survey. All analyses were run using SPSS 23. Prior to running the EFA, Keiser-Meyer-Olkin (KMO) test was run to check that the sample size was sufficient, and Barlett’s test of sphericity was run to check that the correlations between items were sufficiently large ([Beavers et al., 2013](#_ENREF_7); [Field, 2009](#_ENREF_19); [B. Thompson, 2004](#_ENREF_67)). The data met both of these criteria [KMO = .90 ‘superb’ according to Field, 2009; χ2 (990) = 8406, p < 0.001].

Next, the factor structure was examined using Direct Oblimin (an oblique rotation). Direct Oblimin was chosen because it was hypothesised that the factors that underpin EFL TPACK are interrelated (Field, 2009). Application of Guadagnoli and Velicer’s ([1988](#_ENREF_23)) criteria to the results of the Kaiser Criterion, scree test, and parallel analysis ([Beavers et al., 2013](#_ENREF_7); [Costello & Osborne, 2005](#_ENREF_16); [Field, 2009](#_ENREF_19)) suggested a six factor solution (seeAppendix D).

20 items that had a loading value of less than .500 or that did not load onto a factor were deleted (see Appendix D; Field, 2009). This resulted in a 45-item survey that accounted for 57 % of the variance, which is an acceptable percentage in the field of social sciences ([Dunteman, 1989](#_ENREF_18); [Netemeyer, Bearden, & Sharma, 2003](#_ENREF_51)). Item loadings within their related factors ranged from 0.507 to .888 (see Appendix D).

Exploring the factor structure presented in Appendix D, it can be seen that 7 PK and 4 PCK items (coded with “B” and “E” respectively) load onto a single factor, labelled PCK, and that the remaining 34 items load onto their original factors. The resulting questionnaire comprised 5 CK, 8 TK, 11 PCK, 7 TCK, 7 TPK, and 7 TPCK items.

### Confirmatory factor analysis

Confirmatory Factor Analysis (CFA) was next applied to the remaining 45 items in order to check the goodness-of-fit of the six factor model established through EFA. The sample for this analysis consisted in the remaining 220 participants in the online survey. All analyses were carried out using SPSS AMOS 23. Several fit indices, as suggested by Hair et al. ([2010, p. 654](#_ENREF_24)) were used to assess the model fit (i.e. χ2, CFI, CMIN/DF, RMSEA, SRMR, and TLI).

The initial CFA results showed that whilst having acceptable RMSEA (.068) and SRMR (.078) values, the other fit indices were not at the required level suggesting a bad fit for the tested model (χ2= 1861.22, *p* < .001; χ2/df= 2.001; CFI= .84; TLI=.85). The modification indices were therefore checked for correlated residuals and standardized regression weights were analysed. The nine items with low standardized regression weights and/or high correlation residuals were removed one by one until a satisfactory level of fit was achieved. These items were; A19, A21, B2, B6, B9, D9, E9, F2, and G1. The 36-item six-factor solution achieved a good level of fit (χ2= 998.19; *p* < .001; χ2/df= 1.727; CFI=.92; RMSEA= .058; SRMR=.069; TLI=.93; see Table 3). The standardized regression weights of those 36 items are presented in Figure 2.

[Table 3 around here]

### Validity, consistency and reliability of the final questionnaire

The validity and reliability checks as well as factor correlations are reported in Table 4. As can be seen in Table 4, the composite reliability (CR) levels are all above .70, indicating that the model is reliable; the Average Variance Explained (AVE) levels are higher than .50 for all factors, indicating convergent validity; and, the square root of the AVE values for each factor (in italic and underlined) are greater than the inter-factor correlations as well as the Maximum Shared Variance (MSV), indicating discriminant validity (Hair et al., 2010). As a result the final version of EFL-TPACK consisted in 36 items, 5 CK items, 6 TK items, 7 PCK items, 6 TCK items, 6 TPK items and 6 TPK items (see Figure 2).

[Table 4 and Figure 2 around here]

Correlations between the EFL-TPACK subscales are moderate to good. The strongest correlation is between TPK and TCK (*r*= .69). It can also be seen that a strong correlation exists between TPCK and TPK (*r*= .66), and TCK (*r*= .61). The lowest correlations exist between TK and PCK (*r*= .22), and TPCK (*r*= .22). Overall, all correlations between the subscales are positive suggesting that the EFL-TPACK questionnaire has logical consistency.

# Discussion and conclusion

This study introduces a new self-assessment instrument for measuring TPACK among teachers of EFL. Unlike previous instruments, namely Baser et al. (2016) and Chai et al. (2013), reflecting the need for teachers to be able to select among the methods and resources those which are most appropriate to their learners in their context ([Candlin & Widdowson, 1987](#_ENREF_10); [Kumaradivelu, 2001](#_ENREF_37)), the instrument does not prescribe a particular approach to language teaching or the use of specific technologies. The study is also significant for its rigorous three stage approach to the development of a questionnaire for assessing TPACK involving (1) the consultation of standards, curricula and research in the development of the item pool, (2) validation of the item pool by a panel of international CALL experts, and (3) exploration and validation of the factor structure of the questionnaire using EFA and CFA.

An initial item pool of 76 items was developed after an extensive review of literature into the technology, pedagogy, and content knowledge bases for EFL teaching. Evaluation of the content validity of the items in the pool by a sample of 36 CALL experts led to the deletion of 20 items mainly related to underrepresentation of TK knowledge and the addition of 9 items in response to feedback received from subject matter experts. The resulting 65-item questionnaire was then administered online and 542 EFL teachers completed the questionnaire. A random sample of 322 responses were submitted to Exploratory Factor Analysis (EFA).

This analysis suggested a 45-item six-factor solution in which the pedagogy knowledge (PK) and pedagogical content knowledge (PCK) items loaded onto a single factor labelled PCK, while the remaining items loaded onto their original factors. Confirmatory Factory Analysis (CFA) based on the remaining 220 responses confirmed the six-factor solution. The initial results did not, however, suggest a good enough model fit. Nine items were therefore deleted one by one until a satisfactory model fit was achieved. The final version of the EFL-TPACK questionnaire therefore consisted in 36 items (see Figure 2). Final checks for the validity, consistency and reliability of the final EFL-TPACK questionnaire indicate that it is a valid and reliable tool.

Considering the individual constructs that emerged from the exploratory factor analysis, it is not surprising that PK and PCK loaded onto a single factor PCK and that a strong correlation is observed between TCK and TPK. As has been suggested in much previous literature, it is likely that PK and CK are intrinsically linked because all attempts to communicate subject matter are in effect attempts to teach it (McEwan & Bull, 1991; Segall, 2004).

For the same reasons, it is, however, surprising that CK emerges as a separate construct from PK and PCK. One possible explanation for this is that, CK and PK continue to be taught separately on popular English language teacher education programmes such as *Trinity CertTESOL* and *Cambridge CELTA*, with proficiency in English language being a requirement for entry to the programmes and language awareness addressed in a separate unit to approaches and methods, materials development and consideration of the learner and the teaching context ([Hobbs, 2013](#_ENREF_27)), despite calls for an integrated approach to teacher education which focuses on the exploration of the different ways in which subject matter might be represented in order to promote learning ([McDiarmid et al., 1989 as cited in Freeman, 2002](#_ENREF_20)).

That TK loads onto an independent factor in the majority of studies, including this one, might be explained by a number of factors. First, pre-service teacher education programmes and continuing professional development programmes tend to focus on the technical features of technology with little discussion of pedagogy (see for example Chai et al., 2011; [Lawless & Pellegrino, 2007](#_ENREF_33)). Second, discussions of the potential use of technology in education and language learning more specifically, upon which teacher trainers and teachers themselves might draw, are often quite deterministic, appealing to the fact that technology is now omnipresent and it is essential to equip students with digital skills, with little consideration of whether the attributes and affordances of a particular technology align with what we understand about the conditions that need to be in place and the processes that learners need to engage in order to learn a foreign or second language ([Macaro et al., 2012](#_ENREF_44); [Selwyn, 2012](#_ENREF_57)).

There are, however, some limitations of the study and the resulting instrument that ought to be taken into consideration. First, the questionnaire was distributed and completed online. The sample may therefore not be representative of the population, which continues to include participants who do not regularly employ technology. Further validation, with a representative sample recruited by post is therefore recommended. Second, the questionnaire asks teachers to rate their self-efficacy for the use of technology rather than their actual use of it. This decision was taken because not all technologies are available in all contexts. Further validation, against lesson plans and observations is therefore recommended.

Theoretical issues and limitations aside, this study offers a rigorously designed and validated self-assessment instrument for measuring TPACK among teachers of EFL which makes no assumptions about the pedagogy or technology adopted by teachers. The results also provide further support for approaches to English language teacher education in which attempt to integrate TK, PK and CK, rather than introduce them separately, and which highlight the ways in which emerging and established technologies can be employed to represent language and provide opportunities for communication that are known to promote language acquisition.

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# Appendices

# Appendix A

# Table A. 1 Initial Item Pool for the Questionnaire (76 items) with results of content validation

| **Item Code** | **Item** | **Notes** | **N Essential** | **Content Validity Ratio** |
| --- | --- | --- | --- | --- |
| **Technology Knowledge** |  |  |  |
| A1 | I know how to solve my own technical problems  | † | 19 | 0.055 |
| A2 | I can learn how to use technology easily  | \*, † | 25 | 0.388 |
| A3 | I keep up with new technologies  | † | 20 | 0.111 |
| A4 | I frequently play around with technology  | † | 13 | -0.277 |
| A5 | I know how to use computer mediated communication (CMC) technologies (e.g. email, chat) | \* | 31 | 0.722 |
| A6 | I know how to use concordancers |  | 7 | -0.611 |
| A7 | I know how to use off the shelf courseware (educational material intended as kits for teachers or trainers or as tutorials for students, usually packaged for use with a computer) |  | 16 | -0.111 |
| A8 | I know how to use multimedia (e.g. graphics, texts, audio, and video)  | \*, Ψ | 30 | 0.666 |
| A9 | I know how to use online learning environments (e.g. Moodle, Blackboard, and VLE) |  | 23 | 0.277 |
| A10 | I know how to use online dictionaries | \* | 24 | 0.333 |
| A11 | I know how to use an interactive white board (IWB) |  | 7 | -0.611 |
| A12 | I know how to use mobile technologies (e.g. tablet computing, smart phones) |  | 20 | 0.111 |
| A13 | I know how to use authorware (customisable software that allows users to generate their own content by integrating different types of media such as graphic and text, e.g. hot potatoes) |  | 14 | -0.222 |
| A14 | I know how to use web 2.0 technologies (e.g. blogs, social networks, and wikis) | \* | 28 | 0.555 |
| Mean CVR for TK |  |  | 0.099 |
|  |  |  |  |
| **Pedagogy Knowledge** |  |  |  |
| B1 | I know how to maintain classroom management  | \*, † | 33 | 0.833 |
| B2 | I can facilitate learning by creating a comfortable environment in which learners are willing to take risks | \* | 30 | 0.666 |
| B3 | I can react supportively to learners’ interaction  | \*, ‡ | 35 | 0.944 |
| B4 | I can manage activities for individual, partner, group and whole class work | \*, ‡, Ω | 34 | 0.888 |
| B5 | I can create opportunities for individual, partner, group and whole class work | \*, ‡, Ω | 33 | 0.833 |
| B6 | I can adapt my teaching style to different learners  | \*, † | 33 | 0.833 |
| B7 | I can adapt my teaching based upon what students do not understand  | \*, † | 35 | 0.944 |
| B8 | I can use a wide range of teaching approaches in a classroom setting | \* | 29 | 0.611 |
| B9 | I can select teaching materials appropriate to the needs of learners | \*, ‡ | 33 | 0.885 |
| B10 | I am familiar with common student understandings and misconceptions  | † | 20 | 0.111 |
| B11 | I can assess student learning in multiple ways | \*, † | 27 | 0.500 |
| B12 | I can keep students on task | \*, ‡ | 30 | 0.714 |
| B13 | I can understand curriculum requirements | \*, ‡ | 29 | 0.657 |
| B14 | I can recognize the organizational constraints and resource limitations existent at my school | \*, ‡ | 27 | 0.500 |
| B15 | I can draw on relevant research findings to guide my teaching | \*, ‡ | 24 | 0.333 |
|  | Mean CVR for PK |  |  | 0.683 |
| **Content Knowledge** |  |  |  |
| C1 | I can explain the grammatical features of the English language | \* | 24 | 0.371 |
| C2 | I can describe the phonological features of the English language |  | 19 | 0.085 |
| C3 | I am familiar with the differences between spoken and written English | \* | 32 | 0.777 |
| C4 | I can maintain the use of English in the classroom | \* | 33 | 0.833 |
| C5 | I can comprehend English texts accurately | \* | 34 | 0.888 |
| C6 | I can comprehend English speech accurately | \* | 34 | 0.888 |
| C7 | I can monitor my own writing for accuracy | \* | 33 | 0.833 |
| C8 | I can monitor my own speech for accuracy | \* | 33 | 0.833 |
| C9 | I am familiar with the culture(s) of target language communities | \* | 29 | 0.611 |
|  | Mean CVR for CK |  |  | 0.678 |
| **Technological Content Knowledge** |  |  |  |
| D1 | I know about technologies that I can use to teach listening in English | \* | 26 | 0.485 |
| D2 | I know about technologies that I can use to teach speaking in English | \* | 24 | 0.371 |
| D3 | I know about technologies that I can use to teach reading in English | \* | 26 | 0.485 |
| D4 | I know about technologies that I can use to teach writing in English | \* | 27 | 0.542 |
| D5 | I know about technologies that I can use to teach English language grammar | \* | 24 | 0.371 |
| D6 | I know about technologies that I can use to teach English vocabulary | \* | 26 | 0.529 |
| D7 | I know about technologies that I can use to teach pronunciation of English words | \* | 24 | 0.371 |
| D8 | I know about technologies that I can use to teach spelling of English words |  | 20 | 0.142 |
| D9 | I know about the technologies that I can use to teach about the differences between cultures | Δ | 21 | 0.200 |
|  | Mean CVR for TCK |  |  | 0.388 |
| **Pedagogical Content Knowledge** |  |  |  |
| E1 | I can critically analyse my teaching in relation to theoretical principles | ‡ | 23 | 0.314 |
| E2 | I can give appropriate feedback on learner language | \* | 36 | 1.00 |
| E3 | I can provide target language input at an appropriate level of difficulty | \* | 33 | 0.833 |
| E4 | I can select authentic English language resources to suit student needs (e.g. news, magazines...) | \* | 30 | 0.666 |
| E5 | I can select activities which enhance the learners' intercultural awareness. | \* | 24 | 0.371 |
| E6 | I can choose an appropriate approach to teach learners (i.e. communicative approach, direct method) | \* | 30 | 0.666 |
| E7 | I can plan when and how to use the target language, including meta-language I may need in the classroom | \* | 29 | 0.611 |
| E8 | I can identify linguistic problems experienced by learners (i.e. phonological, lexical or grammatical problems) | \*, ‡ | 32 | 0.777 |
| E9 | I can design language courses around the requirements of the curriculum | \*, ‡ | 26 | 0.444 |
| E10 | I am aware of the contextual factors that could inhibit/promote English teaching | \*, ‡ | 29 | 0.611 |
| E11 | I am aware of current research in the field of language teaching |  | 18 | 0 |
| E12 | I am willing to experiment with different methods of language teaching |  | 21 | 0.166 |
|  | Mean CVR for PCK |  |  | 0.513 |
| **Technological Pedagogical Knowledge** |  |  |  |
| F1 | I can evaluate the appropriateness of a technology for teaching a lesson  | \*, § | 32 | 0.777 |
| F2 | I can choose technologies that enhance the teaching approaches for a lesson | \*, † | 32 | 0.777 |
| F3 | I can choose technologies that enhance students’ learning for a lesson | \*, † | 30 | 0.666 |
| F4 | I am thinking critically about how to use technology in my classroom | \*, † | 31 | 0.722 |
| F5 | I can adapt the use of the technologies that I am learning about to different teaching activities | \*, † | 25 | 0.388 |
| F6 | I can design relevant learning experiences to promote student learning, using technology | \*, § | 33 | 0.833 |
| F7 | I can choose technologies to be used in assessment | Δ, §  | 21 | 0.166 |
| F8 | I can engage students in solving authentic problems using digital technologies and resources | \*, § | 29 | 0.611 |
|  | Mean CVR for TPK |  |  | 0.617 |
| **Technological Pedagogical and Content Knowledge** |  |  |  |
| G1 | I can teach lessons that appropriately combine English linguistic concepts, technologies, and teaching approaches | \*, † | 26 | 0.444 |
| G2 | I can select appropriate technologies that combine English culture, technologies, and teaching approaches | † | 19 | 0.083 |
| G3 | I can select technologies to use in my classroom that enhance what I teach, how I teach, and what students learn | \*, † | 29 | 0.611 |
| G4 | I can use technology effectively to communicate relevant information to students and peers | \*, § | 25 | 0.428 |
| G5 | I can use a range of technologies to help students pursue their individual curiosities | Δ, §  | 19 | 0.055 |
| G6 | I can use a range of technologies that enable students to become active participants  | \*, § | 27 | 0.500 |
| G7 | I can provide equitable access to digital language learning tools and resources | \*, § | 25 | 0.388 |
| G8 | I can facilitate intercultural understanding by using technology to engage students with different cultures | Δ, §  | 18 | 0 |
| G9 | I can participate in digital learning communities to explore creative applications of technology to improve student learning | § | 21 | 0.166 |
|  | Mean CVR for TPCK |  |  | 0.297 |
|  | Mean CVR for the Questionnaire |  |  | 0.476 |

**Notes:**

\* The critical value that needed to be achieved to validate an item with 36 experts was 0.327 according to Wilson et al. (2012). Items marked with this symbol passed this criterion.

† Item sourced from Schmidt et al. (2009).

‡ Item sourced from Newby et al. (2007).

§ Item sourced ISTE (2008).

Δ Item did not pass validation criteria, but was reworded and added to the questionnaire based on expert feedback.

Ω Item overlaps with another one and was therefore merged with it to create a new item.

Ψ Item has a broad meaning and was therefore deconstructed to create a number of separate items.

# **Appendix B**

#  Table B. 1 List of items that were added/revised after the content validation stage

|  |  |  |
| --- | --- | --- |
| Section | Item Code | Item |
| Technology Knowledge | A15 | I know about basic computer hardware (i.e. CD-ROM, mother-board, RAM) and their functions |
| A16 | I know how to save data into/from a digital device (i.e. flash disk, USB stick, CD) |
| A17 | I know how to use generic office applications (i.e. Word, PowerPoint, and Excel) |
| A18 | I know how to play audio and video files on my computer |
| A19 | I know how to record audio files (i.e. using a Dictaphone) |
| A20 | I know how to record video files (i.e. using a video camera) |
| A21 | I know how to create images on my computer (i.e. using Windows Paint) |
| A22 | I know how to edit images on my computer (i.e. using Photoshop) |
| Pedagogy Knowledge | B16 | I can facilitate learning through creating opportunities for individual, partner, group and whole class work |

# Appendix C

# Table C. 1 Participant demographics: Geographical location grouped according to Kachru’s (1985) model of English around the world

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | **Most frequently represented countries** | **Frequency** | **Percent** | **Valid Percent** |
| Valid | Inner circle | UK (19), USA (7), Canada (9) | 40 | 7,38 | 7,44 |
|  | Outer circle | Pakistan (8), India (5), Malaysia (4) | 24 | 4,43 | 4,46 |
|  | Expanding circle | Turkey (117), Indonesia (28), Greece (23) | 474 | 87,45 | 88,10 |
|  | Total |  | 538 | 99,26 | 100,00 |
| Missing | System |  | 4 | 0,74 |  |
| Total |  |  | 542 | 100 |  |

# Table C. 2 Participant demographics: Teaching experience

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Frequency** | **Percent** | **Valid Percent** |
| Valid | 0-4 years | 122 | 22.5 | 23.1 |
| 5-9 years | 139 | 25.6 | 26.3 |
| 10-14 years | 115 | 21.2 | 21.8 |
| 15-19 years | 74 | 13.7 | 14.0 |
| 20+ years | 78 | 14.4 | 14.8 |
| Total | 528 | 97.4 | 100.0 |
| Missing | System | 14 | 2.6 |  |
| Total | 542 | 100.0 |  |

# Table C. 3 Participant demographics: Type of institution they teach at

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Frequency** | **Percent** | **Valid Percent** |
| Valid | Teaching in primary/elementary school | 103 | 19.0 | 19.8 |
| Teaching in secondary/high school | 193 | 35.6 | 37.0 |
| Teaching in university/college | 225 | 41.5 | 43.2 |
| Total | 521 | 96.1 | 100.0 |
| Missing | System | 21 | 3.9 |  |
| Total | 542 | 100.0 |  |

# Appendix D

# Table D. 1 Exploratory factor analysis results

| Factors | Items | Factor loading | Eigenvalues | Percentage of variance | Rotation sums of squared loadings | Reliabilityb |
| --- | --- | --- | --- | --- | --- | --- |
| TPCK |  |  | 13.281 | 29.513 | 8.190 | .89 |
| G8 | .776 |  |  |  | .89 |
| G6 | .775 |  |  |  | .86 |
| G4 | .754 |  |  |  | .87 |
| G3 | .654 |  |  |  | .87 |
| G5 | .654 |  |  |  | .86 |
| G7 | .622 |  |  |  | .87 |
| G1 | .551 |  |  |  | .88 |
| PK/ PCK |  |  | 3.688 | 8.196 | 8.339 | .89 |
| B11 | .837 |  |  |  | .88 |
| B9 | .796 |  |  |  | .88 |
| E6 | .720 |  |  |  | .88 |
| B16 | .700 |  |  |  | .89 |
| E7 | .681 |  |  |  | .88 |
| B12 | .660 |  |  |  | .88 |
| B6 | .645 |  |  |  | .88 |
| E9 | .603 |  |  |  | .89 |
| E8 | .561 |  |  |  | .89 |
| B3 | .549 |  |  |  | .88 |
| B2 | .510 |  |  |  | .89 |
| TK |  |  | 3.130 | 6.955 | 5.483 | .78 |
| A16 | .888 |  |  |  | .75 |
| A18 | .800 |  |  |  | .75 |
| A5 | .680 |  |  |  | .77 |
| A20 | .621 |  |  |  | .74 |
| A17 | .605 |  |  |  | .75 |
| A19 | .602 |  |  |  | .76 |
| A15 | .594 |  |  |  | .75 |
| A21 | .556 |  |  |  | .75 |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Factors | Items | Factor loading | Eigenvalues | Percentage of variance | Rotation sums of squared loadings | Reliabilityb |
| TCK |  |  | 2.292 | 5.093 | 7.253 | .86 |
|  | D5 | .788 |  |  |  | .83 |
|  | D3 | .717 |  |  |  | .83 |
|  | D4 | .707 |  |  |  | .84 |
|  | D6 | .651 |  |  |  | .84 |
|  | D9 | .647 |  |  |  | .85 |
|  | D7 | .619 |  |  |  | .84 |
|  | D1 | .565 |  |  |  | .85 |
| CK |  |  | 1.946 | 4.324 | 4.728 | .81 |
| C7 | .843 |  |  |  | .76 |
| C8 | .806 |  |  |  | .74 |
| C6 | .720 |  |  |  | .76 |
| C5 | .710 |  |  |  | .79 |
| C9 | .507 |  |  |  | .84 |
| TPK |  |  | 1.421 | 3.158 | 6.936 | .88 |
| F3 | .749 |  |  |  | .86 |
| F4 | .729 |  |  |  | .89 |
| F5 | .718 |  |  |  | .85 |
| F2 | .689 |  |  |  | .86 |
| F6 | .627 |  |  |  | .85 |
| F7 | .525 |  |  |  | .86 |
| F8 | .519 |  |  |  | .88 |
| Percentage of total variance explained | 57.239 |  |  |
| Overall Scale Reliability |  |  | .94 |

Extraction Method: Principal Component Analysis

1. When components are correlated, sums of squared loadings cannot be added to obtain a total variance.
2. Right aligned reliability values represent the Cronbach’s alpha value of the TPACK subcomponent it is included in, left aligned reliability values represent a particular section’s alpha level if the item it is aligned with is deleted

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# Tables

Table 1. Key sources used to construct the item pool by TPACK dimension

|  |  |
| --- | --- |
| **Sources** | **TPACK Knowledge Domain** |
| **CK** | **PK** | **TK** | **PCK** | **TCK** | **TPK** | **TPCK** |
| **TPACK Publications** | Mishra and Koehler, 2006 |  |  | X |  | X |  |  |
| Schmidt et al., 2009 |  | X | X |  |  | X | X |
| van Olphen, 2008 | X |  |  | X |  |  | X |
| **SLTE Syllabuses** | UCLES, 2010 | X |  |  | X |  |  |  |
| **Educational technology standards** | ISTE, 2008 |  |  |  |  |  | X | X |
| **TESOL technology standards** | Healey et al., 2008 |  |  | X |  | X |  | X |
| **CALL Reviews** | Levy, 2009 |  |  | X |  |  |  |  |
| Macaro et al., 2012 |  |  | X |  |  |  |  |

Table 2. Mean CVR values for Expert Analysis of EFL- TPACK Questionnaire

|  |  |  |  |
| --- | --- | --- | --- |
| **Survey Section** | **Number of items within section** | **Number of validated items** | **Mean CVR** |
| Pedagogy Knowledge (PK) | 15 | 14 | 0.683 |
| Content Knowledge (CK) | 9 | 8 | 0.678 |
| Technological Pedagogical Knowledge (TPK) | 8 | 7 | 0.617 |
| Pedagogical Content Knowledge (PCK) | 12 | 9 | 0.513 |
| Technological Content Knowledge (TCK) | 9 | 7 | 0.388 |
| Technological Pedagogical and Content Knowledge (TPCK) | 9 | 5 | 0.297 |
| Technology Knowledge (TK) | 14 | 5 | 0.099 |
| Total | 76 | 55 | 0.476 |

Table 3. CFA model fit indices

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Model** | **χ2** | **χ2/df** | **CFI** | **RMSEA** | **SRMR** | **TLI** |
| **EFL-TPACK** | 998.19\* | 1.727 | .92 | .058 | .069 | .93 |
| **Suggested** | χ2 can be significant | > 2 | >.92 | <.080 | <.080 | >.92 |
| **Result** | Acceptable | Good | Good | Good | Good | Good |

Note: \* is significant at *p*<.05

Table 4. Reliability and validity of CFA results

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **CK** | **TPCK** | **PCK** | **TK** | **TCK** | **TPK** | **CR** | **AVE** |  **MSV** |
| **CK** | *0.81* |   |   |   |   |   | 0.90 | 0.65 | 0.32 |
| **TPCK** | 0.26 | *0.76* |   |   |   |   | 0.89 | 0.58 | 0.43 |
| **PCK** | 0.57 | 0.46 | *0.73* |   |   |   | 0.89 | 0.54 | 0.32 |
| **TK** | 0.27 | 0.22 | 0.22 | *0.73* |   |   | 0.86 | 0.53 | 0.07 |
| **TCK** | 0.38 | 0.61 | 0.56 | 0.25 | *0.73* |   | 0.87 | 0.53 | 0.47 |
| **TPK** | 0.34 | 0.66 | 0.50 | 0.26 | 0.69 | *0.76* | 0.89 | 0.58 | 0.47 |

Notes: CR= Composite reliability; AVE= Average variance extracted, MSV= Maximum shared variance

# Figures

Figure 1. TPACK framework (source: http://tpack.org/). Reproduced by permission of the publisher, © 2012 by tpack.org



Figure 2. Standardized factor loadings of the six-factor 36-item EFL-TPACK questionnaire obtained with confirmatory factor analysis



1. ‘TPACK’ is henceforth used to refer to Koehler and Mishra’s (2006) framework as a whole, while ‘TPCK’ is used to refer to the central construct of the framework. [↑](#endnote-ref-1)
2. While it is explicitly claimed that the new curriculum is not prescriptive in terms of teaching methodology, an examination of the recommended activities suggests that it is based on a communicative approach. [↑](#endnote-ref-2)
3. CALICO Journal, CALL-EJ, Computer Assisted Language Learning, IJCALLT Journal, Language Learning and Technology, ReCALL, System, The JALT CALL Journal, and The Journal of Teaching English with Technology [↑](#endnote-ref-3)