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Review

A SHORT REVIEW of TPACK for TEACHER EDUCATION

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The aim of this descriptive study is to examine review of the ICT and TPACK literature for teacher education. Firstly, the general characteristics of the ICT and TPACK have been examined. In the study, the researchers answer the questions namely "How is the distribution of the articles of TPACK of the year?", "How is the distribution of the subject of article of ICT and TPACK?", "What is the distribution according to the year of the subject of article of ICT and TPACK?" and "How can we integrate the TPACK to our teacher training program?" 116 articles were analysed. It focused on ICT and TPACK and findings and discussions were conducted. The study presents some recommendations to the teacher education.

Key words: Knowledge, pedagogical knowledge, pedagogical content knowledge, technological pedagogical content knowledge, ICT.

INTRODUCTION

A broad use of technology facilitates everyday life and brings many advantages for people. Technologies have the potential to primarily change the way we think about teaching and learning. Technological tools are seen among the most effective tools both in and out of the school in the educational process of pupils and teachers. Teachers have a role in the schools to integrate the technology into the teacher learning process. For this reason teacher and teachers trainees should follow and integrate technological developments in education. ICT and TPACK studies rapidly increased in last decay. In the literature there are seven kinds of knowledge of teachers such as technological knowledge (TK); pedagogical knowledge (PK); content knowledge (CK); technological content knowledge (TCK); pedagogical content knowledge (PCK); technological pedagogical knowledge (TPK); technological pedagogical content knowledge (TPACK).

Technological Knowledge (TK) Knowledge of how to operate computers and relevant software.
Pedagogical Knowledge (PK) Knowledge for teaching that includes"…understanding of how particular topics, problems, or issues are organized, presented, and adapted to the diverse interests and abilities of learners;" and the "…most useful forms of representation of these ideas, most powerful analogies, illustrations, examples, explanations, and demonstrations," and "…the ways of representing and formulating the subject that make it comprehensible to others," (Shulman, Knowledge and Teaching: Foundations of the New Reform, 1987, pp. 8-9) Content Knowledge (CK) The grasp of information,

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processes, principles, theories, and skills within a field of study (Shulman, 2004).

Technological Content Knowledge (TCK) Technological content knowledge understands technology in a specific subject or discipline; and represents technology.

Pedagogical Content Knowledge (PCK) Blends the content and the pedagogy into understanding of how these are associated for successful teaching (Shulman, 1986): The category of pedagogical content knowledge includes the most regularly taught topics in one's subject area, the most useful forms of representation of those ideas, the most powerful analogies, illustrations, examples, explanations, and demonstrations, in a word, ways of representing and formulating the subject that make it comprehensible to others. Pedagogical content knowledge also contains an understanding of what makes the learning of specific topics easy or difficult; the conceptions and preconceptions that students of different ages and backgrounds bring with them to the learning of those most frequently taught topics and lessons (p. 9).

Technological Pedagogical Knowledge (TPK): Technological pedagogical knowledge understands how technology can shape the ways of teaching. PCK is described as the relationship between the teaching subject and associated pedagogy. For (Shulman, 1987), pedagogical content knowledge identifies the distinctive bodies of knowledge for teaching. It represents the blending of content and pedagogy into an understanding of how particular topics, problems or issues are organized, represented, and adapted to the diverse interests and abilities of learners, and presented for instruction. Pedagogical content knowledge is the category most likely to distinguish the understanding of the content specialist from that of the pedagogue. (p. 4). In teacher education, Pedagogical Content Knowledge has been seen as an important support for teachers' professional development. In order to acquire and update their skills, teachers must keep pace with increasing educational requirements that necessitates adaptable strategy and a long time commitment. An important factor that can help mathematics teachers keep their potentials is the use of technology in classrooms.

Technological Pedagogical Content Knowledge (TPACK): The use of technological tools that helps in delivering PCK (Mishra and Koehler, 2006). TPACK– The new acronym for TPCK (Thompson and Mishra, 2007).

The TPACK theoretical framework has been adopted by different researchers in a multitude of educational areas, and is considered to have shown promising results in integrating technology in teachers' practices. In education such as mathematics education, there have been several studies in using the TPACK framework. Researchers have acknowledged the lack of adequate theoretical and professional frameworks that provide help, guidance, and efficiency to teachers to integrate technology in classrooms (Koehler and Mishra, 2005; Mishra and Koehler, 2006; Niess, 2008; Niess et al., 2009; Valanides and Angeli, 2008a). Many different approaches have been attempted in order to help teachers overcome difficulties of integrating technology in mathematics classrooms (Hew and Brush, 2007)

Technology and ICT were integrated in teaching and learning for teachers, students, educators so on. Research results show evidence of technology being implemented widely in classrooms for teaching (Cuban, 2001; Guzman and Nussbaum, 2009; Hew and Brush, 2007; Kincaid and Feldner, 2002; Lawless and Pellegrino, 2007; McCormick and Scrimshaw, 2001, Banas 2010). Other research results have also asserted that a great number of teachers remain unprepared to use computers in teaching (Cuban, 2001; Hokanson and Hooper, 2004; Russell et al., 2003). Education-technology integration is called the Technology Pedagogical Content Knowledge (Yurdakul, Examining techno pedagogical knowledge competencies of preservice teachers based on ICT usage., 2011, p. 398). Firstly it focused on content know-ledge in these processes (Shulman, 1986; Koehler and Mishra, 2005; Mishra and Koehler, 2006). Technological Pedagogical Content Knowledge (TPACK), technology program content and pedagogical approaches to connec-ting content, pedagogy and technology information field describe the type of interaction (Shin 2010). This model represents teachers' teaching-learning process on how to integrate the technology of technological, pedagogical and content knowledge of the structure. It consists of TPACK, the interaction and combines three information fields (Harris et al., 2009). How to use information technology in teaching pedagogy of various technologies, knowledge, and ability to express change the way teachers teach using technology (Shin 2010). To integrate technology in education, learners and teachers continue to struggle with issues of using educational technology in teaching and learning. Teachers and teacher trainees should adopt seven kinds of knowledge using pedagogical approaches.

Purpose

The purpose of this literature review was to examine the theoretical basis, practical use of TPACK and the development of the TPACK framework. The purpose of this paper is to understand what role, if any, the TPACK construct can provide in advancing the new agenda in teacher education. This study may guide teachers, researchers, teacher educators, educationalists, program makers and so on. ICT and TPACK literature might be analysed according to years.

Research questions

The present study is a qualitative study (Miles and Huberman, 2014). This study has used a descriptive method. A literature review was conducted to answer these research questions.

1. How is the distribution of the articles of TPACK of the year?
2. How is the distribution of the subject of article of ICT and TPACK?
3. What is the distribution according to the year of the subject of article of ICT and TPACK?
4. How can we integrate the TPACK to our teacher training program?

LITERATURE REVIEW

Shulman (1986) asserted that teacher must be organized with content knowledge, curricular knowledge, pedagogical strategies, and pedagogical content knowledge upon which to base professional judgment. Using instructional strategies and programs that have been empirically evaluated can validate the selection of pedagogy. One of the most important ways of providing technological support is to use a framework for integrating complex problems of knowledge from pedagogy, content, technology, and different forms of interactions among these elements in classrooms (Mishra and Koehler, 2008). Adapted from the Pedagogical Content Knowledge model (Shulman, 1986, 1987), the Technological Pedagogical Content Knowledge (TPCK) model is a framework that treats technological integration in education "as a way of thinking about the knowledge [that] teachers need to understand how to integrate technology effectively in their classrooms" (Mishra and Koehler, 2006 pp. 10-11). TPCK, later renamed as TPACK (Thompson and Mishra, 2007), is comprised knowledge of content, pedagogy, and technology, as well as skills to use the interactions among these components (Koehler and Mishra, 2008).

When introducing educational technology in classrooms, researchers noticed that the PCK framework did not explicitly support technology. There were some attempts to adapt the old PCK framework. Some of them, such as TPACK, offer adequate support for technology and offer more opportunities to see how integration of the technology takes place. Since the end of the 1990s, there were several attempts to adapt Pedagogical Content Knowledge to the use of educational technology. From all, the Technological Pedagogical Content Knowledge (TPACK) framework developed by Mishra and Koehler (2006) is the most well-known.

TPACK is an extension of the PCK, defined as a systematic approach to joining technical expertise in teaching with pedagogical content knowledge. TPACK is an emergent model resulting from the intersection of technology, pedagogy and content. This model considers the context as an important aspect. Teaching practices are very important as a source of learning and not just as a consequence of applying a set of learning theories. The TPACK framework offers many insights into how technology should relate to other components of education in order to be successful. This framework offers clear explanations of why technology should not be treated in isolation but related with required pedagogy and content (Mishra and Koehler, 2006).

METHODOLOGY

Identifying journal articles

The literatures were identified in September 2014 by first exploring ERIC database, EBSCOHOST, the Web of Science database and Scopus database. The ICT, TPACK, TPCK, "technological pedagogical content knowledge" entered as keywords. 116 articles has been reached. Only directly related articles were examined. All articles were read, analyzed and coded. All results were represented as a the line graph, the bar graph and the spider graph.

Coding scheme

All articles, subject, content as sub-themes were grouped into themes and years. Themes and years were converted into categories. Basic data, themes of research are also taken into account. Two researchers coded each article. Reliability and validity were considered. The coders' agreements were found as .96 (Bogdan and Biklen, 2007).

Limitation of the study

This review of literature was limited in technological pedagogical content knowledge. In focusing on the TPACK framework, additional limitations are obvious in the types of manuscripts available and the venues in which these manuscripts are presented.

FINDINGS

There is only two-document analysis that engaged the TPACK framework. The first one, Polly et al. (2010) analyze 26 articles. The second one is paper of Chai et al. (2013). Chai et al. examines 55 articles. *This present study analyzed 116 papers from 2001 to 2014*. These studies point to the need of helping pre-service and in-service teachers to build deeper understanding about TPACK. All articles were displayed according to the year in Table 1.

As seen Table 1, Abrami et al. published articles in 2001; Kincaid and Feldner published articles in 2002; Lundeberg et 2003) al., Russell et al. published articles in 2003; Hokanson and Hooper published articles in 2004; Angeli et al. published articles in 2005; Niess et al. published articles in 2006; Hew et al. published articles in 2007; Akkoç et al. published articles in 2008. In 2009, Angeli and Valanides; Cox and Graham; Cuban; Doering et al.; Graham et al. Groth et al., 2009); Holmes; (Koehler et al., 2007).; Ozgun-Koca et al.; So et al. published articles. In 2010, Allan et al.; An and Shin; Archambault and Crippen; Archambault and Barnett; Archambault et al.; (Jamieson-Proctor et al., 2010); (Jang, 2010); Jimoyiannis, 2010); (Kaya et al., 2010); (Kramarski and Michalsky 2010); (Kuşkaya and Usluel, 2010); Landry,

Table 1. Articles of TPACK by year.

2001	Abrami et al.,	2008	Akkoç, Özmantar & Bingölbali, Almas & Krumsvik Graham et al. Greenhow, Dexter & Hughes Hewitt Hofer & Swan Koehler Mishra Niess Shafer Valanides & Angeli
2002	Kincaid & Feldner	2009	Angeli & Valanides, Cox & Graham Cuban Doering, Veletsianos, Scharber & Miller Graham et.al, Groth, Spickler, Bergner & Bardzell Guzman&Nussbaum Harris, Mishra & Koehler Holmes Koehler & Mishra Kramarski & MichalskyLee & Tsai Mishra, Koehler & Kereluik Mistra, P., Koehler Niess, M.L. et al. Niess, Ronau et al. Ozgun-Koca Polly & Brantley-Dias Richardson Schmidt et al. So & Kim Spickler, Bergner & Bardzell Allan, Erickson, Brookhouse & Johnson An & Shin Archambault & Crippen; (a, b) Archambault, & Barnett Archambault,Wetzel,Foulger,&Williams Banas
2003	Lundeberg et al. Russell, Bebell, O'Dwyer & O'Connor	2010	Chai, Koh & Tsai Hardy; a, b Jamieson-Proctor Finger & Albion Albion Jang Jimoyiannis Kaya, Emre & Kaya Koh, Chai & Tsai Kramarski & Michalsky Kuşkaya & Usluel Landry Lee & Tsai Nicholas & Ng Ozgün-Koca, Ozgun-Koca, Meagher & Edwards Özmantar, Akkoç, Bingölbali, Demir & Ergene, Polly, Mims, Shepherd & Inan Wilson & Wright Yang & Chen
2004	Hokanson & Hooper	2011	Akkoç Bowers & Stephens Chai, Koh & Tsai Chai, Koh, Tsai& Tan Chueng & Ho Doukakis, Koilias & Chionidou-Moskofoglou Groth, Haris & Hofer Harris & Hofer Kereluik, Mishra & Koehler Khan Koh & Divaharan Lyublinskaya & Tournaki Öztürk & Horzum Pamuk Polly Sahin Tee & Lee Timur & Taşar Yurdakul
2005	Angeli & Valanides Koehler & Mishra Niess	2012	Adıgüzel & Yüksel Koh, Chai & Tsai Mudzimiri Nicholas & Ng Pamuk, Ülken & Dilek Yurdakul, Odabasi, et.al.
2006	Niess, Suharwoto, Lee & Sadri Mishra & Koehler	2013	Chai, Koh & Tsai Gömleksiz & Fidan Karadeniz, Vatanartıran Kaya & Dağ Sancar-Tokmak, Yavuz-Konakman & YanparYelken
2007	Hew&Brush Koehler, Mishra & Yahya Lawless & Pellegrino Thompson & Mishra	2014	Sancar-Tokmak Yigit

2010; Lee and Tsai; (Nicholas and Ng., 2010); Ozgun-Koca; Ozgun-Koca et al.; (Özmantar et al. 2010); Polly et al.; Wilson and Wright 2010 . published articles. In 2011, Akkoç; Bowers and Stephens; Chai et al.; Chai et al.; Chueng and Ho (2011); Doukakis et al.; (Harris and Hofer, 20011); Kereluik et al., 2011).; Khan; (Koh and Divaharan, 2011); (Lyublinskaya and Tournaki, 2011); Öztürk and Horzum, 2011); (Pamuk, 2011); (Polly, 2011); (Sahin, 2011); Tee and Lee, 2011; (Timur and Tarsa, 2011). published articles. In 2012, Adıgüzel and Yüksel; (Koh et al., 2010; 2012.); (Mudzimiri, 2012); (Nicholas and Ng, 2012); (Pamuk et al., 2012). published articles. In 2013, Chai et al.; Gömleksiz and Fidan (2013); Karadeniz and Vatanartıran; Kaya et al. published articles. In 2014, Sancar-Tokmak and Yigit published articles.

The first research questions was analysed in Figure 1. According to the Figure 1, TPACK studies rapidly increased between 2009 to 2011. According to Figure 2, TPACK studies rapidly declined in 2002 to 2007 and 2014.

According to Figure 3, The biggest improvement of TPACK studies were 2009 to 2011.

The second research question is how is the subject of article of ICT and TPACK distributed?

The present study also analyzed the articles based on the two dimensions ICT and TPACK. Based on these

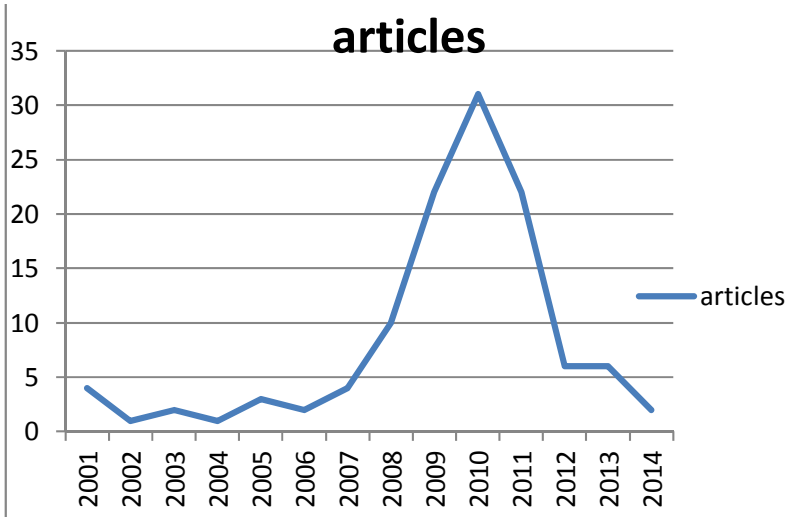

Figure 1. The line graph of TPACK Articles distribution of year.

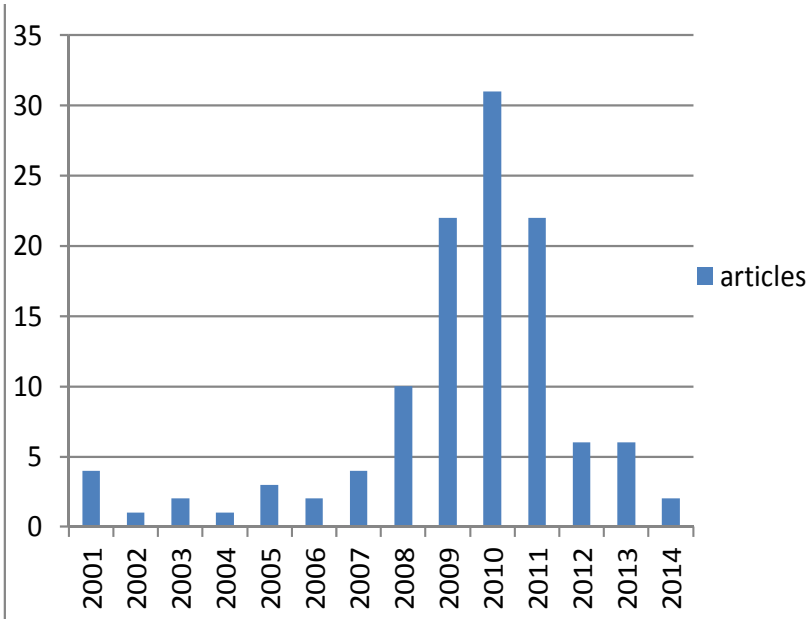

Figure 2. The bar graph of TPACK Articles distribution of year.

criteria, all 136 studies were analyzed and the outcomes are provided below (some of studies both related to the ict and tpack). 51 articles were related to ICT and 82 articles were related to the TPACK. Table 2 provides a summary of the content analysis of ICT and TPACK.

The third research question is the distribution according to the year of the subject of article of ICT and TPACK

Researchers have acknowledged the lack of adequate theoretical and professional frameworks that provide help, guidance, and efficiency to teachers to integrate technology in classrooms (Koehler and Mishra, 2006; Niess, 2008; Niess et al. 2009; Valanides and Angeli, 2008). Many different approaches have been attempted in order to help teachers overcome difficulties of integrating technology in mathematics classrooms (Hew and Brush, 2007). Figures 4 and 5 give emphasis on ICT and TPACK studies. After 2009, Tpack studies have been increased. ICT studies have been increased up to 2009. This is to show that ICT is not only enough for teaching and learning.

Finally, we would like to point out the possibility of cross fertilizing some older framework for the study of

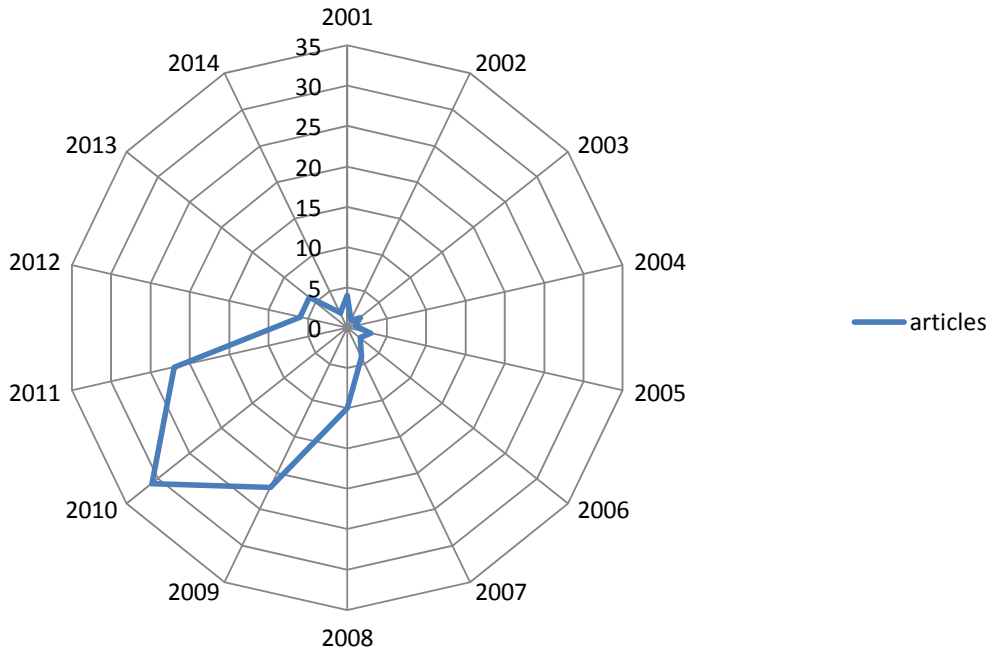

Figure 3. The spider graph of TPACK Articles distribution of year.

ICT integration with the TPACK framework (Figure 6). Established framework such as the technology acceptance model, concern based adoption model and the three models of knowledge creation as reviewed by Paavola et al., (2004) could be brought to bear on TPACK. For example, researchers can possibly envision the acceptance of certain emerging technology by analyzing its TPACK properties and the possible stages of concern that would follow when the technology is implemented. Angeli and Valanides (2009) asserted that the growth or proficiency of each TPACK knowledge construct does not automatically increase the educator's overall TPACK knowledge (Figure 7).

Present research found significant relationships between teachers' TPACK level (Lee and Tsai, 2010; Niess et al., 2006) and their self-confidence in technology, pedagogy, and content (Lee and Tsai). The future studies might focus on teacher characteristics in relation to TPACK and the development of TPACK. Their general conclusion support the foregoing section in that they also found that most intervention produced positive outcomes, especially for TK and pre-service teachers' willingness to use ICT. As illustrated by their work, the TPACK framework can be a common conceptual framework for many more review studies (Figure 7). We would argue that more surveys that compare pre-service teachers TPACK could be helpful in identifying the gaps in their TPACK and teacher educators can then plan how to support the continuous development of TPACK. This is especially so for the faculties in higher education as they are likely to be the most important people to help form the pre-service teachers' TPACK.

The fourth research question is how do we integrate the TPACK to our teacher training program?

In the teacher training faculty mostly cover three area of knowledge that teacher trainees have to be known. In this study asserted that the components of the TPACK models are enlightened (Table 3). The TPACK framework is a generative framework with many more possible future applications. In this paper, we have reviewed a sizable and representative set of studies and pointed out many possible directions for future research. Based on our review, we would propose a revised representation of the TPACK framework to guide future research as depicted. We can ask how we can integrate TPACK in teacher education program. For these, instructional planning process was given as an example.

The problems with teacher education made a lot of countries re-question its teacher education systems and hence start restructuring them to support social coherence, teaching performance and national enlargement.

For this an application of TPACK was recommended in Table 3.

DISCUSSION AND CONCLUSION

This information has to answer the question of how technology will change the teaching-learning process when used in certain ways (Kuskaya and Usluel, 2010). Yurdakul (2011) in terms of competencies in general education teacher candidates' techno pedagojik study concluded they see themselves advanced. As seen

Table 2. Articles related to the themes of ICT and TPACK.

ICT	ICT integration	1.	Abrami 2001
		2.	Akkoç, Özmant & Bingölbal 2008
		3.	Almas & Krumsvik 2008;
		4.	An & Shin, 2010
		5.	Angeli & Valanides, 2005;
		6.	Angeli &Valanides 2009
		7.	Bowers & Stephens, 2011
		8.	Bull et a.l., 2007
		9.	Bull, Hammond & Ferster, 2008;
		10.	Chai, Koh and Tsai 2011b
		11.	Cox & Graham, 2009;
		12.	Graham, Burgoyne&Borup 2010
		13.	Groth et al. 2009
		14.	Guzman & Nussbaum 2009
		15.	Hammond & Manfra, 2009b;
		16.	Harris et al., 2009;
		17.	Harris,Mishra, & Koehler, 2009;
		18.	Hew & Brush, 2007
		19.	Hofer & Swan, 2008
		20.	Hokanson & Hooper 2004
		21.	Jamieson-Proctor et al. 2010
		22.	Jimoyiannis 2010
		23.	Kabakçı Yurdakul, & Coklar 2014
		24.	Kereluik, Mishra, & Koehler, 2011
		25.	Khan 2011
		26.	Koehler & Mishra, 2005b
		27.	Koehler & Mishra, 2009
		28.	Landry 2010
		29.	Lawless& Pellegrino 2007
		30.	McCormick, R., & Scrimshaw 2001
		31.	Mishra, Koehler & Kereluik 2009
		32.	Niess et al. 2009
		33.	Niess, 2008
		34.	Niessen 2005
		35.	Özgün-Koca 2010
		36.	Pierson & Borthwick, 2010;
		37.	Pierson 2001
		38.	Polly et al. 2010
		39.	Robin, 2008
		40.	Russell, Bebell, O'Dwyer & O'Connor 2003
		41.	Shafer 2008
		42.	Swenson, Young, McGrail, Rozema & Whitin, 2006
		43.	Tee & Lee 2011
		44.	Toth, 2009
		45.	Valanides &Angeli 2008
		46.	Valanides, 2005
		47.	Valanides, 2009;
		48.	Wilson&Wright 2010
		49.	Wu et al., 2008
		50.	Yigit 2014
		51.	Yurdakul 2011

Table 2. Contd.

TPACK	1.	Akkoç 2011
	2.	Allan, Erickson, Brookhouse&Johnson 2010
	3.	Angeli & Valanides 2009
	4.	Angeli & Valanides 2005
	5.	Archambault & Barnett, 2010
	6.	Archambault, L. M., & Barnett, J. H. (2010).
	7.	Archambault, L. M., & Crippen, K. J. (2009b).
	8.	Archambault, Wetzel, Foulger & Williams,2010;
	9.	Banas, 2010;
	10.	Bowers & Stephens, 2011
	11.	Chai, Koh, Tsai & Tan 2011
	12.	Chai, Koh & Tsai 2010
	13.	Chai, Koh & Tsai 2013
	14.	Chueng, H-H.,& Ho, C-J. (2011
	15.	Cox, S., & Graham, C. R. (2009
	16.	Cuban C. (2009).
	17.	Gömleksiz.& Fidan2013
	18.	Graham et.al.,2009
	19.	Groth, Spickler, Bergner & Bardzell 2009
	20.	Hardy 2010 a, b
	21.	Haris& Hofer 2011
	22.	Harris, Mishra and Koehler, 2007;
	23.	Harris, Mishra and Koehler, 2009
	24.	Hewitt, J. (2008
	25.	Hofer, M., & Swan, K. (2008
	26.	Holmes 2009
	27.	JamiesonProctor,Finger&Albion, 2010
	28.	Jang & Chen 2010
	29.	Jang, 2010
	30.	Jimoyiannis, 2010
	31.	KabakçıYurdakul&Coklar 2014
	32.	Karadeniz&Vatanartıran 2013
	33.	Kay.& Dağ, 2013
	34.	Kaya, Emre & Kaya 2010
	35.	Koehler & Mishra 2005
	36.	Koehler & Mishra 2008
	37.	Koehler & Mishra 2009
	38.	Koehler, Mishra & Yahya,2007
	39.	Koh & Divaharan 2011
	40.	Koh, Chai & Tsai, 2010
	41.	Koh, Chai & Tsai, 2012
	42.	Kramarski & Michalsky, 2009
	43.	Kramarski&Michalsky,2010
	44.	Kuşkaya & Usluel 2010
	45.	Lee & Tsai, 2010
	46.	Lee, Wu and Tsai (2009)
	47.	Lundeberg et al. 2003
	48.	Lyublinskaya & Tournaki 2011
	49.	Mishra & Koehler, 2006
	50.	Mudzimiri, R. (2012
	51.	Nicholas & Ng, 2010
	52.	Nicholas Ng 2012
	53.	Niess 2005
	54.	Niess 2008
	55.	Niess et al., 2006
	56.	Niess et all. 2009
	57.	Ozgun-Koca, 2009
	58.	Ozgun-Koca, Meagher & Edwards 2010
	59.	Özmantar, Akkoç, Bingölbali, Demir & Ergene,2010
	60.	Öztürk & Horzum 2011
	61.	Paavola et al. 2004
	62.	Pamuk 2011
	63.	Pamuk,Ülken & Dilek 2012
	64.	Polly et al. (2010)
	65.	Polly & Brantley-Dias 2009
	66.	Polly 2011
	67.	Richardson, 2009
	68.	Sahin, 2011
	69.	Sancar Tokmak 2014
	70.	Sancar-Tokmak,Yavuz-Konakman & Yanpar-Yelken 2013
	71.	Schmidt et al. 2009
	72.	Shafer, 2008
	73.	Shin et al., 2009
	74.	So & Kim, 2009
	75.	Tee & Lee, 2011
	76.	Thompson & Mishra 2007
	77.	Timur & Taşar 2011
	78.	Tsai & Wen 2005
	79.	Tsai et al., 2011
	80.	Wilson & Wright, 2010
	81.	Yurdakul 2011
	82.	Yurdakul,Odabasi et al. 2012

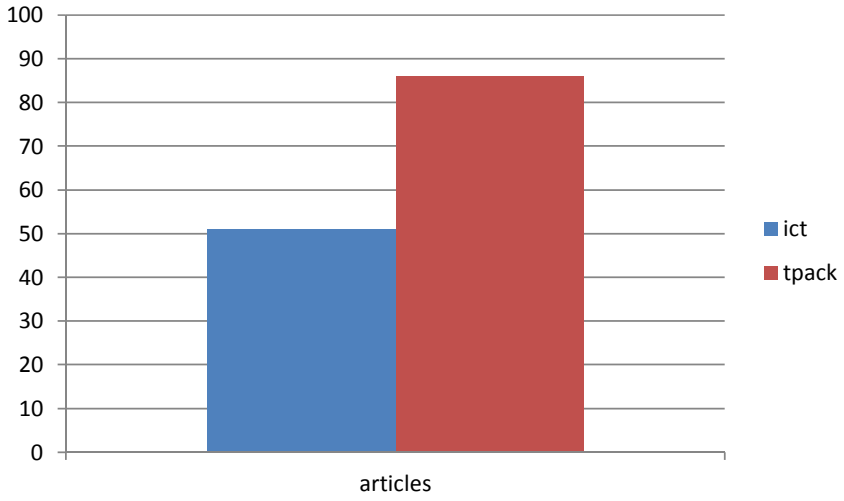

Figure 4. The bar graph of TPACK and ICT articles.

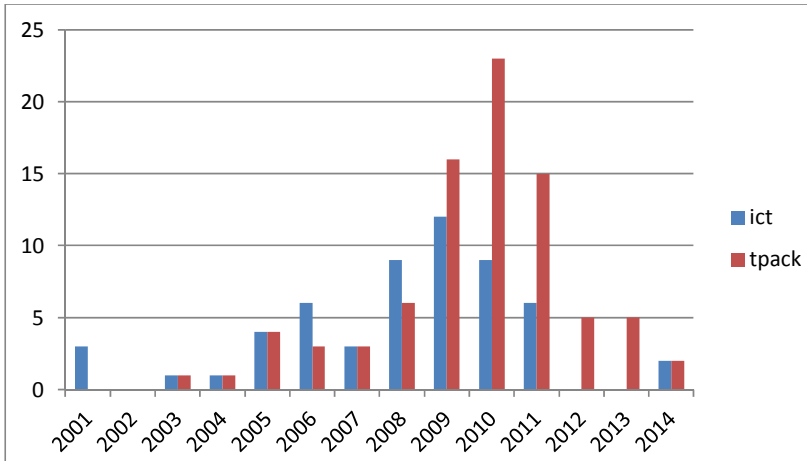

Figure 5. The bar graph of TPACK and ICT Articles distribution of year.

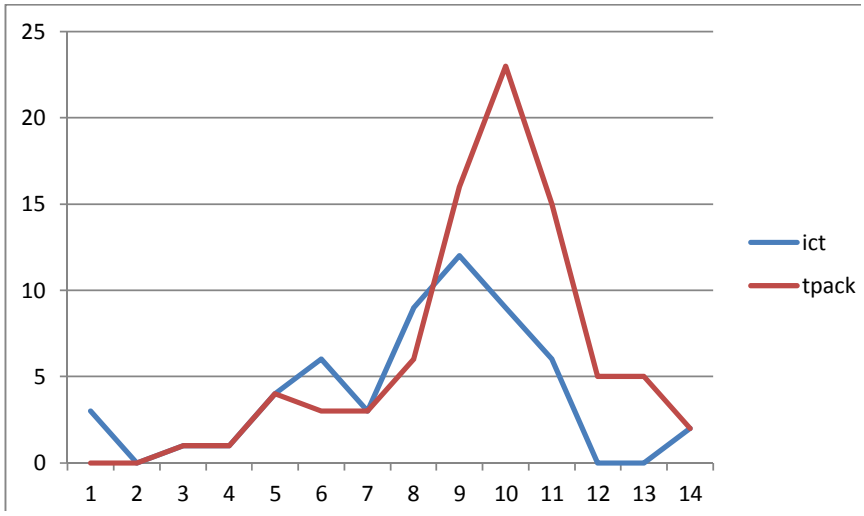

Figure 6. The line graph of TPACK and ICT Articles distribution of year.

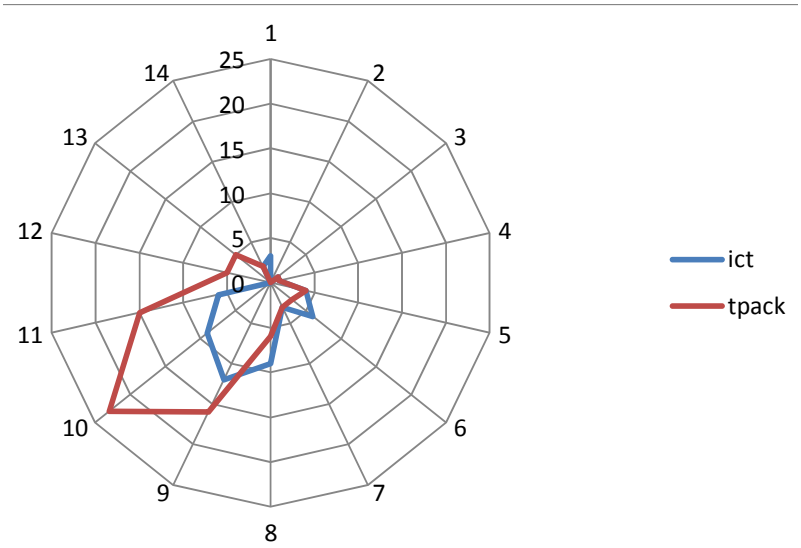

Figure 7. The spider graph of TPACK and ICT Articles distribution of year.

Table 3. Integrated TPACK in teacher education program.

Instructional planning process	**Identifying goals(demands from syllabi, school and/or Ministry policy**			**Analysing learners**	**ICT-based resource**		**Plan Instructional activities**
TPACK dimensions	Content knowledge	Pedagogical knowledge	Technological knowledge	Pedagogical content knowledge	Technological content knowledge	Technological pedagogical knowledge	TPACK
TPACK design scaffolds	What are the targeted attitudes, skills and knowledge that students should learn for the specific subject matter?	What are some general pedagogical requirements? (e.g. the inclusion of self-directed learning, collaborative learning, knowledge creation, etc).	What are some possible content-free general software/ hardware available that may be associated with the identified CK?	Who is facing what types of problems in learning the CK given what types of environment? What are the existing pedagogical practices associated with the teaching of the subject matter?	What are the available forms of technology or computer-based representations of CK? How does the expert/ practitioner use technology to represent and make meaning of the CK?	What are the associated pedagogical approaches for the forms of identified TK/TCK? Any consideration for cyber wellness issues?	How can the preceding dimensions be synthesised to optimise students' understanding and/ or knowledge construction?
Decisions	Formulate the lesson objectives				Articulate on resources, grouping instruction (single, pair,etc), technologies, approaches (problem-based, project-based, inquiry-based, etc), procedures, assessment, classroom management strategies, etc.		
Follow up action	**Implementation −> Reflection −> Revision**						

literature reviewed, we identified four interdependent contextual factors that are to a certain extent characteristic. To sum up, Angeli and Valanides (2009) argued that the growth or proficiency of each TPACK knowledge construct does not automatically increase the educator's overall TPACK knowledge. We would like to point out the possibility of cross fertilizing some older framework for the study of ICT integration with the TPACK framework. For instance, researchers can possibly imagine the acceptance of certain emerging technology by analyzing its TPACK properties and the possible stages of apprehension that would follow when the technology is implemented. All literature review showed that ICT not only enough, also we need the tpack for teaching and learning. While illustrated, the TPACK framework can be a general conceptual framework for many more review studies. In addition, we suggest that TPACK could also be used to analyze policy documents to examine whether there is a shift towards the use of overlapping constructs namely TPACK to formulate policies or standards, which could reflect a deeper understanding among policy makers.

Conflict of Interests

The author(s) have not declared any conflict of interests.

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