Editorial. Teacher education for effective technology integration

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About a decade ago, several researchers used Shulman's (1986) framework about Pedagogical Content Knowledge (PCK) – a body of knowledge that constitutes a special amalgam of content, pedagogy, learners, and context – as a theoretical basis for developing TPCK or TPACK: a framework for guiding teachers' cognition about technology integration in teaching and learning (Angeli, Valanides, & Christodoulou, 2016). Different models of TPCK/TPACK are proposed in the literature, each with a different focus (on practice, instructional design, context, etc.) and with a different theoretical interpretation about the nature and development of the knowledge that teachers need to have to be able to teach with technology (e.g., Angeli & Valanides, 2005, 2009, 2013; Koehler & Mishra, 2008; Niess, 2005). The two dominant TPCK/TPACK models in the literature are the integrative model and the transformative model. The integrative model is more closely associated with the term TPACK, and was proposed by Koehler and Mishra (2008). It conceptualizes TPCK as an integrative body of knowledge that is created on the spot by the mere intersections between different bodies of knowledge, such as content and pedagogy, content and technology, and pedagogy and technology. The transformative model was proposed by Angeli and Valanides (2005) and, unlike the integrative model, it conceptualizes TPCK as a unique body of knowledge that needs to be explicitly taught by teacher educators. In the transformative model, content, pedagogy, learners, technology, and context are regarded as significant individual contributors to the development of TPCK.

While the integrative and transformative models view TPCK as an extension of Shulman's (1986) PCK, the two models are based on different epistemological stances regarding the nature of TPCK. TPACK is represented in terms of three intersecting circles, one for each distinct knowledge base, namely content, pedagogy and technology (Koehler & Mishra, 2008), while its subcomponents, i.e., technological content knowledge (TCK), technological pedagogical knowledge (TPK) and pedagogical content knowledge (PCK), are also distinctly examined. So far, empirical findings from this line of research are rather discouraging, because it has proven too difficult to define the boundaries of the different TPACK sub-components (Graham, 2011).

Angeli and Valanides' framework of TPCK is conceptualized in terms of five distinct knowledge bases, namely content knowledge, pedagogical knowledge, knowledge of learners, knowledge of educational context, and ICT knowledge (Angeli & Valanides, 2005, 2009). Based on the results of empirical investigations, Valanides and Angeli (2008a, 2008b) concluded that TPCK is a distinct body of knowledge that goes beyond mere integration or accumulation of the constituent knowledge bases toward their transformation into something new and unique. For this reason Angeli and Valanides have not adopted the new term

TPACK, opting instead to continue using TPCK, because TPACK appears to be more closely associated with the integrative view rather than the transformative view. TPCK as a transformative body of knowledge is defined as knowledge about how to transform content and pedagogy with ICT for specific learners in specific contexts and in ways that leverage the added value of ICT (Angeli & Valanides, 2009). Angeli and Valanides (2013) invested extensive research efforts in developing TPCK in the form of instructional design competencies that teachers need to develop in order to be able to teach with technology effectively. A conceptualization of TPCK in terms of design competencies has led to more robust and reliable ways of assessing learners' TPCK, bypassing measurement difficulties of the nature that researchers who adopted the TPACK framework reported in their studies (Archambault & Barnett, 2010; Cox & Graham, 2009; Graham, 2011).

In this direction, research is being carried out to identify TPCK design procedures for initial teacher education. In teaching, when transferring TPCK to design and methodological practices, there is a need to consider a number of factors, especially: the different modes of adopting technologies; the integration of tool affordances, content and pedagogy; the implementation of learning environments; the operationalization of knowledge; and detailed analysis of teaching models and approaches (De Rossi, 2015; Messina & De Rossi, 2015; Messina, De Rossi, Tabone, & Tonegato, 2017; Messina & Tabone, 2011; 2012).

In an effort to advance the research into TPCK, this special issue of IJET reports on the latest developments in the field, identifying both gaps and findings that indicate potential for future research directions. The first paper, "*Technological pedagogical content knowledge in the literature: how TPCK is defined and implemented in initial teacher education*", is a contribution by De Rossi and Trevisan which provides a theoretical overview of the construct of TPCK and its development through a systematic literature review. The second article, "*Il modello TPACK nella formazione delle competenze digitali dei docenti. Normative ministeriali e implicazioni pedagogiche*", by Di Blas, Fabbri and Ferrari, investigates how contextual policy factors inhibit or promote the enactment of TPACK when used to promote the development of teachers' digital skills. The three subsequent articles examine TPCK/TPACK in higher education, within the contexts of teacher education and faculty development. In particular, the article by Jaipal-Jamani, Figg, Collier, Gallagher, Winters, and Ciampa entitled "*Developing TPCK of university faculty through technology leadership roles*" examines how faculty who take on technology leadership roles develop TPACK knowledge and build capacity for technology-enhanced teaching. The article by Messina, De Rossi, Tabone, and Tonegato, "*Instructional planning and new technologies in teacher education: the initial phase of a research project*", reports on the integration of technologies in the education of kindergarten and primary school student teachers through instructional planning, while the article by Flynn, "*A Module on Learning Technologies for Teachers in Higher Education*", presents a module in learning technologies for academic staff. The sixth article, "*A methodological framework for investigating TPACK integration in educational activities using ICT by prospective early childhood teachers*", by Tzavara, Komis and Karsenti, provides an analysis of the TPCK approach through the active engagement of teachers and students. Next, the contribution by Benigno, Fante, Epifania, Caruso and Ravicchio, "*A dynamic model for distance learning: evaluation of an online course for hospital teachers' professional development*", examines technology integration in a professional development program for hospital teachers. Lastly, the paper by Ranieri, Raffaghelli and Pezzati, "*Digital resources for faculty development in e-learning: a self-paced approach for professional learning*", presents a self-paced online programme for faculty development in e-learning, and explores its correspondence with users' needs.

As authors of this special issue, we believe that readers will find the articles included in the issue informative and valuable for gaining a better understanding of the TPCK/TPACK conceptual framework in a variety of contexts. At the same time, we recognize the need to invest more effort and resources in examining

the relationship between TPCK and the affective domain, as well as whether TPCK is domain-specific or domain-general: two research areas that remain mostly uncharted so far.

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