



## TPACK Newsletter, Issue #43: April 2020

Welcome to the 43rd edition of the TPACK Newsletter! TPACK work is continuing worldwide. This document contains updates to that work that have not yet appeared in previous issues of this newsletter. We hope that these contents will be interesting and useful to you, our subscribers.

If you are not sure what TPACK is, please surf over to <http://www.tpack.org/> to find out more.

### Gratuitous Quote About Technology

"It's not a faith in technology. It's faith in people."

-Steve Jobs

### In This Issue

- 1. [Gratuitous Quote About Technology](#)
- 0. In This Issue ***(You are here.)***
- 1. [TPACK Newsletter Update](#)
- 2. Recent TPACK [Articles](#) and [Chapters](#)
- 3. Recent TPACK [Dissertations and Theses](#)
- 4. Recent TPACK [Presentations](#)
- 5. [TPACK Newsletter Suggested Citation](#)
- 6. [Learning and Doing More with TPACK](#)
- . [Un-numbered miscellaneous stuff at the end](#)

### 1. TPACK Newsletter Update

The TPACK Newsletter has been published via the tpack.news email list since January 2009. It has 1207 subscribers currently. Subscription numbers have held steady (+ or – 1% to 3%) since October 2011.

To date, the total numbers of TPCK/TPACK-focused or -supported journal articles, chapters in edited books, books, and dissertations that have appeared in all TPACK Newsletter issues are:

Articles: 1246

Chapters: 293

Books: 28

Dissertations: 404

## 2. Recent TPACK Publications

Below are recent TPACK publications that we know about: 76 articles, 2 chapters, and 10 dissertations that have not appeared in past issues of this newsletter. If you know of others that were published within the past several months, please let us know at:

[tpack.newsletter.editors@wm.edu](mailto:tpack.newsletter.editors@wm.edu).

### **Articles**

Acikgul, K., & Aslaner, R. (2019). Effects of Geogebra supported micro teaching applications and technological pedagogical content knowledge (TPACK) game practices on the TPACK levels of prospective teachers. *Education and Information Technologies*. Advance online publication. <https://doi.org/10.1007/s10639-019-10044-y>

**Abstract:** “The aim of this study is to investigate the effects of GeoGebra Supported Micro Teaching Applications and TPACK Game Practices on the TPACK efficacy and self-efficacy perception levels of the prospective math teachers on polygons. The study was carried out using  $2 \times 2$  factorial design. The study group comprised 88 prospective math teachers. The prospective teachers were separated into 4 groups (G1, G2, G3, G4) randomly. Prospective teachers in G1 were participated in Micro Teaching Applications and Game- Based TPACK Activities, G2 participated in GeoGebra Supported Micro Teaching Applications, G3 group participated in Micro Teaching Applications and finally G4 group was participated in GeoGebra Supported Micro Teaching Applications and Game-Based TPACK Activities. The prospective teachers’ efficacy levels were determined by using lesson plan and participant form; TPACK self-efficacy perception levels were determined by using TPACK Scale for Geometry. It was determined all application processes increased prospective teachers’ TPACK efficacy and self-efficacy scores. The result of study showed that in terms of group variable there is a statistically significant difference between prospective teachers’ TCK and TPACK efficacy levels. The results for self-efficacy scores rejected the statistically significant difference for post-test scores in terms of group variable for CK, PCK, TCK and TPACK.”

Agustini, K., Santyasa, I. W., & Ratminingsih, N. M. (2019). Analysis of competence on “TPACK:” 21<sup>st</sup> century teacher professional development. *Journal of Physics: Conference Series*, 1387. <https://doi.org/10.1088/1742-6596/1387/1/012035>

**Abstract:** “Integrating Technology in the learning process is very important in today's digital era so that educators do not only have a component of content and pedagogical knowledge but also be have to be supported by the ability to integrate both components with technology. The purpose of this study was to analyze the competence of Technology, Pedagogy, and Content Knowledge (TPACK) of Education technology alumni in supporting their profession to become professional teachers. The method applied in this study was a Mixed method, using data from alumni who graduated in 2016-2017 through questionnaires and in-depth interviews. The results showed that the variables in TPACK, content knowledge variable and pedagogy content

knowledge variable had a high average compared to other variables, namely 73.50 and 73.10. This indicated that from the pedagogic and content side, Education Technology alumni had a good mastery of content and pedagogical knowledge. However, being viewed from the average score in applying technology, their competence was still low. The Technology Pedagogy Knowledge variable achieved 48.30, while the TPACK variable reached 52.40. These results implies that Education Technology alumni still need to improve their TPACK competence in order to become a professional teacher in the era of industrial revolution 4.0.”

Albrahim, F. A. (2020). Online teaching skills and competencies. *Turkish Online Journal of Educational Technology*, 19(1), 9–20. <http://www.tojet.net/articles/v19i1/1912.pdf>

**Abstract:** “This paper sheds light on the skills and competencies required for teaching online courses in higher education. The paper started with an overview of the issues related to online learning and teaching. Reviewing and analyzing literature in this topic were performed to confine skills and competencies that instructors need to effectively teach in online learning environments. These skills and competencies are classified into six categories:(a) pedagogical skills, (b) content skills, (c) design skills, (d) technological skills, (e) management and institutional skills, and (f) social and communication skills.”

Alsaghir, L., & Wazen, W. (2020). A competency-based education approach for effective on-line program design: Exploring e-Learning platforms compatibility. *International Journal on e-Learning*, 19(1), 5–23. <https://www.learntechlib.org/p/183898/>

**Abstract:** “This paper investigates the compatibility of e-learning platforms with a competency-based educative (CBE) approach. Using the European Tuning program model derived from the Bologna Process declaration, an integrative framework for creating a degree curriculum based on the CBE approach has been designed such as to include degree competencies, learning outcomes, courses and learning activities. This framework and its underlying principles were then experimented on Moodle in order to explore to what extent the platform offers features that are adapted to implement the CBE approach. For comparison purposes, the compatibility of three other learning management systems (LMSs), namely Blackboard, Canvas and Brightspace, with the CBE approach was also examined. The overall results showed that the explored e-learning platforms offer a relatively compatible environment to the elaborated framework for online courses, thereby adding a boost of broadness and validity to the suggested CBE model.”

Andyani, H., Setyosari, P., Budi Wiyono, B., & Tri Djatmika, E. (2020). Does technological pedagogical content knowledge impact on the use of ICT in pedagogy? *International Journal of Emerging Technologies in Learning*, 15(3), 126–139. <https://doi.org/10.3991/ijet.v15i03.11690>

**Abstract:** “The development of information and communication technology (ICT) has led to opportunities and challenges in the educational ideas and practices. This study examines the impact of technological pedagogical content knowledge on the use of ICT in pedagogy. This

study applied a quantitative method using Structural Equation Model (SEM). The population of the study was teacher in Junior high School in Mojokerto of East Java Indonesia while the sample was about 302 participants gathered by using proportionate stratified random sampling. The findings showed that first, technological pedagogical content knowledge directly did not affect teachers' self-efficacy. Second, technological pedagogical content knowledge influences the use of ICT in pedagogy. Third, organizational innovative climate directly influences the teachers' self-efficacy. Indeed, organizational innovative climate affects the use of ICT in pedagogy. Fifth, teachers' self-efficacy influences the use of ICT in pedagogy. Sixth, technological pedagogical content knowledge mediated by teachers' self-efficacy does not directly affect the use of ICT in pedagogy. Lastly, organizational innovative climate-mediated by teachers' self-efficacy affects the use of ICT in pedagogy. This research could be the first step for a similar study in the future."

Anggraeni, N., Ridlo, S., & Setiati, N. (2018). The relationship between TISE and TPACK among prospective biology teachers of UNNES. *Unnes Journal of Biology Education*, 7(3), 305–311. <https://doi.org/10.15294/jbe.v7i3.26021>

**Abstract:** "The purposes of this study were to identify and describe level of TISE and TPACK as well as relationship between TISE and TPACK of prospective biology teacher 2014 and 2015 batches of UNNES. Quantitative descriptive was chosen as the design for this study. A total of 190 prospective biology teachers 2014 and 2015 batches participated in this study. The instruments used were the Computer Technology Integration Survey from Wang et al., TPACK survey from Pamuk et al. and interview guidelines. The results of this study were most of prospective biology teachers had confidence in integrating technology and knowledge to integrate knowledge of technology, pedagogy and content in teaching biology. Correlation test result showed that most of TISE level of prospective teachers were in line with their TPACK level with correlation coefficient  $r=0,611$  and  $p<0.05$ . The conclusions of this study were most of prospective biology teachers had moderate level of TISE and TPACK also there was a significant positive relationship between the level of TISE with TPACK among prospective biology teachers."

Atar, C., Aydin, S., & Bagci, H. (2019). An investigation of pre-service English teachers' level of technopedagogical content knowledge. *Dil ve Dilbilimi Calismalari Dergisi*, 15(3), 794–805. <https://doi.org/10.17263/jlls.631517>

**Abstract:** "The purpose of this study is to identify pre-service English teachers' technopedagogic content knowledge competence levels. The Technological Pedagogical Content Knowledge Model (TPACK) is unique in comparison to other technology-based models in that it incorporates content knowledge as well in addition to technological competences. The participants are 182 pre-service English teachers that study in Istanbul and Sakarya, Turkey. The data was collected via Technological Pedagogical Content Knowledge Scale (TPACK-Deep) that was developed by Kabakçı Yurdakul, Odabaşı, Kılıçer, Çoklar, Birinci and Kurt (2012). The data was analyzed through SPSS and the variables grade, gender, daily amount of time spent on the internet and social media were considered in addition to identifying participants' competence

levels. The findings demonstrated that the participants had a high level of TPACK model in general and also in the three dimensions except for merely the Ethics dimension in which they had a medium level of competence. Out of the variables, none of them was observed to have a significant effect in the TPACK model in a general, but gender and daily amount of time spent on the internet were observed to have a significant effect on the Design dimension. The analysis offers insights into pre-service teachers' competence into technology use, content knowledge, pedagogical knowledge and their integration. The findings are expected to contribute to pre-service teacher training and the successful integration of technology into content knowledge for pedagogic purposes."

Aziz, F., Haryani, S., & Susilogati Sumarti, S. (2020). Analysis of pedagogical content knowledge topic specific PCK model for chemistry teachers at the Vocational School of Semarang in Stoichiometry. *Journal of Innovative Science Education*, 9(2), 159–166. <https://journal.unnes.ac.id/sju/index.php/jise/article/view/33773/14164>

**Abstract:** "Pedagogical Content Knowledge (PCK) is an integration between subject matter knowledge (SMK) or content knowledge (CK) and pedagogical knowledge (PK) owned by teachers as a way to improve student learning and will develop over time and experience. PCK is not only emphasized on content knowledge but with pedagogical knowledge and balanced with teaching experience so that the knowledge and experience can be integrated into a whole knowledge called PCK. The purpose of this study was to analyze the ability of PK, CK, and PCK chemistry teachers at the Vocational School of Semarang. This research is a descriptive study to describe chemistry teacher PCK. The subjects of this study were chemistry teachers gathered in the MGMP Kimia SMK in Semarang. The data are in the form of content and pedagogical knowledge test and TSPCK instruments. The PCK teacher's ability was obtained by analyzing the TSPCK instrument. Based on the analysis shows the following things: (1) the teacher has a good average pedagogical knowledge value (76%); (2) the teacher has an average score of content knowledge very good (82%); and (3) the ability of PCK teachers, there are 2 teachers in the exemplary category, 17 teachers in the developing category, and 3 teachers in the basic category. Teachers who have content or pedagogics knowledge or both are not guaranteed to produce effective learning."

Barisić, K. D., Divjak, B., & Kirinić, I. (2019). Education systems as contextual factors in the technological pedagogical content knowledge framework. *Journal of Information and Organizational Sciences*, 43(2), 163–183. <https://doi.org/10.31341/jios.43.2.3>

**Abstract:** "Digital competences should be considered in teacher education and professional development. The Technological Pedagogical Content Knowledge (TPACK) framework represents the knowledge required by teachers in order to successfully integrate technology into the teaching process. The Survey of Pre-service Teachers' Knowledge of Teaching and Technology (SPTKTT) is one of the inventories developed to measure the TPACK framework. The aim of this study is to validate the SPTKTT inventory in the context of the Croatian education system by the use of exploratory and confirmatory factor analysis. Results showed that the new context structure of the SPTKTT inventory consists of nine factors, while confirmatory factor

analysis established that the two Content Knowledge factors can actually be unified. This can be explained by differing content organization in education systems. There were also differences in the distribution of some of the remaining factors. Internal consistency of the inventory shows high reliability.”

Bedenlier, S., Bond, M., Buntins, K., Zawacki-Richter, O., & Kerres, M. (2020). Facilitating student engagement through educational technology in higher education: A systematic review in the field of arts and humanities. *Australasian Journal of Educational Technology*. Advance online publication. <https://doi.org/10.14742/ajet.5477>

**Abstract:** “Understanding how educational technology can enhance student engagement is becoming increasingly necessary in higher education, and particularly so in arts and humanities, given the communicative nature of courses. This narrative systematic review synthesises 42 peer-reviewed arts and humanities articles published between 2007-2016, indexed in four international databases. The results indicate that the majority of research has been undertaken in language learning, predominantly in East Asian countries, with limited grounding of research in theory. This review found that educational technology supports student engagement, with behavioural engagement by far the most prevalent dimension. Affective engagement was the lowest observed dimension, with affective disengagement the most prevalent negative dimension. Blogs, mobile learning, and assessment tools were the most effective at promoting engagement. However, caution and education in how to use technology are needed, as any use not underpinned by effective and informed pedagogy can also lead to students feeling overwhelmed and disengaging from learning. Further research is needed on online collaboration, as well as international courses that offer cross-cultural opportunities for language use, and the increased use of qualitative methods is also advised.”

Boche, B. (2019). A critical analysis of technology’s impact on teacher’s views of literacy learning and teaching: A continuum of understandings. *Journal of Literacy and Technology*, 20(4), 46–80.  
[http://www.literacyandtechnology.org/uploads/1/3/6/8/136889/jltv20\\_4.pdf#page=46](http://www.literacyandtechnology.org/uploads/1/3/6/8/136889/jltv20_4.pdf#page=46)

**Abstract:** “The purpose of this study was to investigate three middle school English teachers’ understandings of literacy and technology. In particular, how do they view literacy and technology learning and teaching, and how do they use (or not use) technology to enact their views of literacy in their classrooms. This narrative inquiry qualitative study consisted of three open-ended interviews, written literacy narratives, and multiple classroom observations with each participant as well as the collection of various teacher documents, such as lesson plans, presentation notes, rubrics, and student handouts. Narrative methods were used in the data analysis. Findings were organized across a continuum of literacy understandings from traditional understandings to new conceptions of literacy. Discussion and implications point to the need for an expanded definition of literacy with teachers that addresses the complexity of multiliteracies. There is also a need for extending pedagogical repertoires of teachers to recognize TPACK as a beginning to multiliteracies.”

Candeli, S. (2019). Unibo Clil training: Good practices, technology and inclusive education. *International Journal for Cross-Disciplinary Subjects in Education*, 10(3), 4088–4097. <https://infonomics-society.org/wp-content/uploads/Unibo-Clil-Training.pdf>

**Abstract:** “This analysis aims at focusing on the close cooperation between the University of Bologna (Science of Education) and the Italian Ministry of Education issues in relation to Clil training courses addressed to secondary school teachers with different linguistic, pedagogical and technological competences. I was in charge of their technological and methodological didactic design. The right solution to these educational needs was given by the TPACK model, a new type of knowledge originating from the interaction among the knowledge of contents, pedagogy and technology in a well-balanced way, where technology itself represents the trigger to educational inclusion.”

Castera, J., Marre, C. C., Chan Kit Yok, M., Sherab, K., Impedovo, M. A., Sarapuu, T., Pedregosa, A. D., Malik, S. K. & Armand, H. (2020). Self-reported TPACK of teacher educators across six countries in Asia and Europe. *Education and Information Technologies*. Advance online publication. <https://doi.org/10.1007/s10639-020-10106-6>

**Abstract:** “The initial technological pedagogical and content knowledge (TPACK) model was theorised on seven clearly identified factors. However, many studies have failed to empirically identify these seven factors, and elements influencing TPACK level, such as national context, gender, and age, remain unclear. The study is focused on teacher educators’ TPACK as one of the most important elements in schoolteacher training. The main goals were to test the validity of the initial TPACK seven-factor model in a cross-national analysis context and to identify factors influencing the TPACK perception. The sample was composed of 574 teacher educators coming from a total of eight schools of educational institutions from six countries. A 26-item questionnaire, based on a four-point Likert scale, investigated the seven factors of the TPACK model as independent scales. It was administered online and anonymously. A confirmatory factor analysis using the robust maximum likelihood method and Kruskal–Wallis chi-squared tests were performed. The study showed four major results: 1) a relative stability of the seven-factor model structure across countries; 2) the relative differences of university teachers’ TPACK perceptions across six countries in Europe and Asia; 3) the dependence of age and TPACK factors; and 4) an independence of gender/academic level and TPACK.”

Chan, K. K. (2019). Using tangible objects in early childhood classrooms: A study of Macau pre-service teachers. *Early Childhood Education Journal*. Advance online publication. <https://doi.org/10.1007/s10643-019-01011-w>

**Abstract:** “Tangible objects are devices that connect physical objects and digital worlds through tangible user interfaces. With the availability of tangible objects in the market, teacher education courses should be updated to provide opportunities for pre-service teachers to engage in digital environments; by these means, they can make more informed decisions about their teaching. This paper explores the views of pre-service teachers regarding the use of tangible objects to facilitate early childhood learning, from within the framework of the theory

of planned behaviour. The participants were teacher candidates specialising in early childhood education in a teacher-education programme in Macau. Various tangible objects in the market were presented to them and they were invited to design a lesson with them. After their implementation in a real classroom, the candidates' views on the value of and problems attending the use of tangible objects; these data were collected through open-ended questions. Content analysis was conducted to elucidate their views. The teacher candidates seemed to appreciate this modality but, at the same time, expressed concern regarding the new challenges of using tangible objects in their classroom."

Chukwuemeka, E. J., Nsofor, C. C., Falode, O. C., & Aniah, A. (2019). Assessing pre-service teachers' technological pedagogical content knowledge self-efficacy towards technology integration in colleges of education in south-west Nigeria. *Journal of Science, Technology, Mathematics and Education*, 15(3), 131–141.  
[https://jostmed.futminna.edu.ng/images/JOSTMED/JOSTMED\\_153\\_SEPTEMBER\\_2019/12\\_Assessing\\_Pre-Service\\_Teachers\\_TPACK\\_Self-Efficacy\\_towards\\_Technology\\_Integration\\_in\\_COE\\_in\\_South-West\\_Nigeria.pdf](https://jostmed.futminna.edu.ng/images/JOSTMED/JOSTMED_153_SEPTEMBER_2019/12_Assessing_Pre-Service_Teachers_TPACK_Self-Efficacy_towards_Technology_Integration_in_COE_in_South-West_Nigeria.pdf)

**Abstract:** "This study is a comparative investigation of pre-service teachers' technological pedagogical content knowledge (TPACK) self-efficacy towards technology integration. The study employed a descriptive survey research design. A multi stage sampling technique was used to obtain the sample, which comprised of 603 NCE II pre-service teachers from south west colleges of education, Nigeria. TPACK self-efficacy questionnaire (TPACK-SQ) instrument was used to collect data on pre-service perceived self-efficacy. This instrument consisted of 42 items which was used to measure the 7 TPACK knowledge constructs (technology knowledge, content knowledge, pedagogy knowledge, pedagogical content knowledge, technological content knowledge, technological pedagogical knowledge and technological pedagogical content knowledge). The reliability of the instrument was determined using Cronbach Alpha formula within the ranges of 0.71 to 0.86. Mean, Standard Deviation and independent samples t-test were used to analyze the data. The data collected revealed significant difference in technology knowledge ( $t = 2.431$ ,  $p = .015$ ) and technological pedagogical content knowledge ( $t = -2.072$ ,  $p = .039$ ) self-efficacy. Based on the findings, it was recommended that TPACK framework should be used as a tool to aid effective technology integration and assessment of teachers' knowledge so as to improve teacher education curriculums and build higher self-efficacy in pre-service teachers."

Cooper, R., Farah, A., & Mrstik, S. (2020). Preparing teacher candidates to teach online: A case study of one college's design and implementation plan. *International Journal on e-Learning*, 19(2), 125–137. <https://www.learntechlib.org/p/209810/>

**Abstract:** "Educator preparation programs in Georgia received a mandate from the teacher certification governing agency to prepare pre-service teachers to teach online. This represents a change that is needed to keep new teachers equipped to serve the children of this current generation. K-12 education has expanded to include virtual schools. The necessity of online teaching preparation, benefits, student impact, and strategies for the successful



implementation of online instruction are presented. This paper discusses how technology use and online instruction were integrated into an educator preparation program. To meet the needs of their future students, teachers must be prepared to integrate technology into their teaching as well as be prepared to teach online.”

Crâciun, D., & Buniou, M. (2019). Digital comics, a visual method for reinvigorating Romanian science education. *Revista Românească pentru Educație Multidimensională*, 11(4), 322–341. <https://doi.org/10.18662/rrem/172>

**Abstract:** “The Romanian science education reform is targeting a real literacy in science and technology among all graduates of the compulsory education. Writing, talking, and reading about science are desirable goals of scientific literacy, and also ways of achieving it. On the one hand, the current generation of pupils is a digital one, a YouTube Generation or Net Generation, which has grown up in an environment in which it is constantly exposed to digital technology and accustomed to the use of various media, short written texts, pictures and videos, for pleasure and sometimes for learning. On the other hand, hands-on learning activities based on ICT tools aim at increasing pupils' interest in sciences both during formal and non-formal education. In this context, the use of visuals and ICT, in particular, of digital comics, can be a suitable medium/method for science education and communication for this young generation. In this article, we describe and analyze how ICT based formal and non-formal activities incorporating digital comics and other visuals can facilitate learning and can increase student enthusiasm/motivation for learning science. This article presents and analyzes example activities designed for secondary school pupils by students from the Faculty of Physics, from the West University of Timisoara, which are also enrolled in the preservice teacher training program offered by this institution. The favorable feedback we have received from the pupils and preservice science teachers alike leads us to assert that such innovative ICT-based teaching methods can lead to a revival of the Romanian science education in general, and of the Romanian physics education in particular, at least as a result of raising pupils' interest in this discipline.”

De Freitas, G., & Spangenberg, E. D. (2019). Mathematics teachers' levels of technological pedagogical content knowledge and information and communication technology integration barriers. *Pythagoras*, 40(1), 1–13. <https://doi.org/10.4102/pythagoras.v40i1.431>

**Abstract:** “Many mathematics teachers struggle to effectively integrate information and communication technology (ICT) in their teaching and need continuous professional development programmes to improve their technological pedagogical content knowledge (TPACK). This article aims to identify mathematics teachers' levels of TPACK and barriers to integrating ICT as a means to inform their continuous professional development needs. The TPACK framework of Mishra and Koehler was used as a lens for this the study. Both quantitative and qualitative research methods were utilised. Ninety-three mathematics teachers, who completed a quantitative questionnaire, reported higher levels of content, pedagogical, and pedagogical content knowledge, with comparatively lower levels of technology, technological

pedagogical, and technological content knowledge. Ten of these participants also participated in semi-structured interviews and revealed six primary barriers to integrating ICT in the classroom, namely curriculum-related time constraints, technological infrastructure, impact of ICT use on the learning process, ineffective professional development, teachers' pedagogical beliefs and poor leadership. Continuous professional development programmes addressing specific ICT-integration barriers can effect significant changes in teachers' TPACK, which may promote better teaching and learning of mathematics."

Ergen, B., Yelken, T. Y., & Kanadli, S. (2019). A meta-analysis of research on technological, pedagogical content knowledge by gender. *Contemporary Educational Technology*, 10(4), 358–380. <https://doi.org/10.30935/cet.634182>

**Abstract:** "The purpose of this study is, by using meta-analysis method, to examine whether there is a significant difference in the effect size of the Technological Pedagogical Content Knowledge (TPACK) according to gender. For this purpose, it was examined whether both Technological Pedagogical Content Knowledge and the knowledge types related to TPACK shows a statistically significant difference by gender. A total of 29 studies conducted both in Turkey and abroad between 2007 and 2017 and meet the inclusion criteria were synthesized by the meta-analysis method. "Cohen's d" was chosen as the effect size index in order to examine the knowledge types related to TPACK by gender. Since the studies were obtained from the literature, primary studies were combined according to the Random Effects Model. It was concluded as a result of the analysis that there is a significant difference between the knowledge types about TPACK by gender, and in the sub-group analysis, technology knowledge, technological pedagogical knowledge and technological pedagogical content knowledge have a significant effect size in favor of male; on the other hand, content knowledge, pedagogical content knowledge, and technological content knowledge have an insignificant effect size in favor of male and pedagogical knowledge has an insignificant effect size in favor of female."

Espinosa, A. A., Verkade, H., Mulhern, T. D., & Lodge, J. M. (2019). Understanding the pedagogical practices of biochemistry and molecular biology academics. *The Australian Educational Researcher*. Advance online publication. <https://doi.org/10.1007/s13384-019-00369-5>

**Abstract:** "As higher education transitions from an exclusivist to a more accessible endeavour, class sizes are continuously increasing, prompting academics to explore different strategies to facilitate quality learning. In this paper, we explore the current practices of Australian biochemistry and molecular biology academics to understand how academics cope with the mass education context, and whether there are specific blocks to the introduction of active learning into these classrooms. We utilised inductive thematic analysis to identify the themes underpinning the pedagogical practices of a selection of academics in biochemistry and molecular biology. These data indicated that these academics: (1) consider themselves to be, and are, traditional teachers; (2) believe that their students will learn better the way that they were taught at university; (3) are trying to shift their teaching from traditional to non-traditional; and (4) practice reflective teaching. These findings suggest that these pedagogical

practices are primarily influenced by the academics' own presumptions and educational beliefs on how the specific discipline should be taught. Engagement in professional development appears to be influencing some academics to shift their teaching towards a more active and student-centred focus, but still, a lack of formal education qualification is holding many academics back from fully engaging with current pedagogical best practice. The findings in this study are broadly applicable to many higher education disciplines."

Fabian, K., Clayes, E., & Kelly, L. (2019). Putting design into practice: An investigation of TPACK scores of lecturers in a networked institution. *Research in Learning Technology*, 27, 1–13. <https://doi.org/10.25304/rlt.v27.2296>

**Abstract:** "Demand for blended and online learning environments is increasing and concurrent with this is the changing competencies required for teachers to be able to facilitate learning in both face-to-face and virtual space. The Technological Pedagogical Content Knowledge (TPACK) is a measure of teachers pedagogical, content and technical knowledge and their skill to embed technology in practice. Using the TPACK framework, this study explores the relationship between technical skills, learning design and how these relate to pedagogy. The study also investigates how TPACK varies by subject area, teaching qualification, and employment. A survey of 112 lecturers from a multi-campus university was conducted. We found that lecturers who have high TPACK tend to use more varied and interactive learning activities. TPACK did not significantly vary by subject area. It did not also vary between those who received a few trainings over the past year in comparison to those who didn't. However, significant differences in TPACK were found in terms of nature of employment and teaching qualification in higher education. These findings suggest that there is a need to provide a varied approach to develop staff competencies."

Fox, W. H., & Docherty, P. D. (2019). Student perspectives of independent and collaborative learning in a flipped foundational engineering class. *Australasian Journal of Educational Technology*, 35(5), 79–94. <https://doi.org/10.14742/ajet.3804>

**Abstract:** "Flipped teaching and learning approaches are being increasingly used in higher education. Some advantages associated with the approach include providing opportunity for self-directed learning and enhanced collaboration between students. In this study, an implementation of a flipped approach in a first year foundational engineering dynamics course was researched to investigate student views on independent and collaborative learning inherent in flipped learning. Eighteen undergraduate students (11 male and 7 female) participated in this qualitative study. The flipped part of the course was designed to include self-paced independent learning and in-class learning, with opportunities to collaborate, ask questions, and work on examples. Data were collected using semi-structured interviews. The results of the study indicated that students universally enjoyed learning independently and appreciated the increased collaboration induced by the flipped approach. The flexibility of the approach enabled a range of approaches to independent learning and collaboration, and students were able to find learning styles that suited them. This article concludes with a range

of recommendations for practice to further support independent and collaborative learning with the use of flipped approaches.”

Fuentes-Hurtado, M., & González Martínez, J. (2019). Evaluación inicial del diseño de unidades didácticas STEM gamificadas con TIC. *EduTec*, 70, 1–17.

<https://doi.org/10.21556/edutec.2019.70.1469>

**Abstract:** “En este artículo se presenta una *checklist* enriquecida que facilita la evaluación inicial del diseño de unidades didácticas integradas y gamificadas para STEM. Tras un trabajo colaborativo de revisión teórica y operativización entre docentes de Secundaria en activo, se llega a la consideración de los elementos clave en el diseño de unidades que integran los contenidos del ámbito científico-tecnológico como sugiere la iniciativa STEM, que implementa una metodología gamificada que fomenta la motivación y que hace uso de las tecnologías de la información y comunicación (TIC) para estimular el aprendizaje del alumnado de Secundaria, coincidiendo con lo propuesto por el modelo pedagógico TPACK que apuesta por interrelacionar contenidos, pedagogía y tecnología. Esta checklist permite valorar cuantitativamente diez parámetros obteniéndose una calificación para cada unidad didáctica proporcionando una evaluación apriorística de su calidad y permitiendo la comparación rápida entre unidades de este tipo además de orientar el propio proceso de diseño.”

Gawrisch, D. P., Richards, K. A. R., & Killian, C. M. (2019). Integrating technology in physical education teacher education: A socialization perspective. *Quest*. Advance online publication. <https://doi.org/10.1080/00336297.2019.1685554>

**Abstract:** “Physical education teacher education (PETE) programs are encouraged to develop teachers capable of delivering technology integrated learning experiences. Technological pedagogical content knowledge provides a framework for integrating technology into teacher education programs. Occupational socialization theory describes an educator’s recruitment, training, and socialization in the teaching profession. The purpose of this article is to propose a conceptual framework for helping preservice physical educators develop technological pedagogical content knowledge that is grounded in occupational socialization theory. We specifically recommend a four-phase approach to help preservice teachers (a) build their knowledge and learn to value technology in physical education, (b) observe and explore through instructor modeling and integration, (c) experiment and collaborate with mentoring and scaffolding, and (d) discover through innovation and utilization. These suggestions acknowledge the sociopolitical aspects of learning to teach with technology and implications are discussed along with the need to help preservice teachers transfer technology integration into their professional careers.”

Gomez, M. (2019). Exploring 1:1 pedagogy through the lens of a veteran middle school teacher: The case of Ms. Goodman. *Middle School Journal*, 50(5), 32–43.

<https://doi.org/10.1080/00940771.2019.1674769>

Abstract: “Educators and the public often assume that digital technologies lay within the domain of newer teachers who may have grown up in a more digital world or have more practical experience using different mediums of technology, like social media and Web 2.0 applications. However veteran teachers have strong content and pedagogical knowledge at their disposal, knowledge that can prove essential for effective technology enhanced teaching practices. This case study, using the TPACK conceptual framework, examines the 1:1 pedagogical approach of a 32-year veteran middle school teacher. Her integration of technology into her pedagogical practices sheds light on how veteran middle school teachers operationalize their TPACK knowledge to create effective classroom practices with instructional technologies.”

Guillén-Gómez, F. D., Mayorga-Fernández, M. J., Bravo-Agapito, J., & Escribano-Ortiz, D. (2020). Analysis of teachers’ pedagogical digital competence: Identification of factors predicting their acquisition. *Technology, Knowledge and Learning*. Advance online publication. <https://doi.org/10.1007/s10758-019-09432-7>

Abstract: “The current technological revolution has reached all social classes and its educative use by teachers has not gone unnoticed. The introduction of 2.0 tools has become a reality in many classrooms. In order to evaluate the digital competence of teachers, different dimensions must be considered, including knowledge and educative use. The first objective of this research is to find out whether there are any differences between the knowledge and use of teaching staff of ICT, specifically regarding different 2.0 tools, as well as different modules on the Moodle virtual platform, using the t-Student test. The second objective is to analyse, through a multiple linear regression model, which factors have an effect on the level of digital competence: gender, age and educational stage. With this aim, a non-experimental, ex post facto type of research has been carried out with a study population of 81 teachers from the community of Madrid (Spain). The results have shown that there are statistically significant differences between the knowledge and use of 2.0 tools and Moodle Modules. In addition, the results have found that the variables age and gender have an effect on the prediction of the level of pedagogical digital competence of the teaching staff, while the educational stage in which they teach has no effect. The conclusions derived from this study can help to develop educational interventions focused on improving the unfavourable digital competence of teachers.”

Habibi, A., Yusop, F. D., & Razak, R. A. (2019). The role of TPACK in affecting pre-service language teachers’ ICT integration during teaching practices: Indonesian context. *Education and Information Technologies*. Advance online publication. <https://doi.org/10.1007/s10639-019-10040-2>

Abstract: “Flipped teaching and learning approaches are being increasingly used in higher education. Some advantages associated with the approach include providing opportunity for self-directed learning and enhanced collaboration between students. In this study, an implementation of a flipped approach in a first year foundational engineering dynamics course was researched to investigate student views on independent and collaborative learning

inherent in flipped learning. Eighteen undergraduate students (11 male and 7 female) participated in this qualitative study. The flipped part of the course was designed to include self-paced independent learning and in-class learning, with opportunities to collaborate, ask questions, and work on examples. Data were collected using semi-structured interviews. The results of the study indicated that students universally enjoyed learning independently and appreciated the increased collaboration induced by the flipped approach. The flexibility of the approach enabled a range of approaches to independent learning and collaboration, and students were able to find learning styles that suited them. This article concludes with a range of recommendations for practice to further support independent and collaborative learning with the use of flipped approaches.”

Hicks, S., & Bose, D. (2019). Designing teacher preparation courses: Integrating mobile technology, program standards, and course outcomes. *TechTrends*, 63, 734–740.  
<https://doi.org/10.1007/s11528-019-00416-z>

**Abstract:** “This discussion paper demonstrates the need for applying backwards design principles to already-existing course syllabi in order to embed technology alongside pedagogy in teacher preparation programs. The problem is first addressed as a need to integrate technology in one secondary course based on lack of proficiency demonstrated on multiple measures. A design framework that was implemented is then explained, including a step-by-step process for aligning mobile technology applications to course standards and outcomes. Challenges to the process are explored, as well as supports available for duplicating this work in other contexts. The paper concludes with steps the instructor is now taking to encourage and enable other faculty to integrate technology into courses alongside pedagogy training and fieldwork evaluations.”

Houshmandi, S., Rezaei, E., Hatami, J., & Molaei, B. (2019). E-learning readiness among faculty members of medical sciences universities and provide strategies to improve it. *Research and Development in Medical Education*, 43(2), 163–183.  
<https://doi.org/10.31341/jios.43.2.3>

**Abstract:** “Digital competences should be considered in teacher education and professional development. The Technological Pedagogical Content Knowledge (TPACK) framework represents the knowledge required by teachers in order to successfully integrate technology into the teaching process. The Survey of Pre-service Teachers’ Knowledge of Teaching and Technology (SPTKTT) is one of the inventories developed to measure the TPACK framework. The aim of this study is to validate the SPTKTT inventory in the context of the Croatian education system by the use of exploratory and confirmatory factor analysis. Results showed that the new context structure of the SPTKTT inventory consists of nine factors, while confirmatory factor analysis established that the two Content Knowledge factors can actually be unified. This can be explained by differing content organization in education systems. There were also differences in the distribution of some of the remaining factors. Internal consistency of the inventory shows high reliability.”

Hua, B. (2019). Preparing teacher education students to integrate mobile learning into elementary education. *TechTrends*, 63, 723–733. <https://doi.org/10.1007/s11528-019-00424-z>

**Abstract:** “The wide adoption of mobile technology has greatly influenced K-12 education. In teacher education programs, it is necessary for educators to train teacher education students to use mobile technology for educational purpose. This paper reports an exploratory effort in preparing elementary education students for mobile learning. The participants’ perceptions of mobile learning and intended use of mobile technology were examined through the analyses of their online discussion posts, responses to survey items and their projects. Their perceived benefits of mobile learning, limitations of mobile technology, their intended implementation of mobile learning and the challenges they anticipated were reported. Implications and recommendations were discussed regarding the knowledge of mobile apps, pedagogical practices and some non-instructional issues.”

Huang, K-Y, Chen, Y-H., & Jang, S-J. (2020). TPACK in special education for SVI: A comparative study between Taiwanese and Chinese in-service teachers. *International Journal of Disability, Development and Education*. Advance online publication. <https://doi.org/10.1080/1034912X.2020.1717450>

**Abstract:** “While Technological, Pedagogical, and Content Knowledge (TPACK) has been studied in many domains, its application in special education remains limited. This study examined the TPACK of in-service teachers at special education schools for students with visual impairments (SVI,  $N = 415$ ) and further compared the TPACK of Taiwanese and Chinese teachers. Based on both Taiwanese and Chinese samples, we revised and validated a TPACK survey for teachers in special education schools for SVI. Results showed that special education schools for SVI teachers knew content knowledge and teaching strategies better, however, they were less knowledgeable about technological tool applications. Furthermore, Chinese teachers scored higher than Taiwanese teachers in terms of integrated knowledge (TCK/TPACK) and content knowledge and teaching strategies (CKS). Implications were put forward regarding school leadership, peer sharing, and interactions between Taiwanese and Chinese special education in-service teachers.”

Ilmi, A. M., Sukarmin, & Sunarno, W. (2020). Development of TPACK based-physics learning media to improve HOTS and scientific attitude. *Journal of Physics: Conference Series*, 1440, 1–6. <https://doi.org/10.1088/1742-6596/1440/1/012049>

**Abstract:** “21<sup>st</sup>-century physics learning challenges teachers to teach physics that not only memorizes formulas, but is able to improve scientific attitudes and higher order thinking skills (HOTS). Technological, pedagogical, and content knowledge (TPACK) concept is considered capable of presenting this goal with technology integration. Researchers developed TPACK-based learning media that can improve HOTS and scientific attitudes using spreadsheet macros. This study uses the Define, Design, Develop, and Disseminate (4D) method. Media products

have been proven to be able to develop HOTS and scientific attitude as seen from the value of N-gain in the medium category with score of 4 for HOTS and 6 for scientific attitude.”

Jonker, H., März, V., & Voogt, J. (2019). Curriculum flexibility in a blended curriculum. *Australasian Journal of Educational Technology*, 36(1), 68–84.  
<https://doi.org/10.14742/ajet.4926>

**Abstract:** “This study offers insights into the processes that play a role in realising curriculum flexibility. Curriculum flexibility is conceptualised in terms of adaptability and accessibility of the curriculum to students’ needs and capabilities. To realise curriculum flexibility, the teacher education institution in this study designed a blended curriculum with face-to-face and online components. This flexible curriculum aimed at increasing student enrolment and allowing for variety in students’ graduation portfolios. Through semi-structured interviews with 10 teacher educators, conditions that could foster or hinder the realisation of flexibility were investigated. Results indicate that different contextual, teacher-, and student-related conditions were perceived to affect (further) curriculum flexibility. Furthermore, teacher educators identified several challenges related to these influential conditions, which were recognised as tensions. Based on a discussion of these findings, recommendations for research and practice are given.”

Kadijevich, D. M. (2019). Participation in online cooperative professional development: Factors to consider and activities to practice. *The Teaching of Mathematics*, 22(2), 49–57.  
<http://elib.mi.sanu.ac.rs/files/journals/tm/43/tmn43p49-57.pdf>

**Abstract:** “This study deals with relevant components of a technology innovation framework suitable for the examination of online collaborative professional development. By using a sample of 55 lower-secondary mathematics teachers and 155 primary school teachers, this study examined the relationships among teachers’ intention to participate in online collaborative professional development (OCPD), their perspective taking, and their computer self-concept. It was found that while this intention was positively related to computer self-concept, perspective taking could positively relate to this intention only indirectly through computer self-concept. It was also found that, among three OCPD activities used to describe the intention, the activity of cooperatively analyzing videos of lessons given was preferred least by all these teachers. Implications for research are also included.”

Kao, M. A., & Mzimela, P. J. (2019). ‘They are visually impaired, not blind...teach them!’: Grade R in-service teachers’ knowledge of teaching pre-reading skills to visually impaired learners. *South African Journal of Childhood Education*, 9(1), 1–11.  
<https://doi.org/10.4102/sajce.v9i1.651>

**Abstract:** “Background: Teaching reading skills is the cornerstone of all learning; therefore, teachers’ adherence to this mandate is important. However, it becomes complicated and challenging if the teacher has to teach pre-reading skills to Grade R learners with visual impairments. In light of this challenge, researchers have endeavoured to determine the Technological Pedagogical and Content Knowledge (TPACK) that teachers should possess for



the effective teaching of reading in classrooms with visually impaired learners. Aim: This article explores a small sample of in-service teachers' knowledge of using Braille to teach pre-reading skills to Grade R learners with visual impairments. Setting: The study was conducted in a School for the Blind in Maseru, Lesotho, where three Grade R in-service teachers teaching learners with visual impairments were purposively sampled. Methods: This study is underpinned by Koehler and Mishra's theory of TPACK. An interpretivist, qualitative small-scale case study approach was employed, using semi-structured interviews and classroom observations. Document analysis was also used to corroborate findings. Results: Findings reveal that although some of the participants possess a high level of technological knowledge, they tend to teach Braille as a 'stand-alone' skill and fail to integrate it with the teaching of other pre-reading skills to Grade R learners. Conclusion: In-service teachers showed limited knowledge of some of the essential skills for teaching pre-reading skills to Grade R learners who are visually impaired. The study calls for supportive in-service teacher education programmes that equip Grade R teachers of learners with visual impairments with the necessary skills to teach pre-reading skills."

Kartal, B., & Cinar, C. (2018). Examining pre-service mathematics teachers' beliefs of TPACK during a method course and field experience. *Malaysian Online Journal of Educational Technology*, 6(6), 11–37. <https://doi.org/10.17220/mojet.2018.03.001>

Abstract: "The aim of this study is to investigate how and why elementary mathematics pre-service teachers' (PSTs) beliefs about TPACK changed during a method course and field experience. Six PSTs were selected purposefully with reference to their different technological and mathematical backgrounds. Participants were interviewed five times (beginning of the study, after workshops, after method course, beginning and end of field experience) and interviews were conducted within the context of Niess (2005)' TPACK components. Content analysis was performed with the help of a codebook developed by reviewing literature related to TPACK components. It has been seen that PSTs' had naïve beliefs at the beginning of the study. Workshops, method course and field experience seemed to change their beliefs. Management concerns began to affect beliefs when PSTs' experiences about teaching with technology increased. It was suggested to give more opportunities for PSTs to teach with technology because; it was found that experiences had the most effect on beliefs."

Kearney, M., Maher, D., & Pham, L. (2019). Investigating pre-service teachers' informally-developed online professional learning networks. *Australasian Journal of Educational Technology*, 35(5), 21–36. <https://doi.org/10.14742/ajet.4766>

Abstract: "This study investigates how final year pre-service teachers (PSTs) from several countries use social media to support their online professional learning network (PLN) activities. Adopting a mixed-methods approach, it uses a global survey and interview methods to generate fresh insights into PSTs' informally-developed online PLN practices and their perceived benefits of these self-initiated activities. Findings uncover new understandings of contemporary PSTs' patterns of use and configurations of their online PLNs and have implications for their effective transitioning into the teaching profession."

Kopcha, T. J., Neumann, K. L., Ottenbreit-Leftwich, A., & Pitman, E. (2020). Process over product: The next evolution of our quest for technology integration. *Educational Technology Research and Development*. Advance online publication. <https://doi.org/10.1007/s11423-020-09735-y>

**Abstract:** “The purpose of this paper is to introduce the next evolution of our quest for technology integration, one that moves away from the *product* of teacher decision making (i.e., the type of use) towards their *process* of decision making. After presenting a brief history of our field’s quest, we bring together three ideas about teacher decision making with technology that have emerged through the research: technology integration is (1) value driven, (2) embedded in a dynamic system, and (3) a product of a teacher’s perception of what is possible. We then combine these ideas into a model of teacher decision making with technology that reflects how a teacher decides to integrate technology within a dynamic system. Implications for teacher beliefs research, professional development, and technology integration practice are discussed.”

Kuntadi, I., Widiaty, I., Yulia, C., & Rifqi Mubaroq, S. (2019). An Android-based e-observation application on lesson study learning in vocational high schools. *Journal of Engineering Science and Technology*, 14(5), 2499–2508. [http://jestec.taylors.edu.my/Vol%2014%20issue%205%20October%202019/14\\_5\\_4.pdf](http://jestec.taylors.edu.my/Vol%2014%20issue%205%20October%202019/14_5_4.pdf)

**Abstract:** “This study aimed to design an Android-based e-observation application on lesson study learning in vocational high schools. The application made was a digital tool to record the learning process on lesson study comprising plan, do, and see steps. These three steps are the signature of lesson study learning. The procedure of the application development used a waterfall software model-V. The process started with designing the application using Balsamiq Mockup software. In terms of design, the results of the application consisted of the splash screen, login page, menu page, lesson planning in PDF, camera to record the learning process, and video saving with notes. The e-observation application was based on Android operating system to observe, record, distribute information, and evaluate the learning process in a more practical way. The whole processes of the plan, do, and see of the lesson study were recorded well so that it was an integrated part of the quality improvement of the lesson study learning.”

Li, Y., Garza, V., Keicher, A., & Popov, V. (2019). Predicting high school teacher use of technology: Pedagogical beliefs, technological beliefs and attitudes, and teacher training. *Technology, Knowledge and Learning*, 24, 501–518. <https://doi.org/10.1007/s10758-018-9355-2>

**Abstract:** “The current study aims to explore predictors that independently contribute to high school teacher use of technology in general and for different teaching purposes (student-centered and traditional). High school teachers (N = 928) responded to a survey that consisted of measures in several categories: (1) teachers’ background variables, (2) teachers’ pedagogical beliefs, (3) teachers’ attitudes or beliefs towards technology, (4) teachers’ perceived training effectiveness. A series of multilevel models were used to explore the independent effects of these factors on teacher use of technology in general and for different teaching purposes. The

results showed that teachers' technology self-efficacy was a significant predictor of teacher use of technology. More importantly, teachers' instructional approach, openness towards technology, and perceived teaching training effectiveness were more salient when predicting teacher use technology to support student-centered teaching than when predicting teacher use technology to support traditional teaching. Our findings suggest that teachers' pedagogical readiness is as important as technological readiness for teachers to integrate technology in teaching to serve more advanced teaching purposes. This study has important implications for organizing professional learning experiences for teachers."

Loperfido, F. F., Dipace, A., & Scarinci, A. (2019). To play or not to play? A case study of teachers' confidence and perception with regard to digital games at school. *Italian Journal of Educational Technology*, 27(2), 121–138. <https://doi.org/10.17471/2499-4324/1062>

**Abstract:** "Teachers' perception of the use of games for learning is a crucial aspect for the creation of Game-Based Learning experiences. At the same time, solid research on this point is still lacking. For this reason, this study analyses the confidence, knowledge and attitudes of teachers in an Italian school in the context of the use of digital games in teaching activities. To this end, we administered both the TPACK-G and ADGBL questionnaires, and conducted two focus groups. Descriptive statistics were used to analyse the results of the questionnaires, and qualitative content analysis was used to analyse the focus group discussions. Results show that the teachers' perception is characterised by several not necessarily interrelated aspects: they make sense of game based learning by comparing it with traditional didactics; they usually organise teaching activities with games to reach traditional goals (e.g. summative evaluation, individual study, etc.); and finally, they seem to be in a transitional phase during which games have not yet been internalised as a resource for innovation."

Mason, S. L., & Rich, P. J. (2019). Preparing elementary school teachers to teach computing, coding, and computational thinking. *Contemporary Issues in Technology and Teacher Education*, 19(4). <https://www.citejournal.org/volume-19/issue-4-19/general/preparing-elementary-school-teachers-to-teach-computing-coding-and-computational-thinking>

**Abstract:** "This literature review synthesized current research on preservice and in-service programs that improve K–6 teachers' attitudes, self-efficacy, or knowledge to teach computing, coding, or computational thinking. A review of current computing training for elementary teachers revealed 21 studies: 12 involving preservice teachers and nine involving in-service teachers. The findings suggest that training that includes active participation can improve teachers' computing self-efficacy, attitudes, and knowledge. Because most of these studies were fairly short-term and content-focused, research is especially needed about long-term outcomes; pedagogical knowledge and beliefs; and relationships among teacher training, contexts, and outcomes."

Mayer, P., & Girwidz, R. (2019). Physics teachers' acceptance of multimedia applications – adaptation of the Technology Acceptance Model to investigate the influence of TPACK

on physics teachers' acceptance behavior of multimedia applications. *Frontiers in Education*, 4. <https://doi.org/10.3389/feduc.2019.00073>

**Abstract:** “Although multimedia applications can undeniably have a positive impact on the learning success of students, they are not used by all physics teachers. The study presented in this paper examines the influence of technological knowledge of physics teachers on their acceptance behavior by adding TPACK of a physics teacher, as an additional variable to an adapted technology acceptance model (TAM). In addition, the TAM has been adapted to study the acceptance of multimedia applications of physics teachers in physics education. For this purpose, both, the design features were adapted and items were reworded to adjust them to the usage of multimedia applications in school and teaching context. While the first part of the study evaluates the changes of the TAM, the second part of the study deals with the extension of the TAM by the factor TPACK. TPACK acts as a superordinate moderator variable, which has a highly significant influence on the adapted TAM's design features “perceived ease of use,” “perceived usefulness for pupils” and the “personal job relevance assessment.” Interestingly, the results of the study show that TPACK has no significant influence on the “perceived personal usefulness” of multimedia applications in physics teaching. Nevertheless, the prediction of the acceptance behavior of multimedia applications in physics teaching can be improved by extending the adapted TAM2/UTAUT model by TPACK.”

Miguel-Revilla, D., Martínez-Ferreira, J. M., & Sánchez-Agustí (2019). *Australasian Journal of Educational Technology*, 36(2), 1–12. <https://doi.org/10.14742/ajet.5281>

**Abstract:** “Fostering the digital competence of educators is a key aspect that can be addressed in initial teacher training. The TPACK model (Mishra & Koehler, 2006) can be complemented with an approach that takes the Digital Competence of Educators framework (Redecker & Punie, 2017) and 21st century competences into account. This study analysed the practical utility of this conceptual model, and the effectiveness of a teaching intervention in a university setting, during two academic years, with social studies secondary education prospective teachers. Using a quantitative approach and the TPACK-21 questionnaire (Valtonen et al., 2017), the study examined the starting point and evolution of the participants. Results indicate the adequacy of the framework and instrument used and favourable progress towards competence after the assessment of seven factors. Although pre-service teachers showed a low degree of confidence regarding their capabilities of integrating technological with pedagogical and content knowledge, especially in three of the components, this obstacle was overcome after the intervention. It is possible to conclude that the pedagogical and conceptual orientation of the teaching proposal has shown a positive effect, evidencing the effectiveness of a comprehensive approach capable of adapting to the specificity and challenges of social studies education.”

Mohd Noor, N., Alwadood, Z., Sulaiman, H., & Adb Halim, S. (2019). The prospect of teaching and learning engineering mathematical courses using learning tool. *International Journal of Academic Research in Business & Social Sciences*, 9(7), 510–519. <http://dx.doi.org/10.6007/IJARBSS/v9-i7/6143>

Abstract: “Mathematic is often perceived as difficult subject by most students, even from engineering background. However, previous studies have shown that technology has proven to help students learn mathematics in a fun and easy way. In this study, we developed a learning tool with the objective to determine the prospect of learning engineering mathematical courses using an interactive learning tool developed with Maple 2016. We also measure the inclination of using the tool as part of teaching and learning in classroom. There are 40 Students from 2 different classes took part in the study. They are in the fourth semester of engineering program at a selected local university. The process starts by briefing the students on how to use the tool. Students are then answering several questions on a selected topic from vector calculus chapter. Later, they were given a set of two-part questionnaire. The first part was used to investigate the students’ perception on the learning tool. The second part was used to evaluate the students’ willingness in using the tool in classroom for solving vector calculus problems. While the tool require some improvements, students are likely to use it as part of learning in classroom.”

Mpungose, C. B. (2020). Is Moodle or WhatsApp the preferred e-learning platform at a South African university? First-year students’ experiences. *Education & Information Technologies, 25*(2), 927–941. <https://doi.org/10.1007/s10639-019-10005-5>

Abstract: “First-year students are compelled by South African universities to use the Moodle e-learning management platform. Recent studies outline that this creates challenges during the learning process, since students struggle to use Moodle owing to their disadvantaged school background; however, they are familiar with and good at using the WhatsApp social media platform. While these studies have attempted to provide possible solutions, there is a need for an alternative option. This qualitative case study proposes alternatives and the possible use of WhatsApp to supplement Moodle, depending on the personal needs of the student. Twenty five first-year students doing Physical science education modules were purposively and conveniently sampled, and the data generated from semi-structured interviews, focus group discussion, and emailed reflective activities were thematically coded to produce a theory of e-learning platforms. Technological, Pedagogical, and Content Knowledge (TPACK) theory was used to direct the study and make sense of the data. The findings revealed that a personal e-learning platform which has been neglected in the past could be used to improve e-learning. It also revealed that while students only had the option of using a formal e-learning platform (Moodle), they would prefer to use their more familiar informal e-learning platform (WhatsApp). The study concludes that without considering the use of a personal e-learning platform that blends both Moodle and WhatsApp, the problem might be further escalated.”

Muirhead, K., Macaden, L., Clarke, C., Smyth, K., Polson, R., & O’Malley, C. (2019). The characteristics of effective technology-enabled dementia education for health and social care practitioners: Protocol for a mixed studies systemic review. *Systematic Review, 8*, 1–9. <https://doi.org/10.1186/s13643-019-1212-4>

Abstract: “The global prevalence of people living with dementia is expected to increase exponentially and yet evidence suggests gaps in dementia-specific knowledge amongst

practitioners. Evidence-based learning approaches can support educators and learners who are transitioning into new educational paradigms resulting from technological advances. Technology-enabled learning is increasingly being used in health care education and may be a feasible approach to dementia education.

This protocol aims to describe the methodological and analytical approaches for undertaking a systematic review of the current evidence based on technology-enabled approaches to dementia education for health and social care practitioners. The design and methodology were informed by guidelines from the Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols.

The evidence generated from a systematic review of the current evidence is intended to inform the design and implementation of technology-enabled dementia education programmes and to advance the current academic literature at a time of unprecedented demographic and technological transition.”

Ntuk, E. A., & Umoh, I. (2018). Integrating creativity and innovation educational technology in 21<sup>st</sup> century teacher education programme for life-long learning. *Journal of Educational Realities*, 6(1), 43–52. <https://benchmarkjournals.com/wp-content/uploads/2019/08/Integrating-Creativity-and-Innovation-through-Educational-Technology-in-21st-Century-Teacher-Education-Programme-for-life-long-learning-1.pdf>

**Abstract:** “In this article, the authors explore creativity alongside educational technology, as fundamental constructs of 21st century education. Creativity has become increasingly important, as one of the most important and noted skills for success in the 21st century. A definition of creativity was draw upon a systems model of creativity, to suggest that creativity emerges and exists within a system, rather than only at the level of individual processes. It is suggested that effective infusion of creativity and technology in teacher education must be considered in a three-fold systematic manner: at the levels of teacher education, assessment and educational policy. This paper provides research and practical implications with broad recommendations across these three are as, to build discourse around integrating creativity and innovation through educational technology in 21stcentury teacher education program for life-long learning.”

Nurdiani, N., Rustaman, N. Y., Setiawan, W., & Priyandoko, D. (2019). Reasoning patterns and modes of prospective biology teachers on embryology learning with TPACK framework. *Jurnal Pendidikan Biologi Indonesia*, 5(1), 93–100. <https://doi.org/10.22219/jpbi.v5i1.7375>

**Abstract:** “The study was aimed at determining the effectiveness of learning using TPACK (Technological Pedagogical and Content Knowledge) framework in helping the change of reasoning patterns and modes of Biology prospective teachers so that it facilitates in encompassing the Embryology as one of abstract concepts. The subjects used were 49 students of Biology teachers who were having a contract in Embryology course in Biology Education Study Program, in a private educational institute in Bandung. The research design used was quasi-experimental with time-series design type. The measurement of the level of reasoning

ability, patterns, and modes of the students were done through the Test of Logical Thinking (ToLT) three times (before the learning program takes place, after learning the first four main subjects, and after the learning program was over). The results showed that the Embryology learning with TPACK framework could directly change the from concrete and transitional reasoners categories to formal reasoners. The learning with TPACK framework also influenced the shift of the students' logical thinking modes; from the ownership of proportional and/or correlational mode to the ownership of two or three reasoning modes between proportional, probability, correlational, and combinatorial, except the variable control mode."

Oakley, G. (2020). Developing pre-service teachers' technological, pedagogical and content knowledge through the creation of digital storybooks for use in early years classrooms. *Technology, Pedagogy and Education*, 29(2), 163–175.  
<https://doi.org/10.1080/1475939X.2020.1729234>

**Abstract:** "This article reports on an investigation of pre-service teachers' views on creating digital storybooks for use in early childhood classrooms, and how this activity helped them develop technological, pedagogical and content knowledge for teaching literacy. Cohorts of Master of Teaching PSTs ( $n = 67$ ) participated in the study over five years. This article also presents a rationale for the creation of digital storybooks as a resource for teaching early literacy. Data for this mixed-methods study came from an online survey, focus group discussions, and PSTs' reflective comments and analysis of their digital storybooks and rationales. This article focuses primarily on the survey data. The majority of PSTs reported that the process of creating digital storybooks and using them during professional practice was useful in helping them develop their technological, pedagogical and content knowledge for teaching literacy in the early years, as well as their knowledge about students."

Ozgen, K., & Narli, S. (2020). Intelligent data analysis of interactions and relationships among technological pedagogical content knowledge constructs via rough set analysis. *Contemporary Educational Technology*, 11(1), 77–98.  
<https://doi.org/10.30935/cet.646769>

**Abstract:** "This study focuses on the relationship among Content Knowledge (CK), Pedagogic Knowledge (PK), and Technological Knowledge (TK) using Technological Pedagogical Content Knowledge (TPACK). The aim of the study is to use the determined relationship to provide mathematical clarity using the Rough Set Theory, which is commonly used in areas such as Artificial Intelligence, Data Reduction, Determination of Dependencies, Estimation of Data Importance and the establishment of Decision (control) Algorithms. Accordingly, TPACK scale was applied to 340 preservice teachers who, at the time of conducting this study, were continuing their teaching at elementary (grade 5-8) and secondary (grade 9-12) Mathematics Teaching Department. The gathered data was broken into three different groups - low, medium and high. The data grouping allowed for applying of the Rough Set Analysis. This will enable TPACK constructs to assign prospective teachers to any of the three identified groups. Analysis has put forth that the CK, PK and TK components explain TPACK with a dependency degree of 0.105 and that even though the levels of significance of each component is low by

itself, it cannot be removed from the data set. Lastly, decision rules have been established between CK, PK and TK with TPACK."

Philipsen, B., Tondeur, J., Pynoo, B., & Vanslambrouck, S., & Zhu, C. (2019). Examining lived experiences in a professional development program for online teaching: A hermeneutic phenomenological approach. *Australasian Journal of Educational Technology*, 35(5), 46–59. <https://doi.org/10.14742/ajet.4469>

**Abstract:** "The increased number of courses taught in an online environment has led to more teachers in need of professional development for online or blended teaching. Although various professional development programs have been scrutinised, only a few studies integrate the feelings of teachers during their professional development process. Teachers' feelings form an inherent part of their teacher-selves and are reflected in their everyday practice. Therefore, this study uses a hermeneutic phenomenological research method to examine the lived experiences – the feelings – of educational staff within a professional development program that targets online and blended teaching. The results indicate that teachers experience a large range of feelings and that these fluctuate throughout the program. These include positive feelings of connectivity, responsibility, and satisfaction, but also more negative feelings of chaos and frustration. The recognition and understanding of these feelings can illuminate particular aspects of professional development that are experienced more positively or negatively, which can guide further efforts for qualitative improvement."

Powers, J., & Azhar, M. (2020). Preparing teachers to engage students in computational thinking through an introductory robot design activity. *Journal of Computers in Mathematics and Science Teaching*, 39(1), 49–70. <https://www.learntechlib.org/p/213891/>

**Abstract:** "This article describes an introductory computational thinking (CT) lesson that was implemented into five educational technology classes at a large university in the southern United States. A total of 88 undergraduate and graduate students participated in the lesson. The project was the result of a collaboration between education faculty and a computer science professor from another university. The CT lesson was a basic robot design activity adapted for different course formats: face-to-face, online, and blended. The author's impressions of how the students responded to the activity, what they learned about CT, and future directions for integrating CT into teacher education curricula are also discussed."

Prapulla, S. B., Shetty, J., Kulkarni, V. A., Subramanya, K. N., Uma, B. V., Ramakanth Kumar, P., & Shobha, G. (2020). Design and analysis of an online course using Moodle Platform. *Journal of Engineering Education Transformations*, 33, 270–274. <http://journaleet.org/index.php/jeet/article/view/150158>

**Abstract:** "The components of Technological (T) Pedagogical (PA) Content (C) Knowledge (K) (TPACK) needs to be effectively integrated and disseminated for achieving Knowledge, Assimilation and Reflection of learner's learning. A case study of learners responses in Digital



Logic Design course is demonstrated in this paper by following an integrated approach of LeD, LbD and RCA. It is found that learners' ability to achieve Higher Order Thinking Skills (HOTS) is enhanced up to 61.57%."

Prasojo, L. T., Habibi, A., Mukminin, A., Indrayana, B., & Anwar, K. (2020). Factors influencing intention to use web 2.0 in Indonesian vocational high schools. *International Journal of Emerging Technologies in Learning*, 15(5), 100–118.  
<https://doi.org/10.3991/ijet.v15i05.10605>

**Abstract:** "E-learning based on Web 2.0 technology is widely available for education to support teaching and learning efficiency and effectiveness. The main objective of this research is to examine factors influencing teachers' Intention to Use Web 2.0 (IUW) into teaching in Indonesian Vocational High Schools (VHSs) using Technology Acceptance Model (TAM) and Technological Pedagogical Content Knowledge (TPACK) frameworks. Based on these two frameworks, we developed a survey instrument from previous related studies. The instrument was piloted; it was examined through factor analyses and Cronbach's alpha for the reliability. For the main data collection, this study involved 640 participants who completed 31 online items of seven validated variables. For data analysis, we applied Analysis of Variance and t-test, and Confirmatory Factor Analysis (CFA). To assess the model, a Covariance-Based Structural Equation Modeling (CB-SEM) was used. Results informed that there was a significant difference based on gender regarding IUW; however, no significant differences were informed based on age and subject area. The findings also informed that TPACK, Subjective Norm (SN), and Facilitating Condition (FC) significantly influenced IUW."

Rienties, B., Lewis, T., O'Dowd, R., Rets, I., & Rogaten, J. (2020). The impact of virtual exchange on TPACK and foreign language competence: Reviewing a large-scale implementation across 23 virtual exchanges. *Computer Assisted Language Learning*. Advance online publication. <https://doi.org/10.1080/09588221.2020.1737546>

**Abstract:** "Several studies on Virtual Exchange (VE) have highlighted positive learning experiences, increases in technological pedagogical and content skills (TPACK) and foreign language (FL) competence. However, most VE research to date use qualitative or descriptive case-studies of how VEs have been implemented, and what "might" have worked. In this large-scale quantitative two-study design, we explored how 622 pre-service teachers developed TPACK skills and (perceived) FL competence over time in 23 VEs across 34 institutions in 16 countries. In Study 1, we used a (quasi-) experimental design of 3 VEs in an experimental (n = 151) or control group (n = 77) to explore the impact on TPACK. In Study 2, we used a larger sample of 20 VEs and 394 participants to replicate and contrast the findings from Study 1 in a broader context. In contrast to our expectations, participants in the experimental condition did not have higher TPACK skills growth relative to the control condition in Study 1, which was further confirmed in Study 2. Nonetheless, in Study 2 pre-existing TPACK skills influenced the development of (perceived) FL competence over time, whereby those participants who further strengthened their TPACK skills during the VE were more likely to nurture FL competence. A major lesson from this large-scale implementation is that VEs do not generate TPACK skills and

FL competence by osmosis. We encourage CALL researchers to carefully reflect on any positive or negative finding that something has “worked” when there is no comparison or control group included.”

Rowston, K., Bower, M., & Woodcock, S. (2019). The lived experiences of career-change pre-service teachers and the promise of meaningful technology pedagogy beliefs and practice. *Education and Information Technologies*. Advance online publication. <https://doi.org/10.1007/s10639-019-10064-8>

**Abstract:** “Career-change pre-service teachers appear to offer more to teaching due to the knowledge, experiences and mindset garnered from previous vocations. How these experiences contribute to this cohort’s technology pedagogy is not well understood. This explanatory case study applied a social cognitive lens to investigate how incumbent technological capabilities, teacher-training and Professional (field) Experience affect career-change pre-service teachers technology integration beliefs and practice. Narratives from semi-structured interviews with 19 career-change pre-service teachers enrolled in graduate-entry teacher-training courses at an Australian university were analysed using a hybrid of deductive and inductive thematic approaches. Technology confidence was linked to previous technological mastery, with associations between curriculum and occupation-specific technology apparent. Past experiences fostered resilience and self-regulation, facilitating second-order control supporting technology integration during Professional Experience. Transmission-oriented pedagogy was buoyed by preconceived beliefs, content knowledge insecurities, and limited mastery and modelling of effective technology during teacher-training. The findings from this study highlight the current deficiencies in graduate-entry teacher education programs from a technological and pedagogical perspective.”

Schmidt, N. (2019). Digital multimodal composition and second language teacher knowledge. *TESL Canada Journal*, 36(3), 1–30. <https://doi.org/10.18806/tesl.v36i3.1319>

**Abstract:** “Before second language writing (SLW) teachers' digital practices can be supported, their needs must first be understood. To accomplish effective technology enhanced instruction, SLW teachers must blend their knowledge of composition theory, second language acquisition, and multimodal composition technologies. However, many teachers struggle to do this, which highlights the need for research addressing the cognitive aspects that influence digital instruction. This case study reports on an investigation of three in-service university SLW teachers' Technological Pedagogical Content Knowledge (TPACK) during a digital reflective portfolio module. Data from an online survey, instructional content, classroom observations, and semistructured interviews were triangulated to uncover the nature of SLW teachers' TPACK, including which factors supported and constrained their use of technology. Findings suggest that pedagogical content knowledge played a dominant role in how the teachers used technology. The teachers' TPACK was enhanced by professional beliefs about the importance of multimodality and contextual factors involving institutional support and communities of practice. However, it was constrained by limited self-efficacy and pedagogical beliefs concerning the influence of technology on student learning and student engagement. This

study contributes to a growing body of research on how to support language teachers in their digitally mediated practices.”

Sen, S. (2020). Modelling the relations between Turkish chemistry teachers’ sense of efficacy and technological pedagogical content knowledge in context. *Interactive Learning Environments*. Advance online publication.  
<https://doi.org/10.1080/10494820.2020.1712430>

**Abstract:** “This study aims to analyse the correlations between chemistry teachers’ sense of efficacy and their technological pedagogical content knowledge in context (TPCKCx). For this purpose, 201 chemistry teachers were included in the study on the basis of volunteering. A total of 121 of the participants were female chemistry teachers and 80 of them were male chemistry teachers. Technological Pedagogical Content Knowledge Scale and Teachers’ Sense of Efficacy Scale were used as the tools of data collection in this study. The data were analysed through descriptive statistics, correlation analysis and structural equation model. Consequently, it was found that TPCKCx had positive and directly significant effects on both efficacy for classroom management and efficacy for student engagement. Additionally, it was found following the analyses done with the structural equation model that TPCKCx did not have a statistically significant effect on efficacy for instructional strategies.”

Shonfeld, M., & Magen-Nagar, N. (2017). The impact of an online collaborative program on intrinsic motivation, satisfaction and attitudes towards technology. *Technology, Knowledge and Learning*. <https://doi.org/10.1007/s10758-017-9347-7>

**Abstract:** “This research examined the contribution of an online collaborative program involving students from two different teacher training colleges. It measured the impact of the program on attitudes towards technology with regard to technological anxiety, self-confidence and technological liking among students. The advanced online collaborative program at the training colleges was based on a model that used technology to increase trust between students from different cultures through online learning. The research was qualitative and was based on 58 graduate students who participated in the program. The questionnaires answered by participants dealt with the level of collaboration, intrinsic motivation, satisfaction, and attitudes towards technology. The results indicate that in an online collaborative program the student’s intrinsic motivation is affected by the level of his/her satisfaction, and this affects his/her attitudes towards technology when this is the only course for enhancing technology in education. The most significant contribution is to the liking of the use of advanced technologies, then to the self-confidence in using technology, and finally to decreasing the anxiety of technology.”

Snelson, C. (2019). Teaching qualitative research methods online: A scoping review of the literature. *The Qualitative Report*, 24(11), 2799–2814.  
<https://nsuworks.nova.edu/tqr/vol24/iss11/9>

**Abstract:** “Online education has become well established as an avenue for flexible access to educational opportunities. Those who teach qualitative research methods online may find it difficult to locate research or best practice literature to inform practice. A scoping review was conducted to identify and synthesize the literature about teaching qualitative research methods courses online. Eleven peer-reviewed journal articles were identified through a scoping review of the literature. The TPACK framework, which defines teacher knowledge in terms of technological, pedagogical, and content knowledge, was used as a conceptual framework. Results from this scoping review indicate that online qualitative research methods educators choose course goals, instructional modules, and topics in a manner consistent with instructional design approaches. Pedagogical approaches included orientation strategies, strategic use of instructional media, online discussions, applied research activities, and writing projects. Technology was used for course management, to develop content, for communication, and to enable online teaching strategies in an online environment. The literature informs teaching practice in qualitative research methods education, but more research is needed to develop knowledge in this under explored area.”

Song, Y–K., & Hwang, S–H. (2019). Relationship among pre-service early childhood teacher’s perception on technology equipment use, computational thinking, and TPACK. *Journal of Convergence for Information Technology*, 9(9), 166–174.  
<https://doi.org/10.22156/CS4SMB.2019.9.9.166>

**Abstract:** “This study aims to determine factors influencing pre-service early childhood teachers' perception of technology equipment. Online survey is conducted to 289 students majoring in Early Childhood Education and Child Development located in city A, B, and C. SPSS 25 program analyzes 273 answers. The results show that technology education experience in high school influences TPACK and TPACK's sub-factor technology knowledge; and that technology education experience in college (university?) has a positive influence on computational thinking, perception of technology, TPACK, and TPACK's sub-factors-technology knowledge, early childhood education knowledge, and TPACK knowledge. In addition, perception of technology equipment shows high correlation with TPACK and computational thinking. Indeed, computational thinking and TPACK have 42.3% explanatory power on perception of technology equipment. The results imply that education system supporting computational thinking and TPACK should be prioritized for pre-service early childhood teacher to use technology effectively in the field.”

Spiteri, M., & Chang Rundgren, S-N. (2020). Literature review on the factors affecting primary teachers’ use of digital technology. *Technology, Knowledge and Learning*, 25, 115–128.  
<https://doi.org/10.1007/s10758-018-9376-x>

**Abstract:** “Digital technology is widely available in schools; however, results from international studies indicate that they are not effective toward students’ educational achievement. Teachers need to realise the potential of digital technology in their daily practises and use them well. However, teachers need training and guidelines to develop their expertise when using technology for teaching and learning. Failure to do so might result in students lacking the

necessary coping skills for their future life in the information age. This literature review aimed to find out what factors affect primary teachers' use of digital technology in their teaching practices, so as to suggest better training, which will eventually lead to a more guided and relevant use of technology in education. After applying the concept map to the data from the selected studies, four influencing factors were identified: teachers' knowledge, attitudes and skills, which are also influenced by and influence the school culture. From these findings, recommendations on teacher training with technology and suggestions for further research are given."

Stapf, K., & Martin, B. (2019). TPACK + mathematics: A review of current TPACK literature. *International Journal on Integrating Technology in Education*, 8(3), 13–20.  
<https://doi.org/10.5121/ijite.2019.8302>

**Abstract:** "This paper will summarize a review of current literature on the Technology, Pedagogy and Content Knowledge (TPACK) framework, discuss innovative technology integration in teacher preparation and mathematics methods courses for teacher candidates studying elementary education. Themes that emerged in the review of current TPaCK literature included the importance of understanding the TPACK framework, developing self efficacy, the vital role that modeling plays, how collaboration impacts and finally, just how powerful reflection can be in the application of TPACK. This paper will examine and explain these different themes and summarize the current literature as well as highlight trends on technology integration and TPACK."

Stork, M. G. (2020). Supporting twenty-first century competencies using robotics and digital storytelling. *Journal of Formative Design in Learning*. Advance online publication.  
<https://doi.org/10.1007/s41686-019-00039-w>

**Abstract:** "Design thinking is a collaborative problem-solving approach that fosters innovation and communication by enhancing learners' creative thinking abilities. This article discusses the use of domains identified by the Framework for 21st Century Learning (P21 Framework) to conduct a qualitative, exploratory case study to identify design thinking attributes perceived to be instrumental in building students' capacity for communication, collaboration, critical thinking, and creativity using robots and digital storytelling. The purpose of this study was to understand how students perceive the use of robots to help them build these 21st century competencies and to help identify practical implementation strategies for teachers interested in using robots to support 21st century skills. Sixteen students in a three-week summer camp were grouped and used Sphero Bot robots to design and build an interactive story using the robots as characters. Data collected included classroom observations, student reflections, and student-created artifacts. The P21 Framework recognizes three domains related to design thinking, identified as major contributors to authentic learning, adaptive critical thinking, and new media literacies. This case study addresses two domains relevant to using robotics and digital storytelling within this bounded case, (a) learning and innovation skills and (b) information, media, and technology literacy skills. Five student competencies within these two domains provided the conceptual framework used as a foundation to facilitate reliability of this

research. The results of the current study indicate that using robots in this manner to build an interactive story sparked engagement in coding and digital storytelling, offered an authentic context applying design thinking to build 21st century competencies, and encouraged participants to further explore their newly developed skills.”

Tan, L., Chai, C. S., Deng, F., Zheng, C. P., & Drajadi, N. A. (2019). Examining pre-service teachers' knowledge of teaching multimodal literacies: A validation of a TPACK survey. *Educational Media International*, 56(4), 285–299.  
<https://doi.org/10.1080/09523987.2019.1681110>

**Abstract:** “Several studies have been undertaken to develop instruments to measure English teachers' TPACK, but few studies have measured English teachers' TPACK to develop meaningful relationships among technology, content, and pedagogy in the context whereby literacy should be associated with a range of semiotic modes beyond the written language. The interactions with a wider range of texts across modes, media and contexts point to the need for an instrument that can measure English teachers' TPACK in the context of teaching multimodal literacies. In this study, we investigated what factors and items were necessary for examining pre-service teachers' TPACK in multimodal literacy teaching. The proposed TPACK instrument was validated with 220 pre-service teachers across three institutions in Indonesia, China, and Australia. The study shows that the proposed eight-factor instrument generally expressed acceptable validity and reliability and was appropriate for assessing pre-service teachers' TPACK for multimodal literacies. Implications and further research are discussed with the aim of equipping pre-service teachers with the capabilities to integrate content, pedagogy, technology and understand the complex interdependence of contextually bound factors that influence their classroom readiness in teaching multimodal literacies.”

Taopan, L. L., & Drajadi, N. A. (2019). Discovering the teacher's beliefs in TPACK framework for teaching English in high school. *Indonesian Journal of Informatics Education*, 3(1), 11–21.  
<https://doi.org/10.20961/ijie.v3i1.34914>

**Abstract:** “Teacher' belief is essential in classroom practice because it is the principle that teachers hold to be true and the rationale of the attitude in the classroom. In applying the TPACK framework, the teacher has to believe in it. This study intended to reveal the story of an English teacher regarding her beliefs in the TPACK framework for teaching English in high school and reveal how these beliefs shaped during her teaching career. To collect the data, the researcher used a semi-structured interview, observations, and document analysis. The participant was an experienced English Teacher in a high school in Indonesia. A narrative inquiry with the thematic analysis was applied to analyze the interview data. The study revealed that the teacher holds several beliefs in the TPACK framework for teaching English. First, the TPACK framework will be a success when the technology, pedagogy, and content knowledge are well-balanced. Second, the teacher also believes that technology integration should facilitate students to learn English easier. The third, negotiation in classroom is important. These beliefs shaped through experiences, training, contextual factor, and classroom practice. The findings

are beneficial input for English language teachers in the developing country dealing with the TPACK implementation in the classroom.”

Thinzarkyaw, W. (2020). The practice of technological pedagogical content knowledge of teacher educators in education colleges in Myanmar. *Contemporary Educational Technology, 11*(2), 159–176. <https://doi.org/10.30935/cet.660829>

**Abstract:** “The purpose of this study was to investigate the practice of technological pedagogical content knowledge (TPACK) of teacher educators (N=108) in three Education Colleges in Myanmar. A quantitative survey research design focusing on a set of questionnaire was used. The results showed that there were no significant differences in the TPACK-based practices of teacher educators in terms of their Education College, experience, degree, rank, department and gender. However, significant differences were unearthed in their practices of technological knowledge according to their experience and degree. Besides, by their ranks, significant differences were found in the practice of technological and content knowledge.”

Uysal, S., & Gundogdu, K. (2019). Predictors of self-regulated learning skills of computer education and instructional technology (CEIT) students. *International Journal of Psycho-Educational Sciences, 8*(3), 29–40.

<https://www.journals.lapub.co.uk/index.php/IJPES/article/view/1233>

**Abstract:** “In this correlational survey study, it was aimed to determine significant predictors of self-regulated learning skills of Computer Education and Instructional Technology (CEIT) students. The sample consisted of 458 CEIT students registered at some universities among the ADIM Universities Consortium in Turkey. As data collection tools, the “Web Pedagogical Content Knowledge Scale” which was developed by Lee, Tsai & Chang (2008) and adapted to Turkish by Horzum (2011), the “Curriculum Orientations Inventory” which was developed by Cheung and Wong (2002) and adapted to Turkish by Eren (2010), and the “Self-Regulated Learning Scale” which was developed by Turan (2009) were used in the study. Descriptive statistics, correlation and path analysis were used in analyzing data. Findings showed that there were low, medium and high significant correlations found among sub-factors. Path analysis results showed that academic and technological orientations of CEIT students were significant predictors of attitude toward web-based instruction. Results also showed that curriculum orientations and attitudes toward web-based instruction were significant predictors of self-regulated learning skills.”

Vasetskaya, N., & Glukhov, V. (2019). Transformation of university functions in the conditions of knowledge-digital economy. *Atlantis Highlights in Computer Sciences, 1*, 409–414.

<https://doi.org/10.2991/icdtli-19.2019.71>

**Abstract:** “The subject of the research is the university in the conditions of knowledge economy. The purpose of the article is to analyze and rethink the basic functions of the university, to identify new functions of the university in the conditions of formation of modern economy. The research of the content and innovative potential of knowledge-digital economy

is carried out. It is shown that the activity of universities in the conditions of formation and development of knowledge-digital economy is accompanied by revision and renewal of its mission and functions.”

Wang, S–W. (2019). The application of the interconnected model of professional growth and the change of teacher role in the development process of expert teacher. *Advances in Social Science, Education and Humanities Research*, 369, 239–239.  
<https://doi.org/10.2991/ichess-19.2019.48>

**Abstract:** “The cultivation of expert teacher symbolizes the improvement of educational quality. In recent years, the research of expert teacher has been numerous in the education field, but more emphasis is placed on the comparison of the characteristics of expert and novice teacher, including knowledge construction and teaching practice. This article focuses on the development of expert teacher with the Interconnected Model of Professional Growth (IMPG), to help expert teacher to develop professionally more effectively. This paper proposes three application strategies of the "IMPG", which include: 1. Expanding the influencing factors of "environmental change" with the internet. 2. Expanding the "change sequence" of personal domain with the learning community. 3. Building the stronger "growth networks" with action research. After the application of this model, the analysis of expert teachers in this paper should appear in four new roles, which include "learning expert", "research expert", "cooperative expert", and "expert in physical and virtual teaching", so that teachers' professional growth will be more open, diverse and concrete.”

Wei, C., Xiaodong, W., Keijan, C., & Zhongda, L. V. (2019). Measurement and improvement path of TPACK context of professional teachers of civil engineering in higher education. *Revista de Cercetare si Interventie Sociala*, 65, 276–291.  
<https://doi.org/10.33788/rcis.65.17>

**Abstract:** “In the information age, with the rapid emergence of multimedia computers, smart phones and various Web-based RIA applications and AR and VR technologies, the information and intelligence of the education and teaching environment has continuously enhanced. The innovation of teacher training mode and the development of teacher professionalization should be achieved by continuously improving the teacher’s knowledge structure and promoting the integration of technology and teaching. To study how to construct and continuously improve the new teacher knowledge structure system integrating information technology, it will become the basic part of the innovative teacher-training model and the professional development of teachers in the new era. The college civil engineering professional education has been developing with the development of the national social economy; the demand for talents has continuously increased. In addition, the innovation of civil engineering professional teaching is in urgent need of development. It is necessary to improve the quality of the teaching team. It is imperative to study the TPACK level of civil engineering teachers. Based on this, this paper builds a dedicated test scale and retains 34 items after screening. 180 data results were obtained, through the collection of questionnaires. Then we use SPSS statistical analysis software to conduct project analysis on the test results to verify the relevance and reliability of



the test items in the test scale. Then, we determine the structural validity of the test scale by factor analysis of the test results. Finally, we analyzed the factors affecting the TPACK context based on the resulting data. The results show that the national policy school environment is a macro factor that affects TPACK, and the teacher's self-efficacy is a micro factor. Based on this, we have proposed different development plans from different angles."

Widorento, S., & Dwiastuti, S. (2019). Improving students' thinking skill based on class interaction in discovery instructional: A case of lesson study. *Indonesian Journal of Science Education*, 8(3), 347–353. <https://doi.org/10.15294/jpii.v8i3.20003>

**Abstract:** "Lesson Study (LS) activity aims to improve teachers' professionalism using discovery-based instructional design. Teachers' professionalism was measured based on communication during the learning process, especially questions and statements from the teachers and students on various topics. Thirty-two high school biology teachers and twelve model teachers involved in this research. The procedures of the LS activity included curriculum review (up to constructing learning objectives); lesson plan making; implementation of lesson plans; communication of the results; and workshop. The research showed that LS activity changed the questioning skills of the teachers and students. Changes in the quality of teachers' questions and statements were proportionate with the changes in students' answers quality. The quality of questions and statements affected the teachers' competencies; also, improved the quality of learning as it facilitated students' thinking of learning as thinking categories."

Yuyun, I. (2018). Curriculum and technology design: A course to explore technology applications in EFL curriculum design. *Journal of ELT Research*, 3(1), 78–86. [https://doi.org/10.22236/JER\\_Vol3Issue1pp78-86](https://doi.org/10.22236/JER_Vol3Issue1pp78-86)

**Abstract:** "Teaching and technology pedagogy should be mastered by a teacher in this digital era. It is an inevitable fact that teachers should realize. To be in line with technology development, teachers are expected to bring any technology-based applications to the classroom. Many education institutions from Kindergarten to Higher Education around the world equip their teachers with technology-based training. In particular, Technology Enhanced Language Learning (TELL) has been mushrooming in English Language Teaching trends. To comply with this demand, Technological Pedagogical and Content Knowledge (TPACK) framework has been developed by Koehler & Mishra (2006) to equip student teachers in English Department. Therefore, Technology and Curriculum Design course is designed to tailor Pre-Service English Teachers how to integrate technology in EFL curriculum design. By having blended learning activities, teaching and learning activities are conducted to explore technology applications to design an EFL curriculum. Any class projects are technology-based assignments such as infographic, poster, mind map, questionnaire, presentation, etc. using CANVA, Google applications, presentation applications, lesson plan application (LessonWRITER), quiz application (Quizlet), and interactive book applications (AnyFlip, Flipping Book, FlipSnack), etc."

Zhan, R. (2019). Research on the model of technological pedagogical content knowledge of teachers (TPACK). *Zhishi guanli luntani*, 4(4). <http://www.kmf.ac.cn/>

Abstract: “TPACK framework doesn’t describe the level of knowledge, and the generation and transformation process of knowledge. This paper constructed a TCP teacher knowledge system model to describe the TPACK structure of teachers more comprehensively. [Method/process] Based on the TPACK, this research constructed a three-dimensional TCP teacher knowledge system model, added three dimensions, including knowledge domain, knowledge level and knowledge related degree. Then, it drew on the principle of system science and knowledge science for thinking deduction and deduction and analyzed the relationship between system variables in the form of solid geometry. [Result/conclusion] It was concluded that knowledge domain, knowledge level and knowledge related degree of TK, PK and CK can influence integration of TPACK, and the influence is positive. Besides, four ways to improve teachers’ TPACK integration ability were put forward.”

Zidoun, Y., Dehbi, Talea, M., & El Arroum, F-Z. (2019). Designing a theoretical integration framework for mobile learning. *International Journal of Interactive Mobile Technologies*, 13(12), 152–170. <https://doi.org/10.3991/ijim.v13i12.10841> Actions

Abstract: “New technologies are rapidly changing mobile learning and making it difficult to control. In addition to educational factors and learning content, a modern mobile learning system must take into account the technical and personal aspects of learning, the devices and aspects related to its evolution and interoperability. Teaching on the other hand has also evolved involving more flexibility in tasks and learning stages, thus using modern technologies that offer more alternatives now. In addition, such tasks may be specific to the learning content as well as the learning context or furthermore the learner's environment. Traditionally, mobile platform design relies on the skills of a mobile developer whose knowledge allows him to design mobile applications that are useful to users. But with mobile learning, the design phase involves more than just mobile development skills. For example, if you are designing a platform for practical work, the instructors responsible for the training should be involved. However, the empirical results show that educators do not integrate technology effectively into their curricula. To enable these instructors to develop mobile learning platforms, it is important to facilitate their integration through a theoretical model that will take into account all the ingredients necessary to complete this learning and to balance them in order to ensure its efficiency. In this study authors used a thematic synthesis methodology to present a framework for mobile devices integration in learning. They focused on three models that they think are the most cited in the field of ICT (information and communication technologies) integration in learning. The five-axis framework consists of enriching the TPACK framework (Technological Pedagogical Content Knowledge model in order to more precisely address mobile learning by covering the following parts: pedagogy, content, mobile technology, learning environment and learner’s profile. It describes relatively in depth the various factors involved as well as the effective interconnection to be ensured to achieve an optimal and efficient integration of m-learning. Balancing those five parts will be a matter of plural reflection when designing or consulting on a mobile learning platform.”

## Chapters

Allen, D. S., Wood, A. J., Sponberg, E., & Arnold, T. M. (2019). Digitally mediated supervision: Redefining feedback systems in field-based courses. In T. E. Hodges & A. C. Baum (Eds.), *Handbook of research on field-based teacher education* (pp. 542–564). IGI Global. <https://doi.org/10.4018/978-1-5225-6249-8.ch023>

**Abstract:** “This chapter focuses on the praxis behind the development of digitally mediated supervision and distance-based field experiences. The theoretical framework combines past principles of supervision with present technological models. The practical application lies in both a hybrid digitally mediated program at the undergraduate level and a fully functional model at the graduate level. The concerns addressed represent those facing higher education institutions across the United States, and the solutions presented are those initiated at a Mid-Western land-grant institution. The authors examine the hardware, firmware, and cloud technology used to deliver the program, and the reflective feedback model developed for online teacher preparation. Four types of feedback are defined: (1) self-reflection, (2) 10-minute walk-through, (3) focused feedback, and (4) formal evaluation.”

Swallow, M. J. C., & Will-Dubyak, K. (2020). Exploring digitally enhanced literacy practices with preservice teachers. In P. M. Sullivan, J. L. Lantz, & B. A. Sullivan (Eds.), *Handbook of research on integrating digital technology with literacy pedagogies* (pp. 394–416). IGI Global. <https://doi.org/10.4018/978-1-7998-0246-4.ch017>

**Abstract:** “Two professors in a teacher preparation program purposefully examined their courses for ways in which the learning opportunities in each separate course could be connected to facilitate development of preservice teachers' understandings of purposeful integration of technology within literacy instruction for elementary student learners. Preservice teachers in the courses used their knowledge of children's literature and best practices to create rich learning opportunities before examining them through the lens of the TPACK framework and SAMR model. This process enhanced and transformed preservice teachers' instructional decisions to illuminate educational technology as part of literacy instruction.”

### 3. Recent TPACK-Related Dissertations and Theses

Browne, C. C. (2019). *A qualitative multiple case study investigating novice elementary teachers' use of information communication technologies in 1:1 classrooms* (Publication No. 27540412) [Doctoral dissertation, Northcentral University]. ProQuest Dissertations and Theses Global.

**Abstract:** “The use of information communication technologies (ICTs) in classrooms is a common practice for many schools; however, the technological tools have changed drastically over time while teachers' instructional practices often have not. The problem studied was that novice elementary teachers ineffectively utilize ICTs due to inconsistent and poor examples of

ICT instructional strategies during their preservice teacher preparation program. The purpose of this qualitative multiple case study was to examine novice teachers' experiences, knowledge, and understandings of technological instructional strategies when using ICTs that were gained during their preservice experience and determine how they influenced their use of ICTs during their first year of teaching. The Technological Pedagogical Content Knowledge (TPACK) framework guided this investigation of novice teachers' technological integration competencies. Data was collected from a sample of four novice teacher participants via semi-structured interviews, teacher observations, and content analysis. Two themes were identified after analyzing the data: engaging technological instructional strategies and independent technological-student-teacher interactions. The results indicated that the novice teacher participants greatly modeled their use of ICTs and technological instructional strategies after the experiences, knowledge, and understandings gained from their preservice educators; however, they also noted additional enhancements necessary to enrich the effectiveness of their ICT utilization by identifying supplementary information they considered when planning instructional experiences. Future research could include using varied methodological study designs, determining if there are additional research based instructional strategies that lead to more effective integration of ICTs, and investigating whether ICT usage has a positive impact on students' academic progress and achievement."

Cunningham, W. F. (2019). *Assistive technology integration for students with speech and language impairments: A mixed methods study* (Publication No. 10974787) [Doctoral dissertation, Wayne State University]. ProQuest Dissertations and Theses Global.

Abstract: "Few studies are examining technological pedagogical content knowledge (TPACK), and special education teaches (Demirok & Baglama, 2018). Therefore, the purpose of this study is to examine Detroit Public School Pre-K-12 (DPS) teachers' self-assessment of their TPACK and to investigate how teachers of students with SLI in Detroit Public Schools Pre-K-12 integrate AT in the classrooms during instruction and the variances that exist in special education and general education classrooms, the differences across elementary, middle, high school grade levels, and during math, science, literacy, social studies instruction. This study serves to evaluate teachers' self-assessment of TPACK, the existing state, and integration of AT and to provide necessary recommendations to improve educational practices adding to the body of knowledge of instructional technology filling in the gaps that are needed to improve educational practices."

David, A. S. (2019). *An investigation of technological pedagogical and content knowledge of visual art teachers in selected senior high schools in Kumasi metropolis* [Master's thesis, Kwame Nkrumah University of Science and Technology]. ResearchGate.  
[https://www.researchgate.net/publication/336839621\\_AN\\_INVESTIGATION\\_OF\\_TECHNOLOGICAL\\_PEDAGOGICAL\\_AND\\_CONTENT\\_KNOWLEDGE\\_OF\\_VISUAL\\_ART\\_TEACHERS\\_IN\\_SELECTED\\_SENIOR\\_HIGH\\_SCHOOLS\\_IN\\_KUMASI\\_METROPOLIS](https://www.researchgate.net/publication/336839621_AN_INVESTIGATION_OF_TECHNOLOGICAL_PEDAGOGICAL_AND_CONTENT_KNOWLEDGE_OF_VISUAL_ART_TEACHERS_IN_SELECTED_SENIOR_HIGH_SCHOOLS_IN_KUMASI_METROPOLIS)

Abstract: "A lot of studies on TPACK for teachers has been done concerning the integration of technology in classroom instructions on different. But the problem is, there hasn't been any

studies done concerning the TPACK of Visual Art teachers in Ghana., Therefore the research sought to investigate the TPACK of Visual Art teachers in Kumasi Metropolis to investigate the Technological Pedagogical and Content Knowledge (TPACK) of Visual Art Teachers in Kumasi Metro to find out their efficient use of technologies, Competences of technology and Barriers preventing them in integrating technology in the teaching of the visual art subjects. TPACK is Knowledge of various technology-oriented teaching approaches that can be used to deliver subject matter. In view of this, Research questions were formulated based on the objectives of the study. The objectives are: 1. To investigate the access to Technology by Visual Art teachers in Kumasi Metropolis 2. To examine the level to which Visual Art teachers in Kumasi Metropolis use Technology for classroom activities 3. To examine the competences of technology integration by Visual Art teachers in Kumasi Metropolis 4. To explore the barriers and concerns preventing technology integration by Visual Art teachers in Kumasi Metropolis. Qualitative research method based on descriptive survey design was used for the study. Questionnaire was formulated based on Technological Pedagogical Content Knowledge (TPACK) Questionnaire serving as an instrument for testing the Visual Art teachers in Kumasi Metropolis. Four public Senior High Schools in Kumasi Metropolis were selected for the study. The population for the study was 30 respondents to fill out the questionnaire which was formulated. Statistical Package for Service Solution (SPSS 21.0) and Graphical representations of Charts and tables were used to analyze the data. The research found out evidently that, Visual Art teachers of Kumasi Metropolis have the technological knowledge and they are able to access technology on their own. It was also found that, the absence of Technological Pedagogical Knowledge (TPK) and Technological Content Knowledge (TCK) of Visual Art teachers in Kumasi Metropolis is low, this means that the Visual Art teachers would receive instructional teaching methods that are without digital devices and they will dwell more on textbooks to present their subject matter. The research also found that, Visual Art teachers Technological Pedagogical Content Knowledge (TPACK) is moderately low due to this the competences of using technological tools or devices to integrate technology into classroom pedagogy and content is low and this is actually going to hinder their success in subject delivery. In respect to these findings, it was recommended that, The Teacher Training Institutions (UEW, UCC, KNUST) ought to restructure their course programs to help Visual Art teachers improve more on their Technological content Knowledge. Again, The Government of Ghana together with GES should capitalize on this research provide frequent workshop for Visual Art to aid them on how they can easily integrate technology into their classroom instructions.”

Fallas, L. F. G. (2019). *Technological and pedagogical content knowledge (TPACK) knowledge in the initial training of third-cycle mathematics and secondary education teachers* [Doctoral dissertation, University of Lisbon Educational Institute]. University of Lisbon Repository.  
[https://repositorio.ul.pt/bitstream/10451/39751/1/ulsd733685\\_td\\_Luis\\_Fallas.pdf](https://repositorio.ul.pt/bitstream/10451/39751/1/ulsd733685_td_Luis_Fallas.pdf)

**Abstract:** “This study aims to understand how middle school and secondary mathematics pre-service teachers’ TPACK is developed, in a context of a pre-service teacher education experiment that is guided by a conjecture with two dimensions: (1) the content dimension, which conceives the development of TPACK of mathematics pre-service teachers based on four

cognitive components: (i) overarching conceptions about the integration of technology in Mathematics Education; (ii) knowledge about the curriculum when the technology is integrated; (iii) knowledge about students' learning with technology; and (iv) knowledge about teaching strategies with technology; and (2) The pedagogical dimension, which promotes the articulation between didactic and technological knowledge in the resolution of tasks that offer to the pre-service teachers an opportunity for reflection, discussion and planning of mathematics teaching and learning situations with technology as well as opportunities to explore new technologies, namely specific educational software. This study follows a Design Based Research methodology and two cycles of design were implemented involving the preparation of a teacher education experiment, its experimentation in the classroom and a retrospective analysis. The participants in the study were twelve mathematics pre-service teachers (six in each cycle of experimentation) enrolled in a master's program in the teaching of Mathematics at the Institute of Education of the University of Lisbon. Data collection included the participant observation by the researcher-teacher educator, field notes and audio recordings of classroom episodes, document collection of pre-service teachers work on tasks, questionnaires and interviews. The data were analysed interpretatively and according to the content analysis method, focusing on the pre-service teachers' TPACK components. The theoretical framework that underlies the study addresses the professional knowledge of the Mathematics teacher, in particular TPACK, the initial teacher training and ways to promote TPACK in this context. The main results allow to conclude that pre-service teachers' TPACK is a complex, dynamic and flexible knowledge, consolidated through the articulation of different domains of the teacher professional knowledge. This articulation is more evident in the conceptions and in the knowledge about the students' learning, and less evidenced in the knowledge about the curriculum and the teaching strategies. It is also possible to conclude that the pre-service teacher education experiment, with the characteristics defined in this study, contributed significantly to the development of the pre-service teachers' TPACK."

Gumness, G. (2019). *Faculty initiative and the role of self-efficacy in raising digital literacy* (Publication No. 27540970) [Doctoral dissertation, St. Francis College of Education]. ProQuest Dissertations and Theses Global.

Abstract: "From sprocket-holed film to radio and television, and especially since the personal computer revolution in the eighties, the history of technology for teaching has had mixed results with faculty. Stanford researcher Larry Cuban and other techno-critics have long held that faculty shun technology unless they see its value in teaching situations. It has been difficult for instructional designers and educational technologists to help faculty see the benefits of digital tools, with professional development strategies meeting only partial success and, in some quarters, disdain. This mixed methods explanatory study of a convenience sample of faculty at a private Midwest university sought to discover the factors that persuade higher education faculty to engage with technology on their terms and assess how much of an effect such engagement had on attaining technological literacy. The study discerned statistically significant differences between a control group of faculty who individually selected their own topics for a professional development activity, and a treatment group of faculty who did not have a choice. Through parametric analysis of Likert-style surveys, the study found statistically

significant increases with strong effect in self-reported perceptions of digital literacy, technology receptiveness, adoption, and perceptions of engagement and involvement within the treatment group. The study also found a moderate positive correlation between perceptions of self-efficacy and digital literacy. Qualitative statements revealed that a desire to learn new technology, the presence of responsive support, feelings of intrinsic motivation, and peer reinforcement were related to technology receptiveness and the ability to overcome fear of technology."

Liu, H. (2019). *Modeling the determinants of foreign language teachers' intentions to use technology for student-centered learning: An extension of the theory of planned behavior* (Publication No. 22589556) [Doctoral dissertation, Michigan State University]. ProQuest Dissertations and Theses Global.

**Abstract:** "Prior studies have highlighted the relative rarity of student-centered technology use among teachers and concluded this was due – at least in part – to teachers' constructivist-oriented pedagogical beliefs (CPB) and their technological pedagogical content knowledge (TPACK). Nevertheless, few studies have included these concepts in models aimed at predicting teachers' intentions to use technology for student-centered learning; nor have many examinations of such teacher' intentions been conducted using the well-established theory of planned behavior (TPB). The present study helps fill this gap by testing how well the TPB predicts teachers' intentions to use technology for student-centered learning using 621 in-service college-level English as foreign Language (EFL) teachers, and also compares the original TPB's predictive validity, data fit, and variance explained against those of a modified TPB model that incorporates both CPB and TPACK. The participants, all of whom were from southern China, completed a survey that measured their attitudes towards student-centered technology use (ATTU), subjective norms about student-centered technology use (SN), and perceived behavioral control about student-centered technology use (PBC), along with their CPB, TPACK and intentions to use technology for student-centered learning. Structural equation modeling was employed to examine the validity of the TPB and the modified TPB, and the relationships among the factors in the models. The results indicate 1) that both models are effective at predicting Chinese EFL teachers' intentions to use technology for student-centered learning; 2) that two factors in the TPB (ATTU, PBC), together with TPACK, were significantly correlated with the participants' intentions to use technology for student-centered learning, whereas SN and CPB had no such significant correlation with it; and 3) that the modified TPB model significantly outperformed the TPB model in terms of predictive validity, data fit, and variance explained. As well as contributing to our understanding of the TPB and teachers' intentions to use technology for student-centered learning, this study provides valuable guidance for policy-makers in the spheres of teacher education and technology use."

Ngan, V. P. T. (2019). An investigation of ICT policy implementation in an EFL teacher education program in Vietnam [Doctoral thesis, Edith Cowan University]. Research Online. <https://ro.ecu.edu.au/cgi/viewcontent.cgi?article=3252&context=theses>

**Abstract:** "Due to the increasing pace of advances in technology and attempts to integrate Information and Communications Technology (ICT) into education in Vietnam, teachers are now expected to make routine use of ICT in their teaching. The Vietnamese government has promulgated ambitious policies aimed at engaging in an increasingly globalised world and promoting the country's economic development. These policies focus on education, and in particular, the development of ICT and English as a Foreign Language (EFL) competencies, seen as key requirements for greater international participation. The competencies of teachers are a major factor in the successful implementation of these educational changes. Given the key role played by ICT and EFL knowledge and skills in the educational reforms underway in Vietnam, this study investigated the process of implementing ICT into a pre-service EFL teacher education program. It was aimed at exploring and understanding lecturers' and pre-service EFL teachers' perceptions, knowledge and skills in the use of ICT in their teaching and learning practice, particularly as they related to pedagogical reforms in EFL that were occurring at the same time. The theoretical framework for this study, derived from Fullan's (2007) Educational Change and the TPACK framework (Mishra & Koehler, 2006), was used to determine the factors that affected the implementation of new policies and reforms in the use of ICT in EFL teacher education in Vietnam. The study applied a mixed method design involving a quantitative data collection phase followed by a qualitative data collection phase (Creswell & Clark, 2018) through an analysis of national ICT policy, institutional translation and classroom implementation. At each level the analysis provided useful insights into the factors that impeded and supported the implementation progress. The quantitative data were derived from a questionnaire, and the qualitative data, from document analysis, focus groups and face-to-face interviews. Additional data were provided from analyses of policies, teacher education and course documents, lecturers' teaching outlines and pre-service teachers' lesson plans. The participants included faculty managers, EFL lecturers and pre-service teachers."

Ncube, S. (2019). *Eighth grade teachers' and students' experiences with iPads in math inclusion classes* (Publication No. 22624694) [Doctoral dissertation, Walden University]. ProQuest Dissertations and Theses Global.

**Abstract:** "Although educators have embraced technology in mathematics inclusion classrooms, students with math learning disabilities (MLD) still have anxiety and negative attitudes about mathematics and score lower than their counterparts. The purpose of this qualitative single case study was to investigate and describe the experiences of middle school 8th grade inclusion iPad math app users. The technological pedagogical content knowledge model, the universal design for learning model, and the experiential learning theory provided the conceptual framework of technology integration. The research questions addressed the experiences of middle school inclusion teachers and students with MLD regarding iPad use in a Common Core standards-based math curriculum. Two inclusion co-teachers and 8 special education students from 2 inclusion classes in a middle school participated in the study. Data were collected from direct lesson observations, document analysis, and individual teacher and student interviews. An interpretative approach of clustering codes and categories was employed to identify emerging themes. Findings indicated that iPads increased student engagement and student access to the Common Core math curriculum. Teachers and students using iPads faced some



challenges including lack of knowledge of using text-to-speech and keeping up with relevant new apps. Educators may use findings to understand how technology integration can provide equal access to the Common Core standards-based math curriculum for students with MLD and can reduce learning barriers for all students.”

Ozel, O. (2019). *An exploration of Turkish kindergarten early career stage teachers’ technology beliefs and practices* (Publication No. 22582492) [Doctoral dissertation, University of South Florida]. ProQuest Dissertations and Theses Global.

Abstract: “The purpose of this study was to explore Turkish kindergarten early career stage teachers’ self-efficacy beliefs towards technology and their technology integration practices in their classrooms by answering: What are self-efficacy beliefs of Turkish kindergarten early career stage teachers towards technology? How do Turkish kindergarten early career teachers integrate technology into their classrooms’ instructions? The study was designed as a qualitative multiple case study and guided by Bandura’s (1986) social cognitive theory and Mishra and Koehler’s (2006) TPACK conceptual framework. I conducted this study in Istanbul, where is the most crowded and metropolitan city in Turkey. The schools were chosen by the Ministry of National Education (MoNE) after the permissions were received from IRB and MoNE, and the participants were assigned by the directors of schools based on research criteria. Participants were chosen purposefully, and there were four female kindergarten teachers in their early career stages, which were identified based on Steffy, Wolfe, Pasch and Enz (2000)’ stages: novice teacher and apprentice teacher, teaching five-year-old students at technologically well-equipped classrooms, and who had a bachelor’s degree in preschool teaching. Data was collected from three sessions of semi-structured interviews and two sessions of observation based on TIM-O. Data was coded and analyzed based on Technological Pedagogical Content Knowledge (TPACK) to make sense teachers’ technology self-efficacy beliefs towards technology and Technology Integration Matrix (TIM)’s to understand their technology practice into classroom instructions.”

Torres, C. S. (2020). *The implementation of math technology supplemental programs for elementary students* (Publication No. 27736211) [Doctoral dissertation, Walden University]. ProQuest Dissertations and Theses Global.

Abstract: “Many studies have focused on using technological devices in elementary education; however, more research is needed on the implementation of technology to improve student learning in math. The problem addressed in this study was the lack of information about how teachers implemented and used the new math software programs, Imagine Math and Reflex in their instruction and their perspectives on differences the programs made in students’ math learning. The Technological Pedagogical Content Knowledge (TPACK) served as the conceptual framework for this study. The purpose of the study was to understand how teachers are using the new math software programs and to analyze their perspectives on differences they notice in students’ math learning and comfort with online math tools after using the programs. This qualitative case study used data from interviews and observations from local teachers to illuminate the positive and negative aspects of implementing the new software programs. The

data were coded into theme categories including usage, strengths, concerns, and professional development. The data showed the participants had generally a positive view of integrating the programs and felt the programs were beneficial to students, that the biggest challenges were lack of training and some technological issues, and TPACK changes were more prevalent for program-experienced teachers and limited to center time for those new to the programs. The finding helped identify the gap between what the math technology programs claim and what the programs actually do for teachers and learners. The potential for social change is to accurately capture the programs' benefits to students and the preparation required by teachers for online learning programs and assessments."

#### 4. Recent TPACK Presentations

Karlsson, G. (2019). Capturing student teachers' technological pedagogical and content knowledge: Using a pedagogical tool called Technology Content Representation and video reflection. In L. Gómez Chova, A. López Martínez, & I. Candel Torres (Eds.), *ICERI 2019: Proceedings of 12<sup>th</sup> annual International Conference of Education, Research and Innovation* (pp. 6254–6263). IATED Digital Library.  
<https://doi.org/10.21125/iceri.2019.1507>

Abstract: "In order to facilitate for student teachers to structure their teaching with digital tools and to study their technological pedagogical and content knowledge (TPACK), we used a pedagogical tool, titled technological content representation (T-CoRe). The T-CoRe is designed as a tool to enable student teachers to prepare for integration of digital technology in their teaching and to reflect on their use of this technology when teaching a specific subject matter. The T-CoRe asks explicit questions about which digital tools they are going to use, their reasons for using these tools and which opportunities the use of these digital tools can provide to facilitate the students' understanding of a specific subject content. The aim of this study was to investigate how student teachers' express their knowledge of use of digital technology in the TPACK framework when reflecting on their video-recorded teaching with use of the T-CoRe. The study included 27 secondary science student teachers following a two-year teacher education programme. The student teachers' T-CoRes, their video clips and their written reflections were analysed with a qualitative content analysis. Most of the student teachers' (18), exhibited an integrated knowledge of the technology dependent domains; TK, TPK and TCK, in the TPACK framework. For nine of the student teachers, only their TK and TPK could be observed. The results indicate that the T-CoRe might provide a fruitful framework for supporting student teachers' in their work on planning and reflecting on their teaching with digital technology and capture their TPACK. Thus, our study proposes a structure for teacher education that might work to improve how student teachers' are prepared for using digital technology in their teacher preparation program and, ultimately, in their future classrooms."

Li, Y., Qian, C., & Han, M. (2019). Exploring mathematics teachers' TPACK competency development. In S. Wang, L. Lin, T. Hartsell, H. Zhan, & K. Beedle (Eds.), *EITT: Proceedings of 8<sup>th</sup> Annual International Conference of Educational Innovation through*

*Technology* (pp. 99–105). IEEE Xplore Digital Library.  
<https://doi.org/10.1109/eitt.2019.00027>

**Abstract:** “The Technical Pedagogical and Content Knowledge (TPACK) framework was developed to measure teaching efficiency using information and communication technology (ICT). It was based on a literature review and research with 902 mathematics teachers in Beijing. In this study, mathematics teachers scored the highest in 'informational teaching belief' and the lowest in knowledge of student learning with integrated technology. K-means cluster analysis was used to classify teachers into five different types based on the framework. This research proposed a strategy to improve mathematics teachers' TPACK ability and promote ICT integration into education.”

Mare, A., Jormanainen, I., & Tedre, M. (2019). Eritrean pre-service teachers' perceptions of and proficiency with TPACK and ICT integration in education. In M. A. Conde González, F. J. Rodríguez Sedano, C. Fernández Llamas, & F. J. García-Peñalvo (Eds.), *Proceedings of 7<sup>th</sup> International Conference on Technological Ecosystems for Enhancing Multiculturality* (pp. 582–588). ACM Digital Library. <https://doi.org/10.1145/3362789.3362804>

**Abstract:** “This research was set out to explore and analyze the status of integration of Information and Communications Technology (ICT) into teacher education and development programs in the context of a developing country, Eritrea. It based its investigation on the requirements of teacher professionalism in contemporary learning environments, where teachers are expected to develop the required proficiency for effectively integrating technology, pedagogy and content knowledge into their teaching so as to meet the educational needs of 21st century learners. In doing so, the research undertook this study by investigating pre-service teachers' perceptions and proficiency of ICT integration in education from the perspective of Technological, Pedagogical and Content Knowledge (TPACK). Results from analysis of pre-service teachers' basic ICT skills, attitudes towards ICT, competencies in ICT, perceptions on ICT for teaching and learning, revealed that they possess satisfactory levels of strengths in these areas of technological knowledge and skills. On the other hand, results from analysis of pre-service teachers' experiences and purpose of using ICT and ICT related support received from their institutions and teacher-educators indicate low level of readiness in integrating technology into teaching and learning. These results indicate that teacher educators and teacher education institutions have lagged behind in providing the required support, clearly revealing a gap between the educational needs of the 21st century generation of pre-service teachers and the educational provision of teacher education programs. This calls for a systemic approach to the process of integrating ICTs into teacher education and development programs in Eritrea.”

Njiku, J., Mutarutinya, V., & Maniraho, J. F. (2020). Mathematics teachers' technology integration self-efficacy and technology use. In K. K. Mashood, T. Sengupta, C. Ursekar, H. Raval, & S. Dutta (Eds.), *Proceedings of 8<sup>th</sup> annual International Conference to Review Research in Science, Technology and Mathematics Education* (pp. 283–289). Homi

Bhabha Centre for Science Education – TIFR.  
<https://episteme8.hbcse.tifr.res.in/proceedings/>

**Abstract:** “Technology integration self-efficacy plays a great role in determining teachers’ use of technology in teaching. This study investigated the association between mathematics teachers’ use of technology and their technology integration self-efficacy. The study employed a survey design and 125 mathematics teachers participated in filling the questionnaire. Data analysis was done descriptively and inferentially and processed using Statistical Packages for Social Science version 20. Independent samples t-test and effect sizes were used. Despite teachers reporting to have a moderate level of self-efficacy, the study found a significant association between technology use and self-efficacy in technology integration. However, very few teachers reported using technology for instructional purposes. The study recommends that developing teachers’ self-efficacy levels and facilitating their actual classroom technology integration may be important in enhancing technology use in mathematics education.”

Zhang, Y., & Wang, X. (2019). Empirical study on the influencing factors of ICT-TPCK vocational teachers in higher education. In S. Wang, L. Lin, T. Hartsell, H. Zhan, & J. Beedle (Eds.), *EITT: Proceedings of 8<sup>th</sup> Annual International Conference of Educational Innovation through Technology* (pp. 137–141). IEEE Xplore Digital Library.  
<https://doi.org/10.1109/eitt.2019.00034>

**Abstract:** “Teachers' information and communication technology (ICT) competencies are crucial during the process of teaching. This paper explored the relationship of TPCK knowledge from a technical perspective, the way to define ICT-TPCK influencing factors and their relationship with the technological knowledge, technological pedagogical knowledge, technological content knowledge and technological pedagogical content knowledge. A questionnaire adapted from Angeli, Valanides was validated by using factor analyses and regression analyses. The results revealed that TK, TCK and TPCK have a two-way relationship. The ICT-TPCK of vocational teachers in higher education was generally at a positive level and the level of influencing factors of ICT-TPCK in vocational teachers in higher education was also relatively high. Path analysis showed that teacher training and self-efficacy had a direct impact on TK and TCK. School environment, teacher training and self-efficacy had a direct impact on TPCK. School environment and compatibility had an indirect impact on TK, TCK and TPCK.”

Zhao, J., Hua, X., & Li, Z. (2019). Empowering learning community of teachers in computer mediated communication. In S. Wang, L. Lin, T. Hartsell, H. Zhan, & J. Beedle (Eds.), *EITT: Proceedings of 8<sup>th</sup> Annual International Conference of Educational Innovation through Technology* (pp. 165–169). IEEE Xplore Digital Library.  
<https://doi.org/10.1109/eitt.2019.00039>

**Abstract:** “The cooperative development of teachers through societal interactivity is an impartial way for rural teachers. Teachers transfer urban and rural education information in cooperation and interaction. In the process of building teacher' s TPACK ability, using Design-based Experiential Learning plays key role. The paper, based-on the perspective of computer

mediated communication, analyzed the social relations of the forum replies relations among the Urban-Rural-University (U-R-U) Learning Community for Teachers. As a result of "decreasing intervention" strategy, cooperative teaching research had promoted the in-depth interaction of U-R-U learning community and served as the backbone to help teachers gradually dominated in the community."

## 5. TPACK Newsletter Suggested Citation

Our thanks to [Lisa Winebrenner](#), who wrote to suggest that we suggest a citation format for you 'academic types' who might want to cite something that appears in this humble virtual publication. Our reading of the most recent (7<sup>th</sup> edition) of the *Publication Manual of the American Psychological Association* suggests that the citation should look like this:

Harris, J., & Wildman, A. (Eds.). (2020, April 7). *TPACK newsletter issue #43: April 2020*. TPACK Newsletters Archive.

<https://activitytypes.wm.edu/TPACKNewsletters/TPACKNewsletterIssue43.pdf>

## 6. Learning and Doing More with TPACK

Interested in learning more about TPACK or getting more involved in the TPACK community? Here are a few ideas:

- Visit the TPACK wiki at: <http://tpack.org/>
- Join the TPACK SIG at: <http://site.aace.org/sigs/tpack-sig/>
- Read past issues of the newsletter at: <http://bit.ly/TPACKNewslettersArchive>
- Subscribe to the tpack.research, tpack.teaching, tpack.grants and/or tpack.future discussion lists at: <http://site.aace.org/sigs/tpack-sig/>
- Access the TPACK Learning Activity Types taxonomies at: <http://activitytypes.wm.edu/>
- Access three tested TPACK assessment instruments at: <http://activitytypes.wm.edu/Assessments>
- Access and/or adapt TPACK online short courses at: <http://activitytypes.wm.edu/shortcourse/>

Please feel free to forward this newsletter to anyone who might be interested in its contents. Even better, have them subscribe to the TPACK newsletter by sending a blank email to [sympa@lists.wm.edu](mailto:sympa@lists.wm.edu), with the following text in the subject line: subscribe tpack.news FirstName LastName (of course, substituting their own first and last names for 'FirstName' and 'LastName' — unless their name happens to be FirstName LastName, in which case they can just leave it as is).

If you have a news item that you would like to contribute to the newsletter, send it along to: [tpack.newsletter.editors@wm.edu](mailto:tpack.newsletter.editors@wm.edu).

### Standard End-Matter

If you have questions, suggestions, or comments about the newsletter, please send those to [tpack.newsletter.editors@wm.edu](mailto:tpack.newsletter.editors@wm.edu). If you are subscribed to the tpack.news email list, and — even after reviewing this impressive publication — you prefer not to continue to receive the fruits of our labors, please send a blank email message to [sympa@lists.wm.edu](mailto:sympa@lists.wm.edu), with the following text in the subject line: unsubscribe tpack.news

- Judi & Amelia

...for the SITE TPACK SIG leadership:

<a href="#">Yi Jin</a> ,	Co-Chair, Sonoma State University
<a href="#">Daniel Mourlam</a> ,	Co-Chair, University of South Dakota
<a href="#">Teresa Foulger</a> ,	___ Chair, Arizona State University
<a href="#">Mamta Shah</a> ,	Plantation Chair, Drexel University
<a href="#">Josh Rosenberg</a> ,	Camping Chair, University of Memphis
<a href="#">Petra Fisser</a> ,	<a href="#">Red-Blue Chair</a> , SLO Expertise Center, National Curriculum Development
<a href="#">Candace Figg</a> ,	Rocking Chair, Brock University
<a href="#">Mark Hofer</a> ,	Sedan Chair, William & Mary School of Education
<a href="#">Judi Harris</a> ,	Wing Chair, William & Mary School of Education
<a href="#">Mario Kelly</a> ,	Futon, City University of New York
<a href="#">Matt Koehler</a> ,	Chaise Lounge, Michigan State University
<a href="#">Punya Mishra</a> ,	Recliner, Arizona State University