



TPACK Newsletter, Issue #38: September 2018

Welcome to the 38th edition of the (approximately bimonthly) TPACK Newsletter! TPACK work is continuing worldwide. This document contains recent updates to that work that we hope 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

"Electronic aids, particularly domestic computers, will help the inner migration, the opting out of reality. Reality is no longer going to be the stuff out there, but the stuff inside your head."

- J.G. Ballard

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1. TPACK Newsletter Update

The TPACK Newsletter has been published via the tpack.news email list since January 2009. It has 1239 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: 964

Chapters: 243

Books: 26

Dissertations: 302

2. Recent TPACK Publications

Below are recent TPACK publications that we know about: 54 articles, 5 chapters, and 9 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.

Articles

Bakac, E. (2018). The impact on technology integration self-efficacy beliefs of prospective teachers' self-directed learning trends with technology. *European Journal of Educational Studies*, 12(4), 72–87. <https://doi.org/10.5281/zenodo.1341050>

Abstract: “The purpose of this research is to determine the effect of self-directed learning tendencies of prospective teachers on the self-efficacy beliefs of technology integration. In addition, prospective teachers' opinions of technology integration were researched. The research was designed using a mixed method. The study group of the research consisted of prospective teachers (pre-test n = 170 and post-test n = 131) who are studying at the Faculty of Education located in Northwest Black Sea Region of Turkey during the spring semester of the 2016-2017 academic year and who are taking the course of Instructional Technology and Material Design. The Technology Integration Self-Efficacy Scale, Self-directed Learning with Technology Scale and focus group interview were used to collect the data of the study. At the end of the research, it was found that prospective teachers' self-directed learning tendency scores were predictive both pre-test and post-test scores their technology integration self-efficacy beliefs.”

Barac, K., Prestridge, S., & Main, K. (2017). Stalled innovation: Examining the technological, pedagogical and content knowledge of Australian university educators. *Australian Educational Computing*, 32(1). Retrieved from <http://journal.acce.edu.au/index.php/AEC/article/view/140>

Abstract: “This paper presents a summary of the key findings of a TPACK survey adapted for a higher education context and serves as an initial sampling technique for a larger study in the design and delivery practices of academics. There are few studies that investigate how technologies are used and experienced in courses from an objective pedagogical perspective. In this first stage, a survey was implemented to understand academic perceptions of the role that technologies play in relation to their content and their pedagogies. The initial findings indicate that the connections within these domains are limited in the academic context.”

bin Ishak, M. F. F. & Abu, A. G. (2018). Exploring TPACK domains of Malaysian non-option ESL teachers in an online flipped learning course through Blendspace. *EduLite: Journal of English Education, Literature, and Culture*, 3(2), 110-124. <http://dx.doi.org/10.30659/e.3.2.110-124>

Abstract: "The purpose of this paper is to explore teachers' Technological Pedagogical and Content Knowledge (TPACK) domains in planning digital tools-based activities. It discusses a small part of a major study that investigated Malaysian non-option ESL teacher's flipped ESL instructional design of teaching and learning in their own classroom context. Participants were involved in this case study. The miniscule analysis was done for a digital tool called Blendspace (a learning management system – LMS) in order to investigate teacher's classroom activity plans. The digital tools introduced to the participants were meant to support their ESL flipped learning instructional design. Findings show that new input ameliorated the existing TK domain and made it developmental. This has resulted an improvised TPACK which I coined a term 'Augmented TPACK' – an inclusive TPACK domains that consists of developmental TK and non-developmental PK and CK. Participants used Augmented TPACK to plan digital tools-based activity."

Boda, P., & Weiser, G. (2018). Using POGILs and blended learning to challenge preconceptions of student ability in introductory chemistry. *Journal of College Science Teaching*, 48, 60–67. Retrieved from https://learningcenter.nsta.org/resource/?id=10.2505/4/jcst18_048_01_60

Abstract: "Success for students majoring in STEM (science, technology, engineering, and mathematics) within undergraduate chemistry courses is crucial for retention in science degree programs, especially for students perceived as lacking content knowledge and skills. This study leveraged blended learning structures in a remedial chemistry course combined with a Process-Oriented Guided Inquiry Learning (POGIL) curriculum as a potential intervention. The authors collected two data measures from this course and its nonremedial counterpart during the same semester: (a) pre-/postcourse Assessment of Basic Chemistry Concepts and (b) final grades. The authors also collected final grades of all students who populated the nonremedial course during the following semester and analyzed the data via descriptive statistics, t-tests, and analysis of covariance methods. The data support that students who were in the remedial class exhibited increases in conceptual understandings. This conceptual growth was comparable to the growth of students admitted directly into the nonremedial course. These "remedial" students went on to be 134% more likely to get a satisfactory matriculation grade (>80%) in this same subsequent nonremedial class compared with those directly admitted. Implications for this study emphasize the importance of remedial science course pedagogy and curriculum influencing student success and retention."

Bower, M., & Vlachopoulos, P. (2018). A critical analysis of technology-enhanced learning design frameworks. *British Journal of Educational Technology*. Advance online publication. <https://onlinelibrary.wiley.com/doi/pdf/10.1111/bjet.12668>

Abstract: "Numerous models have been developed to help teachers efficiently and effectively design learning opportunities using new and emerging technologies. However, the literature to date makes little reference to the variation that exists within the models and frameworks as far as their scope, context, epistemological and pedagogical underpinnings and so on. In this paper,

we critically contrast models of technology-enhanced learning design in order to support educator selection of models, as well as to derive an overarching understanding of how learning design models may differ ontologically. A total of 21 models were selected from a systematic search of the technology-enhanced learning design research literature. Findings indicated that technology-enhanced learning design models can be differentiated according to whether they constitute a conceptual framework or a procedural method, their epistemological and pedagogical underpinnings, the level of granularity of the model, the extent to which contextual elements are considered, whether interactions between teachers and students are integral, whether guidance for selecting technologies is included and whether any sort of evaluation of the model has been conducted. The utility of each of these dimensions in terms of supporting technology-enhanced learning design is considered, and the value more broadly of learning design models is critically discussed.”

Brinkley-Etzkorn, K. E. (2018). Learning to teach online: Measuring the influence of faculty development training on teaching effectiveness through a TPACK lens. *Internet & Higher Education, 38*, 28–35. <https://doi.org/10.1016/j.iheduc.2018.04.004>

Abstract: “The purpose of this study was to examine one model for training new online instructors and measure the influence it had on their teaching effectiveness and knowledge integration. The Technological Pedagogical Content Knowledge (TPACK) model served as the conceptual framework. Using a quantitatively-driven mixed-methods design, three data sources were used: (1) instructors' pre and post-training course syllabi, (2) pre and post-training student evaluations of teaching scores, and (3) results of a follow-up online survey. The findings of this study revealed that instructors demonstrated: (a) statistically significant changes in their incorporation of elements into the redesign of course syllabi and (b) improvements in their teaching abilities as self-reported in the follow-up survey. However, there were no significant changes in their student evaluations of teaching pre- and post-training. Overall, instructors demonstrated modest improvements in their teaching effectiveness.”

Buss, R. R., Foulger, T. S., Wetzels, K., & Lindsey, L. (2018). Preparing teachers to integrate technology into K-12 instruction II: Examining the effects of technology-infused methods courses and student teaching. *Journal of Digital Learning in Teacher Education, 34*(3), 134–150. <https://doi.org/10.1080/21532974.2018.1437852>

Abstract: “In a 2-year longitudinal study, we examined the effectiveness of a new technology-infused approach for teaching technology integration (TI) skills to teacher candidates. In the new approach, we infused learning to teach with technology into program methods courses. We measured candidates' understanding of various Technological Pedagogical Content Knowledge (TPACK) indicators associated with TI. Candidates' TPACK scores increased between the beginning of their teacher preparation courses and their student teaching experience; within-subject effect sizes were large; and data exhibited linear and cubic trends. Qualitative data were complementary exhibiting continued TI growth and application of TI to course and student teaching efforts in the classroom. Results suggest the new, technology-infused courses and student teaching are effective in fostering TPACK development and TI skills among teacher

candidates. (Keywords: technology-infused methods courses, technology integration, teacher candidates, TPACK).”

Cabero, J., & Barroso, J. (2016). ICT teacher training: A view of the TPACK model. *Cultura y Educacion*, 28(3), 633–663. <http://dx.doi.org/10.1080/11356405.2016.1203526>

Abstract: “This paper presents a study on the TPACK model (Technological Pedagogical Content Knowledge), which focuses on the assumption that in order to use ICTs effectively in teaching, the instructor must be trained in technological, content and pedagogical knowledge. In consequence, education, teacher training and professional development programmes should provide learning opportunities so that teachers can develop and put into action the three areas included in the model. To analyse the TPACK model of the teachers included in the study, a translation of an already developed instrument was applied; its reliability resulted in a Cronbach’s alpha of .97. The sample was comprised of 1,368 people who conducted training activities related to education and technologies at universities in Spain, Argentina, Colombia, the Dominican Republic and Venezuela. The results reveal the need to stress not the technological aspects but the pedagogical and content knowledge, which is where the respondents earned the lowest scores.”

Cando, F., Tituana, I., Cando, B., & Lema, Y. (2018). Competencia tecnologica pedagogica del contenido en el arena de lengua y literatura. *Inicio*, 13, 178–181. Retrieved from <https://journal.espe.edu.ec/ojs/index.php/cienciaytecnologia/article/view/732/633>

Abstract: “The main aim of this research was to determine the level of Technological, Pedagogical Content Knowledge of Basic Education teachers in the area of Language and Literature. The focus of the research was quantitative, descriptive in scope. 48 teachers were surveyed using a questionnaire according to the TPACK model, which stands for Technological Pedagogical and Content Knowledge. This model includes the knowledge, skills and abilities that the teacher needs to integrate ICT effectively in the teaching-learning process of any subject. The data collected show that most teachers have a Very High and High level in the technological, pedagogical and content competences individually; however, the level is low in the integration of them, basically in the competencies: Content Technology, Pedagogical Technology and Technology Pedagogical Content. This result makes it possible to show the scarce formation of the teacher of Basic Education in the pedagogical use of ICT. And it suggests a) designing proposals for teacher training under the TPACK model, b) integrating this model in the curriculum of Basic Education Major and c) considering the structure of the TPACK model in the micro curricular planning guaranteeing better learning experiences with ICT.”

Celik, I., Hebebcı, M. T., & Sahin, I. (2016). Role of use of online case study library in technology integration: A study based on TPACK. *Gaziantep University Journal of Social Sciences*, 15(3), 739–754. Retrieved from <https://doaj.org/article/cf0b85e958145adb4a7e7bf6033d949>

Abstract: “The purpose of this study is to investigate the effect of usage of an online casestudy library including teacher case studies about technology use on teacher education. For this purpose, the case study library is utilized in the teaching practice class of preservice teachers from the Department of Geography Education. This research is designed according to one group pre-test/post-test modeling to investigate effects of the usage of the library on preservice teachers’ Technological Pedagogical and Content Knowledge (TPACK) and teacher self-efficacy beliefs. To analyze the data obtained through pre- and post-tests, t-test is implemented. The findings of the study reveal that there is statistically significant difference in the post-test scores of TPACK, PK, CK, TCK, and PCK subdimensions compared to the ones of pre-tests. Moreover, in the other sub-dimensions, TK and TPK post-test scores increase but they are not significantly different from the pre-test scores. Similarly, the scores in all sub-dimensions of teachers’ self-efficacy beliefs scale increase compared to the pre-tests scores.”

Chalmers, C. (2018). Robotics and computational thinking in primary school. *International Journal of Child-Computer Interaction*, 17, 93–100.
<https://doi.org/10.1016/j.ijcci.2018.06.005>

Abstract: “This paper reports on a research study that examined how Australian primary school teachers integrated robotics and coding in their classrooms and the perceived impact this had on students’ computational thinking skills. The study involved four primary school teachers, (Years 1–6) from four schools, introducing LEGO® WeDo® 2.0 robotics kits in their classrooms. The data collected from questionnaires, journal entries, and semi-structured interviews were analyzed using computational thinking and teaching frameworks. The results demonstrate that exploring with and using the robot kits, and activities, helped the teachers build their confidence and knowledge to introduce young students to computational thinking. The study identified that teacher professional development (PD) needs to focus explicitly on how to teach developmentally appropriate robotics-based STEM activities that further promote computational concepts, practices, and perspectives.”

Cheah, Y. H., & Chai, C. S., & Toh, Y. (2018). Traversing the context of professional learning communities: Development and implementation of technological pedagogical content knowledge of a primary science teacher. *Research in Science and Technological Education*. Advance online publication.
<https://doi.org/10.1080/02635143.2018.1504765>

Abstract: “Background: Professional learning communities are increasingly recognized for their significance in building teachers’ competencies for educational reform. However, the knowledge development cycle of technological pedagogical content knowledge (TPACK) through multiple professional learning communities is not well researched. Purpose: This qualitative case study investigates a primary science teacher’s TPACK development in the context of two interdependent learning spaces: a joint-school and a within-school professional learning community. The school’s organizational and sociocultural influences on teacher learning are also examined. Participant: Teacher Sean (pseudonym) embarked on a science

innovation project after two years of teaching in a Singapore mainstream school. He was tasked to integrate mobile-based inquiry learning and visible thinking pedagogical approaches, and to pilot the designed lessons for a primary three class. Design and methods: A case-study approach involving multiple sources of data with cultural historical activity theory as the analytical lens was employed, to unpack the complementary and contradictory interactions across different interrelated activity systems. The purpose was to understand the (mis)alignments within and between the two professional learning communities. Results: The findings indicate that Sean's (subject) learning from the joint-school professional learning community to the within-school professional learning community faced multiple tensions that hindered his TPACK development (object). He faced difficulty in manipulating tools (technology and visible thinking routines) to translate the joint-school co-designed lessons into classroom implementation. Additionally, the volatility of the school's organizational routines (rules) and the lack of communicative leader-teacher partnership (division of labor) did not afford sufficient infrastructure or instructional support. Conclusions: Interactions between the teacher's personal and contextual factors inhibited the designed TPACK from being implemented successfully. For ambitious pedagogical undertakings as illustrated in this case, more perceptive and synergistic organizational design thinking is needed to support beginning teachers' TPACK development."

Ching, Y-H., Hsu, Y-C., & Baldwin, S. (2018). Developing online teaching expertise: An analysis of prospective online instructors' reflections. *Journal of Interactive Learning Research*, 29(2), 145–167. Retrieved from <https://eric.ed.gov/?id=EJ1179801>

Abstract: "Effective online teaching requires instructors to develop knowledge and new skills conducive to creating meaningful and successful learning experiences for online students. This exploratory case study examined 34 prospective online instructors' reflections on their development of online teaching expertise at the end of a graduate course. We analyzed participants' written reflections for their developed understanding of online teaching. We presented and discussed three major themes: (1) Perceptions of online instructors' roles; (2) Development of pedagogical and technological knowledge; (3) Shifting from online learners' perspectives to online instructors' perspectives. These themes represented the major patterns revealed in the prospective online instructors' reflections. showing the areas of expertise they had developed in the class. We also provided implications for programs to develop online instructors and directions for future research."

DeCoito, I., & Richardson, T. (2018). Teachers and technology: Present practice and future directions. *Contemporary Issues in Technology and Teacher Education*, 18(2). Retrieved from <http://www.citejournal.org/volume-18/issue-2-18/science/teachers-and-technology-present-practice-and-future-directions>

Abstract: "Technology cannot be effective in the classroom without teachers who are knowledgeable about both the technology itself and its implementation to meet educational goals. While technology use in the classroom is increasing, improving learning through its application should remain the goal. In this study, the authors explored 74 middle school

teachers' beliefs about and use of technology through a technology, pedagogy, and content knowledge (TPACK) lens. They sought to understand how middle school teachers use and perceive technology in practice and the factors influencing their pedagogical decisions to incorporate technology into their practice. Data included surveys, administered after a science, technology, engineering, and mathematics (STEM) outreach program and teacher interviews. Findings revealed that both internal and external barriers were present and influenced how teachers situated their pedagogy in terms of technology integration. It was also found that teachers were confident in content, pedagogy, and technology; however, most viewed technology as a tool rather than an embedded part of the learning process. This study contributes knowledge about professional development initiatives and the need to address not technology knowledge as much as the interdependence of technology, pedagogy, and subject content matter."

Dysart, S. A., & Weckerle, C. (2015). Professional development in higher education: A model for meaningful technology integration. *Journal of Information Technology Education: Innovations in Practice*, 14, 255–265. Retrieved from <https://www.informingscience.org/Publications/2326>

Abstract: "While many institutions provide centralized technology support for faculty, there is a lack of centralized professional development opportunities that focus on simultaneously developing instructors' technological, pedagogical, and content knowledge (TPACK) in higher education. Additionally, there are few professional development opportunities for faculty that continue throughout the practice of teaching with technology. We propose a model of continuing professional development that provides instructors with the ability to meaningfully integrate technology into their teaching practices through centralized support for developing TPACK. In doing so, we draw upon several theoretical frameworks and evidence based practices."

Ekrem, S., & Recep, C. (2014). Examining preservice EFT teachers' TPACK competencies in Turkey. *Journal of Educators Online*, 11(2). <https://doi.org/10.9743/JEO.2014.2.2>

Abstract: "The purpose of the study was to understand the TPACK (Technological Pedagogical Content Knowledge) competency of preservice English teachers and to determine whether there were any significant differences in terms of gender and academic achievement. This study was conducted at a state-run university and subjects were 137 preservice English teachers. The results of the research suggest that males' technological knowledge was higher than females; however, females were better than males in pedagogical knowledge. Moreover, no significant difference was found between TPACK mean and academic achievement in terms of the correlation between TPACK scale and academic achievement of the participants."

Gonzales, A. L. (2018). Exploring technological, pedagogical, and content knowledge (TPACK) and self-efficacy belief of senior high school biology teachers in Batangas City. *The Palawan Scientist*, 10, 29–47. Retrieved from http://www.palawanscientist.org/tps/wp-content/uploads/2018/07/3_Gonzales_Palawan-Scientist_2018.pdf

Abstract: “Teachers are considered as one of the key factors in the educational process, especially, in the implementation of a new curriculum. Thus, the introduction and implementation of the new K to 12 curricula, requires monitoring, assessment and evaluation of areas in teaching and learning, in order to ensure that the set goals and objectives were successfully attained. This study aimed to explore two important aspects of teaching such as self-efficacy belief and technological, pedagogical, and content knowledge (TPACK) of private and public senior high school biology teachers from Batangas City for AY 2017-2018. Surveys, focus group discussion and class observation methods were used to gather data. Using mean and standard deviation, the results revealed that biology teachers have moderate self-efficacy belief in both aspects of self-efficacy belief, the personal biology teaching efficacy and biology teaching outcomes expectancy. On the other hand, in TPACK, they were rated as moderately proficient. Furthermore, the study also implies that there is no significant relationship between these two variables when compared using Pearson’s r , which means that the self-efficacy belief of senior high school (SHS) biology teachers of Batangas City has nothing to do with their TPACK. Designing of a training design framework for faculty development programs and similar studies for physics and chemistry teaching are suggested.”

Guler, M., & Celik, D. (2018). Uncovering the relation between CK and PCK: An investigation of preservice elementary mathematics teachers’ algebra teaching knowledge. *REDIMAT – Journal of Research in Mathematics Education*, 7(2), 162–194.
<https://doi.org/10.17583/redimat.2018.2575>

Abstract: “This article discuss the algebra teaching knowledge of preservice elementary mathematics teachers in the context of CK and PCK as well as the relationship between them. The study was conducted with 101 preservice teachers sampled from a state university in Turkey. Rasch analysis was used to interpret the data. The results revealed that preservice teachers performed at mid-level for both CK and PCK tests. It was also found that there was a significant correlation between the CK and PCK test scores. Weaknesses of the preservice teachers in terms of knowledge of the learner component of PCK, in comparison with presentation of content, were identified.”

Haston, W. (2018). In-service music teachers’ self-perceived sources of of pedagogical content knowledge. *Bulletin of the Council for Research in Music Education*, 217, 45–66.
<https://doi.org/10.5406/bulcouresmusedu.217.0045>

Abstract: “The purpose of this multiple case study was to examine the perceived sources of identifiable pedagogical content knowledge (PCK) used by 5 in-service secondary band teachers. Participants agreed to plan, teach, and video-record a 30-minute band rehearsal early in the second semester of the school year. I viewed each video and created a log of applications of PCK based on previous models. An independent researcher confirmed the identified instances of applied PCK. Without exception, participants confirmed the researcher-identified applications of PCK. The responses from the participants varied: 1 participant reported apprenticeship of observation as the primary source of PCK; 1 reported apprenticeship of

observation and methods courses equally; another reported intuition and peers equally; 1 reported peers; and another reported cooperating teacher. Participants recognized the positive impacts this type of metacognition had on their teaching and expressed eagerness to reflect about their PCK in the future.”

Jimenez, J. D., & Moorhead, L. (2017). Recasting the history textbook as an e-book: The collaborative creation of student-authored interactive texts. *The History Teacher*, 50(4), 565–595. Retrieved from http://www.societyforhistoryeducation.org/pdfs/A17_Jimenez_and_Moorhead.pdf

Abstract: “In millions of households across the world, many teenagers will come home from school to enthusiastically design content to post on social media sites. Yet many of them will only open their history textbooks to complete their coursework with great reluctance. For the past few decades, discussion of student-centered pedagogy and technology in the classroom have often dominated educational discourse; however, the daily grind of teaching in an era of high stakes testing leaves many technological developments underutilized in classroom instruction. Thus, a pivotal question remains: in what ways might recent advances in digital technology be coupled with student-centered pedagogy to elicit greater engagement in history classes? In this paper, we explore the ways in which students can construct historical narratives using digital technology. We study how students can synthesize digitized primary source documents with content-authoring software. We consider how digital technology can not only increase students’ access to primary sources but also how student-authored historical texts can facilitate their usage. Our yearlong exploratory effort culminates in a 9-day school intervention in which 96 students from a Northern California public high school author their own interactive digital history textbooks, as a way to expand their view of world history through multiple perspectives as well as develop greater media literacy.”

Jones, S. J. (2017). Technology in the Montessori classroom: Teachers’ beliefs and technology use. *Journal of Montessori Research*, 3, 16–29. <https://doi.org/10.17161/jomr.v3i1.6458>

Abstract: “As technology becomes ubiquitous in society, there is increasing momentum to incorporate it into education. Montessori education is not immune to this push for technology integration. This qualitative study investigates four Upper Elementary Montessori teachers’ attitudes toward technology and technology integration in a public school setting. Interviews and observations were used to understand the teachers’ thoughts and actions regarding technology in the classroom. Both the school context and teacher background played important roles in teachers’ beliefs and actions. Teachers in this study expressed positive views of technology in general, exhibiting high technology efficacy and valuing the development of technology skills in their students. However, all four teachers struggled to include instructional technology in ways that are consistent with a Montessori paradigm. Although individual student use of adaptive tutoring software was the most common use of technology, the teachers varied greatly in both the amount of student time spent on computers and the roles that technology played in their classrooms.”

Karalar, H., & Aslan Altan, B. (2018). New technologies in microteaching: Is it possible for web 2.0 tools to affect prospective teachers' web pedagogical content knowledge and teacher self-efficacy? *International Online Journal of Education and Teaching (IOJET)*, 5(3), 535–551. Retrieved from <http://iojet.org/index.php/IOJET/article/view/353>

Abstract: “The purpose of this study was to determine the effect of Web 2.0 tools applied in microteachings on prospective teachers' web pedagogical content knowledge and teacher self-efficacy, and to examine their views on the procedure. This research used mixed research design and was conducted with 24 prospective teachers who participated in teacher training certificate program in Faculty of Education in a state university in Turkey. Web pedagogical content knowledge scale, teacher self-efficacy scale, and an open-ended question form were used as data collection tools. Paired samples t-test and Pearson correlation analysis were applied for the analysis of quantitative data; content analysis was used to analyze the qualitative data. The findings showed that there was a significant difference on prospective teachers' web pedagogical content knowledge and teacher self-efficacy levels after Web 2.0 tools implementation. The research also concluded that there was a medium level positive relation between teacher candidates' web pedagogical content knowledge and teacher self-efficacy. They stated that it was easy to use these tools, learning was fun, easy, and permanent, and they actively involved in instructional time. They added that they were eager to apply Web 2.0 tools in their future classrooms.”

Kim, S. (2018). Technological, pedagogical, and content knowledge (TPACK) and beliefs of preservice secondary mathematics teachers: Examining the relationships. *Eurasia Journal of Mathematics, Science, and Technology Education*, 14(10), 1–24. <https://doi.org/10.29333/ejmste/93179>

Abstract: “The purpose of this paper is to examine the relationships between preservice secondary mathematics teachers' beliefs and knowledge regarding teaching mathematics with technology. By conducting three semi-structured interviews, I investigated four preservice secondary mathematics teachers' technological, pedagogical, and content knowledge (TPACK) and their beliefs about the nature of mathematics, learning and teaching mathematics, and technology use in the mathematics classroom. The findings of this study suggest that preservice teachers with constructivist-oriented or student-centered beliefs about the nature of mathematics, learning mathematics, and technology use displayed higher levels of mathematical knowledge, pedagogical content knowledge, and technological content knowledge, respectively, than preservice teachers with traditional or teacher-centered beliefs about mathematics, learning, and technology use.”

Koh, J. H. L. (2018). Articulating teachers' creation of technological, pedagogical mathematical knowledge (TPMK) for supporting mathematical inquiry with authentic problems. *International Journal of Science and Mathematics Education*. Advance online publication. <https://doi.org/10.1007/s10763-018-9914-y>

Abstract: “Research studies have found that mathematics teachers face challenges when designing technology-integrated lessons to support mathematical inquiry with authentic problems. This suggests that teachers need to develop technological pedagogical knowledge (TPACK) or their professional knowledge for technology integration. Drawing upon the concept of TPACK, this study defines teachers’ professional knowledge for mathematics technology integration as technological pedagogical mathematical knowledge (TPMK) and examines the different kinds of TPMK that are needed to support the design of technology-integrated lessons for mathematical inquiry with authentic problems. Using content analysis, the design talk of three mathematics teachers designing a series of technology-integrated lessons to teach the concept of average through the inquiry of authentic problems was examined to articulate their associated TPMK. Thematic analysis was then used to derive five pathways used by the teachers to create the TPMK for mathematical inquiry with authentic problems throughout the design meetings that the teachers held across 2 months. These pathways articulate the process of teachers’ pedagogical decision-making as they create TPMK. The implications of these findings for future development of teacher knowledge for technology-supported mathematics inquiry are discussed.”

Koh, J. H. L. (2018). TPACK design scaffolds for supporting teacher pedagogical change. *Educational Technology Research and Development*. Advance online publication. <https://doi.org/10.1007/s11423-018-9627-5>

Abstract: "Many empirical studies show that teachers have difficulty designing technology-integrated lessons for student-centered learning. Supporting teachers to change their pedagogical practice is a challenge faced in teacher professional development for technological pedagogical content knowledge (TPACK). This study describes how teachers’ conceptions of pedagogical change can be supported through the use of different kinds of TPACK design scaffolds—a meaningful learning rubric, lesson design heuristics and TPACK Activity Types. The impact of these design scaffolds on the TPACK confidence and lesson design confidence of 47 teachers and instructors who were attending a graduate course in educational technology were assessed through pre and post course surveys. Expert ratings of technology-integrated lesson plans designed at the beginning and end of the course were also used to determine the extent of pedagogical change enacted. It was found that these design scaffolds had positive effects on teachers’ TPACK confidence and were useful for helping the teachers to articulate pedagogical change in their lesson designs. Participants’ feedback for improving the TPACK design scaffolds as well as guidelines for using these to support pedagogical change through TPACK professional development programmes are discussed."

Kucuk, S. (2018). How pre-service teachers learn educational technology with the situated learning approach. *Journal of Technology and Teacher Education*, 26(2), 249–274. Retrieved from <http://www.learntechlib.org/p/180080/>

Abstract: “This research investigated pre-service teachers’ motivation, learning strategies, and engagement in a situated learning based educational technology course. In this study, correlational research design was used. The sample of this study was 65 second year science

education pre-service teachers. The data were collected through two questionnaires. Descriptive and multiple linear regression analyses were carried out. According to the results, pre-service teachers' engagement and motivation were at a high level; they mostly used sophisticated learning strategies such as organization, elaboration, critical thinking, and metacognitive self-regulation. The results also indicated that the significant predictors of engagement were organization, task value, and effort regulation. Critical thinking, effort regulation, organization, and peer learning strategies were significant predictors of metacognitive self-regulation. The findings are discussed in detail in this paper, and implications are offered for both future studies and the design of effective courses in situated learning based educational technology."

Lai, T-L., & Lin, H-F. (2018). An investigation of the relationship of beliefs, values and technological pedagogical content knowledge among teachers. *Technology, Pedagogy and Education*. Advance online publication.
<https://doi.org/10.1080/1475939X.2018.1496137>

Abstract: "The purpose of this study was to investigate the relationship among student-centred beliefs, technology value beliefs and technological pedagogical content knowledge (TPACK) in junior high school mathematics teachers. A survey was administered to 408 teachers in Taiwan. Regression analysis results showed that teachers' student-centred beliefs and technology values were significantly correlated with TPACK. MANOVA results found that teachers with high student-centred pedagogical beliefs may not have high technology values, and teachers with lower student-centred pedagogical beliefs may not have lower TPACK. Implications for professional development and suggestions regarding teachers' beliefs and TPACK are discussed."

Lee, D., Morrone, A. S., & Siering, S. (2018). From swimming pool to collaborative learning studio: Pedagogy, space, and technology in a large active learning classroom. *Educational Technology Research & Development*, 66(1), 95–127.
<https://doi.org/10.1007/s11423-017-9550-1>

Abstract: "To promote student learning and bolster student success, higher education institutions are increasingly creating large active learning classrooms to replace traditional lecture halls. Although there have been many efforts to examine the effects of those classrooms on learning outcomes, there is paucity of research that can inform the design and implementation process. This study investigates how spatial and technological features of a large collaborative classroom support active learning based on the Pedagogy-Space-Technology framework. The findings from our study suggest short lecture and class-wide discussion are essential in framing learning content before group activities, and connecting group outputs to the learning content after group activities. Through interviews, surveys, and focus groups, we found that-while small group activities are generally well-supported in large active learning classrooms-facilitating short lecture and class-wide discussion is key to the success of active learning in large classrooms. Technology should be carefully laid out in the space to

accommodate those activities. Specific design and implementation suggestions and implications are provided.”

Levy, K. S., Kali, Y., & Tal, T. (2015). Teachers as designers of technology-enhanced outdoor inquiry. *Interdisciplinary Journal of e-Skills and Lifelong Learning*, 11, 209–235.
<https://doi.org/10.28945/2320>

Abstract: “Implementing inquiry in the outdoors introduces many challenges for teachers, some of which can be dealt with using mobile technologies. For productive use of these technologies, teachers should be provided with the opportunity to develop relevant knowledge and practices. In a professional development (PD) program in this design-based research, 24 teachers were involved in adaptation of a learning environment supporting inquiry in the outdoors that included the use of mobile technologies. They first experienced the learning environment as learners, then adapted it for their own use, and finally, enacted the adapted environment with peers. We examined the scope and character of teacher involvement in adaptation, and the consequent professional growth, by analyzing observations, questionnaires, interviews and the adapted learning-environments. Findings indicate that all teachers demonstrated change processes, including changes in knowledge and practice, but the coherence of the learning environments decreased when substantial adaptations were made. Some teachers demonstrated professional growth, as reflected by their implementation of ideas learned in the PD program in their daily practice, long after the PD program had ended. This study demonstrates how the Teachers as Designers approach can support teacher learning and illustrates productive use of scaffolds for teacher growth and professional development.”

Mabuan, R. A. (2018). Using blogs in teaching tertiary ESL writing. *Journal of English Education*, 6(2), 1–10. Retrieved from
<https://doaj.org/article/346e510b93834caf8329ead534b8c662>

Abstract: “Anchored on the Technological, Pedagogical and Content Knowledge or TPACK Framework (Koehler & Mishra, 2009) and Substitution, Augmentation, Modification and Redefinition or SAMR Model of Technology Integration into the classroom (Puentedura, 2014), this study investigated a corpus of 58 blog posts written by ESL learners through weblogs. It aimed to determine the views of students on the use of blogs in learning English writing skills and to explore students feedback on the advantages of blogging as a virtual writing platform. Research participants were 58 freshman university tourism students enrolled at a Study and Thinking Skills class in a private university in Manila, the Philippines during the first semester of the academic year 2017-2018. Research data drawn from students blogs, survey questionnaires and focus group discussion revealed that despite accessibility issues due to technological resources, the learners viewed blogging as a viable platform in learning English writing skills because it affords them freedom to express their thoughts, it develops or improves their writing skills, and it allows them to connect and engage with their peers online, inter alia. Pedagogical implications for ESL writing teachers and researchers are offered based on these results.”

Milner-Bolotin, M. (2018). Promoting reflective physics teaching through the use of collaborative learning annotation system. *Physics Teacher*, 56(5), 313–316.
<https://doi.org/10.1119/1.5033879>

Abstract: “Effective physics teaching requires extensive knowledge of physics, relevant pedagogies, and modern educational technologies that can support student learning. Acquiring this knowledge is a challenging task, considering how fast modern technologies and expectations of student learning outcomes and of teaching practices are changing. Therefore 21st-century physics teachers should be supported in developing a different way of thinking about technology-enhanced physics teaching and learning. We call it Deliberate Pedagogical Thinking with Technology, and base it on the original Pedagogical Content Knowledge and Technological Pedagogical Content Knowledge frameworks. However, unlike the two aforementioned frameworks, the Deliberate Pedagogical Thinking with Technology emphasizes not only teachers’ knowledge, but also their attitudes and dispositions about using digital tools in order to support student learning. This paper examines how an online system that allows an ongoing discussion of videos uploaded on it by the students can support reflection in physics teacher education. Examples of using such a system in physics teacher education and teacher-candidates’ feedback on their experiences with it are also discussed.”

Pareto, L., & Willermark, S. M. L. (2018). TPACK in situ: A design-based approach supporting professional development in practice. *Journal of Educational Computing Research*. Advance online publication. <https://doi.org/10.1177/0735633118783180>

Abstract: “Technological pedagogical and content knowledge (TPACK) is a well-known conceptual framework for what knowledge teachers need in order to teach successfully using technology. Most recent TPACK studies address assessment of teacher TPACK by quantitative self-reporting surveys. Such an approach provides little guidance for teachers in how to develop their everyday teaching practice. We argue for a revival of the original TPACK design-based approach and propose a design-based, operationalization of the framework that is situated in action, context specific, and integrated in practical teaching. The approach has been developed, evaluated, and validated in a school development project in a Nordic Elementary School context using design-based research. The project engaged more than 100 professionals: in-service elementary teachers, school administrators and researchers, and more than 1,000 students during 3 years. The theoretical development evolved from rich descriptions of 38 didactic design as delimited units of teaching including planning, implementation, and evaluation of specified learning tasks acted out in practice. Contributions include framing teaching practice as design activity and a TPACK in situ model and methods targeting reflective practitioners. Our proposed approach addresses current limitations of TPACK and is aligned with advocated professional development methods.”

Park, E. K., & Hargis, J. (2018). New perspective on TPACK framework in the context of early childhood education: The “A” stands for affective. *International Journal for the Scholarship of Teaching & Learning*, 12(2), 1–9.
<https://doi.org/10.20429/ijstl.2018.120217>

Abstract: “The purpose of this exploratory single-case study is to investigate the affordances of iPad transpired within a technological pedagogical and content knowledge (TPACK) framework by four early childhood educators with varying Technological Knowledge (TK) at a low-income preschool. Pre/post and follow-up survey, group and follow-up interviews, classroom observations and document of iPad workshop data were analyzed using coding methods in two cycles. The exploration in how teachers discovered the iPad affordances indicated parallel progression in TK and change in their value system. The exploration in the progression of TK and change in their value system suggest a relationship between progression of TK towards TPACK and of affective-valuing (AV) towards affective-characterization (AC).”

Redmond, P., & Lock, J. (2019). Secondary pre-service teachers’ perceptions of technological pedagogical content knowledge (TPACK): What do they really think? *Australasian Journal of Educational Technology*, 35(3), 45–54. <https://doi.org/10.14742/ajet.4214>

Abstract: “Meaningful integration of digital technology into learning and teaching is ill-structured, complex, and messy. Inherent in the complexity is the interaction between the different domains of teacher knowledge. The multifaceted problem is further compounded by the diversity of learners and technology in today's dynamic classroom contexts. Pre-service teachers often feel ill-prepared to plan for effective technology integration in their classrooms. Technological pedagogical content knowledge (TPACK) has provided educators with a theoretical framework to unpack the complexity of technology integration. It sits at the heart of three interrelated components: content knowledge, pedagogical knowledge, and technological knowledge. These knowledge areas interact, support, and constrain each other. This study investigated secondary pre-service teachers’ perceptions of TPACK. Data were collected through an online survey and interviews. Following a brief introduction to TPACK, this article explores secondary pre-service teachers’ perceptions of TPACK and its components, along with their professional learning needs for TPACK development. Implications for teacher education programs are also provided.”

Redmond, P., & Peled, Y. (2018). Exploring TPACK among pre-service teachers in Australia and Israel. *British Journal of Educational Technology*. Advance online publication. <https://doi.org/10.1111/bjet.12707>

Abstract: "The ubiquitous nature of technology in the world has not yet translated into the ubiquitous use of technology to transform learning and teaching. Teachers lack the confidence and competence to integrate technology across a broad range of tools within a range of contexts. Technological pedagogical content knowledge (TPACK) has become a common framework to explore technology within teaching and teacher education. However, little research exists to explore the similarities and differences of TPACK between different teacher education programmes, within different countries or even different disciplines, especially in a secondary context. Using a self-report online survey, this study sought to compare and contrast TPACK results from pre-service teachers studying in secondary teacher education programmes in Australia and Israel. Findings suggest that TPACK is higher in Australia, and in both countries

for those students who were aged over 26. There were no significant differences between gender and disciplines reported. The paper also discusses broad-scale implications for the future of research in TPACK."

Reichert, M., & Mouza, C. (2018). Teacher practices during Year 4 of a one-to-one mobile learning initiative. *Journal of Computer Assisted Learning*. Advance online publication. <https://doi.org/10.1111/jcal.12283>

Abstract: "This study examines the ways in which all nine middle school teachers in a private school for boys in the United States integrated mobile devices with content and pedagogy 4 years into the implementation of a one-to-one initiative. It also examines teacher perceptions of the benefits and challenges related to the implementation of mobile devices in real classroom contexts. Data were collected from multiple sources including teacher lesson plans, classroom observations, and interviews. Data collection and analysis were situated in the framework of Technological Pedagogical Content Knowledge (TPACK), which is used to examine teacher knowledge and observed evidence of TPACK during classroom instruction. Results indicated that teachers were able to draw connections among mobile devices, content, and pedagogy to support student experiences. Results, however, indicated variability in teacher practice and pointed to the important role of continuous professional learning. Findings have implications for researchers and practitioners involved in the design and implementation of one-to-one initiatives."

Ronan, B. (2018). Standards based technology integration for emergent bilinguals. *Multicultural Education*, 25(2), 7–12. Retrieved from <https://eric.ed.gov/?id=EJ1181535>

Abstract: "The article discusses the use of a standards-based framework to support technology integration for bilingual education in California. Topics discussed include the alignment of the Technological, Pedagogical and Content Knowledge (TPACK) model with the English Language Development (ELD) and International Society for Technology in Education (ISTE) standards, the creation of Pedagogical Language Knowledge, and productive, interpretive and collaborative possibilities for technology integration."

Saltan, F., & Arslan, K. (2017). A comparison of in-service and pre-service teachers' technological pedagogical content knowledge self-confidence. *Cogent Education*, 4(1), 1–12. <https://doi.org/10.1080/2331186X.2017.1311501>

Abstract: "This study aimed to investigate and compare in-service and pre-service teachers' self confidence on technological pedagogical content knowledge (TPACK) in relation to their teaching experience, expertise, technology usage, and gender. To achieve this goal, survey method was conducted as part of a quantitative method design. Participants of the study consisted of 388 pre-service and 211 in-service teachers from four different concentrations: science, mathematics, information, and communications technology (ICT) and classroom teachers. The data were analyzed using paired Sample T-test and MANOVA statistical analysis. Results showed that both pre-service and in-service participants exhibit the highest self-

confidence level in the technological content knowledge domain. While pre-service teachers had the lowest score in TPACK, in-service teachers had the lowest score in the technological knowledge domain. While pre-service mathematics teachers have significantly lower TPACK than pre-service science teachers, in-service ICT teachers' TPACK level is significantly higher than science, math, and classroom teachers' levels considering TPACK, pedagogical content knowledge (PCK) and technology knowledge (TK) domains."

Saralar, I., Isiksal-Bostan, M., & Akyuz, D. (2018). The evaluation of a pre-service mathematics teacher's TPACK: A case of 3D shapes with Geogebra. *International Journal for Technology in Mathematics Education*, 25(2), 3–21. Retrieved from <http://eds.b.ebscohost.com/abstract?site=eds&scope=site&jrnl=17442710&AN=130923581&h=5lKpmStv4UplEsiRfKLDuJyasf9MB2TCjzVzPiYcCX4nQMvGodXKbOaTg7jP16kQFC037%2bvCskufzuo%2fcxBuxg%3d%3d&crI=f&resultLocal=ErrCrINoResults&resultNs=Ehost&crIhashurl=login.aspx%3fdirect%3dtrue%26profile%3dehost%26scope%3dsite%26auhttype%3dcrawler%26jrnl%3d17442710%26AN%3d130923581>

Abstract: "This paper describes a pre-service mathematics teachers' technological pedagogical content knowledge (TPACK) during her school experience. This study focuses on how the participant taught different views of three-dimensional objects in a private middle school. It is a descriptive case study in which the data was collected through semi-structured interviews, observations, lesson plans and corresponding GeoGebra files. The data analysis showed that there is an increase in the technological pedagogical content knowledge of the participant during the practicum. In other words, the findings of the study reveal that there was an observable development in the participant's skills in teaching with technology during the school experience course which helped the improvement of her TPACK. It is proposed that the school experience helped her develop her knowledge of teaching in dynamic geometry-integrated mathematics classrooms. This claim and resulting implications for practice are unpacked in further detail."

Sensoy, O., & Yildirim, H. I. (2018). Impact of technological pedagogical content knowledge based education applications on prospective teachers' self-efficacy belief levels toward science education. *Journal of Education and Training Studies*, 6(10), 29–38. <https://doi.org/10.11114/jets.v6i10.3433>

Abstract: "The purpose of this study is to examine the impact of technological pedagogical content knowledge-based education applications on prospective teachers' self-efficacy belief levels toward science education. The study was conducted on the 3rd year prospective science teachers of a public university and continued for 14 weeks. In the study, quasi-experimental method, pretest-posttest experimental design with a control group. The research was performed in the Instructional Technologies and Material Design courses during the education year of 2015-2016. In the research, one of the classes of the 3rd years was determined as a control and another one as an experimental group. There were 65 students (control=33, experiment=32) in the study group. As the instrument of data collection, the self-efficacy belief levels toward science education scale was used and the scale was applied as pretest, posttest

and follow-up test. Cronbach Alpha (α) consistency coefficient of the scale is 0.82. To the students in the experimental group, the education applications based on Technological Pedagogical Content Knowledge were introduced by the researcher; the courses were made with these applications and they were requested to use these applications that they learned in the materials that they were making. As for the control group, the courses were made with the current curriculum. The research results show that the self-efficacy belief levels of prospective science teachers toward science education design is higher in the experimental group than the students in the control group.”

Sintema, E. J. (2018). Evolution of pre-service primary teachers’ TPACK-math profiles. *Journal of Global Research in Education and Social Science*, 11(4), 166–175. Retrieved from <http://www.ikpress.org/abstract/6996>

Abstract: “In this digital era with a rapid evolution of technology, it is a must for teachers and pre-service teachers to have information and skills necessary for the use of technology in mathematics instruction. The Technological Pedagogical Content Knowledge (TPACK) framework was used at various levels of research related to use and integration of different technologies in instruction. However, studies focusing on pre-service primary teachers’ development of TPACK-Math have not provided comprehensive descriptions of pre-service teachers’ TPACK-Math development from the time of entry into their Bachelor’s degree programme until the time they leave university. TPACK-Math implies the application of TPACK to the teaching and learning of mathematics. In TPACK-Math the focus is on the relevance of TPACK skills in a mathematics classroom. Therefore, the purpose of the current study was to investigate the evolution of pre-service primary teachers’ technological pedagogical content knowledge in relation to their grade level (i.e. year of study) as a variable of analysis. The study employed the survey model with data collected from 166 first, second and fourth year male and female students from the Didactics of the Experimental Sciences, Social Sciences, Mathematics Department of the Faculty of Education and Social Work at the University of Valladolid in Spain. As a data collection tool, a 59-item, 8-factor and five-point Likert type Technological Pedagogical Content Knowledge Scale were used. The one-way Analysis of Variance was utilized to test for statistical significance. According to the results of the ANOVA test, there was a significant difference of pre-service teachers’ TPACK-Math profile based on their grade level.”

Sintema, E. J., & Phiri, P. A. (2018). An investigation of Zambian mathematics student teachers’ technological pedagogical content knowledge (TPACK). *Journal of Basic and Applied Research International*, 24(2), 70–77. Retrieved from <http://www.ikpress.org/issue/996>

Abstract: “Zambia is a developing country in Southern Africa faced with numerous social, economic and environmental problems. Faced with the challenges of over enrolment in schools and tertiary institutions of learning, the country continues to account for low levels of technology in the education sector. With the increasing need for integration of technology during lessons in classrooms world over, the purpose of this study is to determine whether mathematics student teachers’ TPACK significantly differ depending on gender and grade level.

The study also aims to examine if mathematics student teachers' TPACK sub-factors differ significantly based on gender and grade level. The study used a survey to gather data from 126 male and female student teachers enrolled on a Bachelor of Education degree programme at Mukuba University in Kitwe, Copperbelt province of Zambia. The study used a TPACK questionnaire, Schmidt et al. [1], with a Cronbach alpha reliability coefficient of 0.96 as a data collection instrument. Data analysis was performed using "IBM" SPSS version 20. Independent samples t-test was conducted to determine if there was a significant difference in the student teachers' TPACK scores based on gender and grade level. Results indicated that there is a significant difference in the TPACK scores of student teachers based on gender but showed no significant difference based on grade level. As regards the TPACK sub-factors, the results showed a significant difference in TK, PK and PCK knowledge bases of the student teachers based on gender while there was no significant difference recorded in their CK, TCK, TPK and TPACK knowledge bases. Further, the results revealed a significance difference in the PK knowledge base of the student teachers based on grade level while a no significance result was shown on TK, CK, PCK, TCK, TPK and TPACK knowledge bases of the students and teachers in relation to grade level."

Sousa, S. O., Lima Tercariol, A. A., & Christino Gitahy, R. R. (2017). Technological pedagogical content of knowledge: Building of concepts and teaching skills. *Perspectiva*, 35(4), 1215–1239. Retrieved from <https://doaj.org/article/2186ea37e04b46228a798881df7655a4>

Abstract: "This article aims to investigate how the Information and communications technology (ICT) are integrated into teaching practices according to the theory of Technological Pedagogical Content Knowledge (TPACK). Participated in the research 44 students enrolled in one subject of Introduction to Computing offered in the Licensure Course of Chemistry from a State University. To the data collection, it was considered the interactions among students, which occurred in the Virtual Learning Environment and in the Facebook social network, besides the reports and materials produced by the students and the questionnaires self-assessment of performance. The data collected showed that the TPACK used as a theoretical framework to address content, combined with an active methodological approach (Blended Online POPBL), allowed the students, future teachers, improve their understanding of how are developed the teachers' pedagogical practices with knowledge in the technology use articulated with their curricular domain."

Spante, M., Karlsen, A. V., Nortvig, A-M., & Christiansen, R. B. (2014). Cross-border collaboration in history among Nordic students: A case study about creating innovative ICT didactic models. *IAFOR Journal of Education*, 2(2), 55–85. <https://doi.org/10.22492/ije.2.2.02>

Abstract: "Gränsöverskridande Nordisk Undervisning/Utdanelse (GNU, meaning Cross-Border Nordic Education), the larger Nordic project, under which this case study was carried out, aims at developing innovative, cross-border teaching models in different subject domains in elementary school, including mathematics, language, science, social studies and history. This paper provides an in-depth description and analysis of how four social science and history

elementary school teachers and their 70 students (5th–7th grades) worked together between November 2011 and December 2012. Previous research regarding the use of information and communication technology (ICT) in history education in elementary schools is limited, thus calling for contemporary investigations in this particular subject domain. The Technological Pedagogical Content Knowledge (TPACK) model, enhancing the combination of teachers’ pedagogical, content and technical competence, was used as the analytical framework, together with nation-specific curricula and the European Union’s recommendations regarding students’ skills for lifelong learning. A range of empirical materials was analyzed, such as classroom observations, students’ video productions, texts and photos distributed and shared on a mutual blog, real-time interaction and teachers’ communication. The teachers tried out two ICT didactic models. In the asynchronous model, the major focus was on the form and content of the video productions being shared, whereas work with the synchronous model concentrated on the content and quality of the communication. Notwithstanding obstacles, cross-border collaboration provided added value. The nation-specific differences triggered curiosity and motivation to produce digital presentations of history content to be understood by the students in the three nations, facilitating goal fulfillment in communication skills and digital competence. However, achieving subject-specific goals in history remained challenging.”

Syaifudin, M., & van Rensburg, H. (2018). Considerations for the development of computer-assisted language learning (CALL) teacher training course: A practical experience from a CALL course development in Indonesia. *Arab World English Journal*, 9(4), 84–108. <https://dx.doi.org/10.24093/awej/call4.7>

Abstract: “The need for technology training for teachers will keep on growing in line with the development of technology itself. Although technology nowadays is more and more user friendly and may need no specific training on how to use it, teachers need to possess the knowledge that underpins the idea of using it for teaching and learning process. Teachers need to have solid pedagogical knowledge on how to use the technology to deliver contents to their students. Therefore, a technology-training course for teachers is always necessary. This paper presents the partial results of a design based study/research (DBR) on the development of online technology training for teachers with focus on CALL in Indonesia. Questions regarding factors affecting online CALL course and ways to improve the course in terms of training materials, activities, as well as the administration of the training are addressed in the study. Based on the study, some considerations on how to design such technology-training course are proposed. The considerations are ranging from aspects associated with technology competence for teacher standards, constructivism in online learning, adult learning theory, online instructional models, the technology, pedagogy and content knowledge (TPACK) framework and open educational resources (OER). Information regarding those aspects will be useful to assist other CALL teacher training course developers later to inform their decision in the development of the course which is based on a good theoretical understanding as well as highly practical in learning activities.”

Tanak, A. (2018). Designing TPACK-based course for preparing student teachers to teach science with technological pedagogical content knowledge. *Kasetart Journal of Social*

Science. Advance online publication. Retrieved from
<https://www.sciencedirect.com/science/article/pii/S2452315118301000>

Abstract: “The rapid technological advancement of the twenty-first century has transformed the ways in which we teach and learn. As a result, student teachers should be equipped to integrate technology into classroom practices, especially for specific subject matter. This research examined the effect of a Technological Pedagogical Content Knowledge (TPACK)-based course on 15 student teachers' TPACK. The research instruments included a questionnaire that covered the four components of TPACK, as well as lesson plans designed and implemented by the student teachers. Descriptive statistics and inductive analysis were used to analyze the data. The findings indicated that a basic understanding of technological knowledge was observed among the participants, rather than a more integrated knowledge of TPACK. The pedagogical knowledge component had a larger impact on student teachers' TPACK. The student teachers with low levels of PK were not able to make the pedagogy-technology linkage even if they had high TK. Moreover, the student teachers demonstrated a combination of technology, pedagogy, and content knowledge, rather than an integration of the three. Most student teachers used technology as a motivation booster, but no ICT-infused learning activities were used to encourage students to do scientific exploration or concept construction. The course should provide opportunities for student teachers to use technology to incorporate more inquiry experiences and more emphasis on PK revealed as a prerequisite for developing TPACK. Future studies related to science teachers' TPACK should develop a TPACK-based course that draws upon transformative viewpoints and inquiry-based instruction. Moreover, the technology course in teacher education programs should not only be conceptually integrated but also require enactment of technology-enhanced lessons.”

Tatar, E., Aldemir, R., & Niess, M. L. (2018). Teaching geometry in the 21st century: Investigating teachers' technological pedagogical content knowledge levels. *Journal of Computers in Mathematics & Science Teaching*, 37(2), 111–129. Retrieved from
<https://www.learntechlib.org/primary/p/174326/>

Abstract: “This qualitative case study investigated teachers' Technological Pedagogical Content Knowledge (TPACK) for teaching high school geometry in Turkey. Four TPACK components and their corresponding five TPACK level descriptions were used for examining three geometry teachers' TPACK through their technological instructional plans, microteaching experiences, and semi-structured interviews. While the interviews suggested TPACK thinking among the TPACK levels, the microteaching experiences and instructional plans revealed a level prior to the formal TPACK levels. A pre-recognizing level indicated that while teachers may envision ways to integrate technologies in their instruction, they are less likely to implement these ideas in their instruction.”

Thomas, H. (2018). Powerful knowledge, technology and education in the future-focused good society. *Technology in Society*, 52, 54–59.
<https://doi.org/10.1016/j.techsoc.2017.09.005>

Abstract: “I contend that access to powerful knowledge is the cornerstone of education in the Good Society. Such powerful knowledge is accessed by students through engagement in vertical discourse. I adopt Bernstein's definition of vertical discourse as a form of pedagogical discourse that enables students to link symbolic knowledge, derived from a context, to other symbolic knowledge structures in a vertical manner. Engagement in vertical discourse enables students to transcend an immediate context to examine social classifications and control mechanisms that are inherent in pedagogical discourse. In the process, both education and technologies integrated into the curriculum are revealed to be ideologically charged. To illustrate this, I use the example of the study of augmented reality in a Postgraduate Certificate of Applied Practice. I then make suggestions regarding engagement in vertical discourse, so that practising teachers enrolled in the course are enabled to recognise and engage with the classifications and control mechanisms inherent in technological discourse. Finally, I suggest that engagement in vertical discourse is not an inevitable aspect of 21st Century learning design. Rather, engagement in vertical discourse and access to powerful knowledge have to be incorporated consciously in learning design by teachers who are familiar with the territory.”

Tzavara, A., Komis, V., & Karsenti, T. (2018). A methodological framework for investigating TPACK integration in educational activities using ICT by prospective early childhood teachers. *Italian Journal of Educational Technology*, 26, 71–89. Retrieved from <http://www.learntechlib.org/p/184091/>

Abstract: “Questo articolo propone un framework metodologico per studiare come il modello della conoscenza tecnologico-pedagogico-disciplinare (TPACK) viene integrato nella progettazione e implementazione di attivit educative. Il framework proposto stato elaborato e applicato nel contesto di un corso nell\u2019ambito del quale gli studenti di un programma universitario per la formazione iniziale di insegnanti della prima infanzia integrano il TPACK nella progettazione e implementazione di attivit che usano le tecnologie della comunicazione e dell\u2019informazione (TIC) e il grado in cui lo fanno. Lo specifico framework metodologico stato progettato tenendo in considerazione, per ciascuna parte del corso (insegnamento, progettazione, implementazione), le componenti costitutive su cui si fonda TPACK e per analizzare e ricombinare queste componenti attraverso l\u2019uso di metodi e strumenti appropriati, come l\u2019analisi tematica per l\u2019elaborazione qualitativa e l\u2019analisi dei dati multidimensionale. I risultati mostrano che, applicando il nostro approccio metodologico iniziale, diversi elementi, per esempio le caratteristiche e le specificit particolari di ogni materia dell\u2019educazione prescolare, devono essere rivisitati.”

Usak, M. (2018). Past, present and future of journal of Baltic science education. *Journal of Baltic Science Education*, 17(3), 364–366. Retrieved from <http://www.scientiasocialis.lt/jbse/?q=node/667>

Abstract: “The author reflects on the articles about science education that were published in the journal in the past 10 years as of May 2018. Topics discussed include inquiry-based learning, science, technology, engineering, and mathematics (STEM) education, the technological

pedagogical content knowledge (TPACK) theory, the trends in international mathematics and science study (TIMSS), and programme for international student assessment (PISA).”

Van der Stap, N. (2017). Ensuring effective flexible learning through blended learning. *Journal of Systemics, Cybernetics and Informatics*, 15, 7–9. Retrieved from <https://doaj.org/article/e76fc988f02c4027acfd93bf5a797188>

Abstract: “This paper discusses how Flexible Learning can be implemented through blended learning at the teacher trainer college of the University of Applied Sciences, Utrecht, Netherlands. To ensure quality blended learning programmes, it is essential that teachers developing blended learning courses are trained, particularly in relation to applied methodology. To understand how best to implement blended learning at the teacher trainer college extensive research was carried out, the findings of which were made available to the University's teachers in the form of a content-based, yet hands-on blended training programme with TPACK as its exit point. The student results showed a marked improvement when following a blended learning course developed by teachers who were trained in the programme as compared to blended learning courses developed by non-trained teachers, In addition, the results of the blended courses (which were developed by trained teachers) showed a vast improvement of the non-blended courses, it's so called 'regular' variant.”

Yilmaz, R., Karaoglan Yilmaz, F. G., & Ozturk, H. T. (2017). Examining the relationship between pre-service teachers’ educational technology and material development competency and their techno-pedagogical competency. *Global Journal of Information Technology: Emerging Technologies*, 7(3), 86–91. Retrieved from <https://sproc.org/ojs/index.php/gjit/article/view/2830>

Abstract: “Although digital technologies signify innovation and prestige, adopting such technology in teaching praxis requires deeper understanding and examination of technology integration with different variables. This study examines the relationship between pre-service teachers' material development competency as a proficiency in which technology is heavily integrated into teaching activities and their techno-pedagogical competency. The survey method used in this study had 202 pre -service teachers enrolled in an instructional technologies and material design course delivered in a Turkish state university. Application-based educational technology and material development competency scale and techno-pedagogical competency scale were employed. The results showed a positive relationship between both the scales. Increase in proficiency in the techno-pedagogical competency showed an increase in the pre -service teachers' proficiency in technology enhanced material development skills. Based on these findings, issues in developing pre -service teachers' technology enhanced material development skills within the context of their techno-pedagogical competency are discussed.”

Young, J. J., Park, S., & Lim, E. (2018). Factors influencing preservice teachers’ intention to use technology: TPACK, teacher self-efficacy, and technology acceptance model. *Journal of Educational Technology & Society*, 21(3), 48–59. Retrieved from

<https://pdfs.semanticscholar.org/2658/259be39a45527421624c04a0d33e52db9647.pdf>

Abstract: “This study aimed to investigate structural relationships between TPACK, teacher self-efficacy, perceived ease of use, and perceived usefulness for preservice teachers who intend to use technology, based on the Technology Acceptance Model (TAM). A total of 296 responses from the College of Education from three Korean universities were analyzed by employing the structural equation modeling methods. The results indicated that preservice teachers' TPACK significantly affected teacher self-efficacy and perceived ease of using technology. The teachers' TPACK also positively influenced their perceived ease of using technology and perceived usefulness of technology in the classroom. Finally, teacher self-efficacy, perceived ease of use, and perceived usefulness of using technology affected teachers' intention to use technology. However, TPACK did not directly affect their intention to use technology. Based on the findings, we discuss implications and suggest future research directions for preservice teachers' intention to use technology.”

Yurdakul, I. K. (2018). Modeling the relationship between pre-service teachers' TPACK and digital nativity. *Educational Technology Research & Development, 66*(2), 267–281. <https://doi.org/10.1007/s11423-017-9546-x>

Abstract: “The purpose of this study is to build a structural equation model that predicts the relationship between Technological Pedagogical Content Knowledge (TPACK) competencies and digital nativity. The data was collected from 1493 Turkish pre-service teachers. Two instruments were used in the data collection; a TPACK-deep scale and a Turkish adaptation of the Digital Native Assessment Scale (DNAS). Structural equation modeling (SEM) was conducted to investigate the assumption that digital nativity was a predictor of TPACK competency. It was found that pre-service teachers considered themselves to have high-level ability in both digital nativity and TPACK competency. The most prominent finding of the study was that digital nativity is a significant predictor of TPACK competency. Based on the research findings, implications for practice and suggestions for future studies are also provided.”

Chapters

Angeli, C., & Valanides, N. (2018). Knowledge base for information and communication technology in education. In J. Voogt, G. Knezek, R. Christensen, & K. W. Lai (Eds.), *Second handbook of information technology in primary and secondary education* (pp. 1–17). https://doi.org/10.1007/978-3-319-71054-9_26

Abstract: “This chapter systematically explores the knowledge base required by teachers for the effective application of ICT in education. The Technological Pedagogical Content Knowledge (TPCK) framework and developments in associated research are reviewed. The authors suggest an alternate approach for better understanding the knowledge base required for application of ICT in education by providing a theorization about technological knowledge in relation to how a teacher realizes and actualizes the pedagogical affordances of technological tools in teaching

and learning. The authors conclude that this body of knowledge cannot exist outside the frame of reference of the teacher, can be developed through systematic learning activities targeting or facilitating its development, and grows with ongoing participation or involvement in valuable professional experiences. Implications for the nature of TPCK and its development are discussed.”

Castillejos Lopez, B., Torres Gastelu, C. A., & Lagunes Dominguez, A. (2018). El entorno personal de aprendizaje y el modelo TPACK en la mejora educativa. In J. J. Vales Garcia, J. Angulo Armenta, R. I. Garcia Lopez, & C. O. Acosta Quinoz (Eds.), *Aplicaciones de la tecnologia en y para la educacion* (pp. 51–77). Obregon, Sonora, Mexico: Instituto Tecnologico de Sonora.

Abstract: “El documento analiza las posibilidades de relacionar el modelo del Conocimiento Tecnológico Pedagógico del Contenido (TPACK) con el Entorno Personal de Aprendizaje (PLE) en la educación formal. Un estudio documental que parte de la caracterización de ambos enfoques y se centra en la valoración de sus implicaciones didácticas desde una óptica integral. Para tal análisis se consultan estudios empíricos tanto de PLE como TPACK. Como conclusiones se obtiene que ambas propuestas podrían generar sinergia y ser una estrategia de mejora educativa. Sin embargo, es importante resaltar que tales acciones dependerán del contexto donde se desarrolle el proyecto; las competencias digitales y las habilidades de aprender a aprender de docentes y estudiantes; así como del grado de participación de las autoridades para promover este tipo de emprendimientos educativos.”

Chandra, V., & Tangen, D. (2018). Demonstration of twenty-first century skills through an ICT teaching problem: Experiences of pre-service teachers in a Fijian classroom. In T. Hall, T. Gray, G. Downey, & M. Singh (Eds.), *The globalisation of higher education* (pp. 183–195). Retrieved from https://link.springer.com/chapter/10.1007/978-3-319-74579-4_11

Abstract: “University students can become more proactive in dealing with some of the issues associated with globalization. Through this experience, they can demonstrate twenty-first century skills, which include critical and creative thinking, collaboration, and communication (the “4Cs”). This chapter focuses on pre-service teachers ($N = 7$) who provided their service to a school on a remote island in Fiji. The students collaborated in cross-faculty teams to design and deliver classroom activities (based on the local curriculum) that showcased the use of information and communication technology (ICT). Data gathered through participant observations and their journals showed evidence of the pre-service teachers applying their disciplinary knowledge and the 4Cs to solve seen and unseen problems. In the process, they grappled with some of the complexities of globalization.”

Crisan, C. (2018). Supporting teachers in developing their RiTPACK through using video cases in an online course. In J. Silverman & V. Hoyos (Eds.), *Distance learning, E-learning and blended learning in mathematics education* (pp. 165–181). https://doi.org/10.1007/978-3-319-90790-1_10

Abstract: “In order to help the participants on our online course engage critically with research to reflect on whether and how digital technology supports students’ understanding and learning of mathematics, a trial focused on the use of online video cases was implemented in a newly designed online course. In this chapter, we report on the use of video cases with the course participants and on the potential of using these videos with the aim of supporting the development of the participants’ Research informed Technological Pedagogical Content Knowledge (RiTPACK), with a particular focus on how the digital environment supports students’ mathematical work.”

Polly, D. (2018). Leveraging elements of understanding by design to develop elementary education candidates’ TPACK in mathematics. In D. Williams, & N. N. Harkness (Eds.), *Diverse learning opportunities through technology-based curriculum design* (pp. 147–162). <https://doi.org/10.4018/978-1-5225-5519-3.ch007>

Abstract: “Technology access is at an all-time high in schools in the United States. However, research continues to document barriers to using technology in mathematics in ways that support higher-level thinking and lead to student achievement. This study examined teacher candidates’ work samples in a course focused on instructional design and technology integration. The inductive analysis of candidates’ work indicated that candidates demonstrated instructional design skills related to planning mathematics units, lessons, and personalized learning playlists. TPACK development was evident at the end of the semester, but barriers related to content knowledge and pedagogical content knowledge were evident in the early and middle stages of the semester. Implications for continuing to examine the development of candidates’ instructional design and TPACK are also shared.”

3. Recent TPACK-Related Dissertations and Theses

Cubos, B. A. C. (2018). *Training of teachers: Analysis of training in platforms through the TPACK model* (Doctoral thesis, National Pedagogical University, San Luis Potosí, Mexico). <https://doi.org/10.13140/rg.2.2.21252.58245>

Abstract (partial): "From the year 2014, the country faces the professionalization of teachers, having two profiles in its ranks, those who are graduates of the Normal Schools with the knowledge about the different disciplines in the educational field and those who are graduated of the different schools with the apprehension about the subject, this is where the difference of knowledge between one profile and another is marked. Under this premise, is identified the knowledge gap of each of them towards the ideal profile represented by the parameter and indicators of comprehension and skills that regulates and standardizes the Secretarial of Public Education of the United Mexican States. Given this scenario, the teacher is involved in the use and integration of ICT and both types of teachers must, as an add value, have knowledge and technological skills, detecting another comprehension gap to close, in the case of the use of educational virtual platforms another profile and role of tutor is defined, where the teacher is required to possess knowledge and technological, disciplinary, educational, motivational and

affective skills, being this other vacancy of knowledge to cover “The accelerated advance in scientific and technological knowledge and the demands of coexistence in the school community and economic and social development, have meant new demands on schools and the work of teachers” says the document of the Educational Reform (2013), undoubtedly we face an educational revolution that will produce new technological projects in education and where the teacher will participate in both roles as a teacher and student in b-learning and virtual education, at this day in the Mexican educational model that he is immersed in Constructivism. The objective that creates and gives the existence to this research is to perform an analysis of the training of teachers on the platform through the TPACK Model, it is considered urgent to know about the current status of knowledge held by groups of teachers who teach or take the training course of tutors for teachers of new entrance given by a Public University of Mexico mediated by educational platforms located favorably in 29 states of the Mexican Republic. The present work analyzes the TPACK Model tool in its dimensions and sub-dimensions of knowledge and now analyzes the current educational context which Mexico is going through, taking as a basis for integration: the Educational Reform, the use of virtual platforms focusing on knowledge technological, as well as the knowledge about the learning styles of their students looked through the seven resources of Shulman (2005) and the product is an instrument TPACK model included in the current educational context in Mexico like survey on Likert scale. This instrument was applied to 6,667 teachers of which only 1,822 self-evaluated their knowledge, these teachers currently serve as tutors who accompany the new teachers who enter the educational system of the entire Mexican Republic from 2015 to this date, transmitting their knowledge of content, pedagogical, didactic and in some cases technological, in order to homologate the training of the two types of teachers that we have in the country derived from the Educational Reform, this homologation is considered to affect on a direct way the knowledge of the teachers and for this reason is taken into account for being the ideal sample for the analysis of teacher training."

Kontkanen, S. (2018). *Starting points of pre-service teachers' technological pedagogical content knowledge (TPACK): Introducing a proto-TPACK model* (Doctoral dissertation, University of Eastern Finland, Joensuu, Finland). Retrieved from http://epublications.uef.fi/pub/urn_isbn_978-952-61-2808-5/index_en.html

Abstract: “This dissertation focuses on pre-service teachers and upper secondary school students as users of Information and communication technologies (ICT) in education from the point of view of the Technological Pedagogical Content Knowledge (TPACK) framework. While the surrounding world and changing school environment requires teachers in training to use ICT meaningfully in their teaching, there is a need to discover how pre-service teachers develop their abilities and knowledge about integrating technology into their studies. The TPACK framework is a widely used theoretical perspective for investigating teachers' professional knowledge about ICT use in educational settings. TPACK is an important area of research, because until now there has not been a straightforward way to develop teachers' TPACK in practice. Hence, the aim of this dissertation is to provide insights into the starting points of pre-service teachers' TPACK, its development and factors influencing its development.

The empirical research in this dissertation consists of three studies undertaken between the years 2010 and 2016, and published in international research journals. The first two surveys concentrate especially on prior experiences, skills and knowledge of ICT use in education, i.e. the foundation for building up TPACK. In Study I, pre-service teachers (n= 146) were asked to reveal their perceptions of ICT use in education through open-ended questions. Study II explored third-year, upper secondary school students' (n= 84) perceptions of how they see the use of iPads for teaching and learning based on their three years of experience. The target group, third-year upper secondary school students, was chosen in order to find out what kind of skills and readiness we can expect from pre-service teachers entering teacher training, while it has been reported that school experiences strongly affect pre-service teachers' beliefs and assumptions about teaching and learning. This was done by collecting empathy-based stories from students and analysing reflective group discussions. The third study discusses experiences of ICT use in teacher education, i.e. the foundation for the development of TPACK in teacher education. Study III, concentrated on pre-service teachers' (n= 20) experiences of a Second Life experiment during their sex education course as part of their teacher education. The data consist of pre-service teachers' empathy-based stories and reflective group discussions. All the data in these studies were analysed using qualitative methods. In Studies I and III, the data was analysed using qualitative theory-guided content analysis where the TPACK framework was the guiding theory. In Study I, also some quantitative methods with descriptive statistics were used. In Study II, qualitative thematic analysis was used.

Results in this dissertation reveal an unsure foundation on which pre-service teachers start to build their TPACK. This implies they have limited scope to realise different technological possibilities and especially a lack of innovative views of technology use in education. There is a general preference for teacher-centred pedagogy, and few ideas about connecting technology, pedagogy and especially content. There is also variation among pre-service teachers' knowledge in different TPACK constructs. Whereas the results reveal challenges in developing TPACK, they also show that students have a readiness to use ICT in education, and some ideas which can be turned into useful skills. Students' learning experiences, and modelling of pedagogically justified ICT use, are important means to this end.

To help pre-service teachers in becoming proficient in connecting technology, pedagogy and content in their teaching, there is a need for a consistent and coordinated model in teacher education. Therefore, results in this dissertation encourage the suggestion that pre-service teachers should be evaluated through a 'proto-TPACK framework', which takes earlier experiences of technology, pedagogy and content into consideration, as the basis for professional development towards a more mature TPACK. This dissertation presents ideas for developing teacher education using the proto-TPACK framework based on results from earlier studies as well as results from the three studies in the dissertation."

Lowder, L. (2013). *Building technological pedagogical content knowledge (TPACK) among pre-service teachers in a science methods course using action research* (Doctoral dissertation). Available from ProQuest Dissertations & Theses Global database. (UMI No. 3647924)

Abstract: “In this study I investigated the problem of helping my pre-service elementary science teachers to develop the skills necessary to intentionally design effective lessons with technology integration within content areas. I needed to develop a strategic plan of action to facilitate the development of these skills among my students. I developed a teacher education course to support the growth of technological, pedagogical, content knowledge (TPACK) among pre-service teachers within a science methods course and, through carefully planned action research, evaluated the impact of the course and how it might be improved for future semesters. Using TPACK surveys, learning activities, and an assessment rubric, pre-service teachers were introduced to the TPACK framework in an effort to guide their lesson plan development. Researcher reflections and lessons learned provided direction for changes in future science methods courses and to improve the TPACK development of my students. This research aimed to answer two questions: In what ways will my pre-service teachers’ TPACK knowledge change during a carefully designed science methods course? and What teaching strategies and learning activities will support TPACK development among pre-service teachers in a science methods course? This research study is significant in the field of education as teachers are continually challenged to meet the needs of a diverse population of increasingly digital learners. In order to meet these teaching and learning needs, graduates of teacher education programs must become competent in lesson design that effectively integrates appropriate technology with content, in pedagogically sound ways that supports student learning.

Data collection included a pre and post TPACK survey, pre and post lesson plans, exit interviews of pre-service teachers, and a researcher reflection journal. I utilized analysis of the TPACK survey to compare paired data from each survey category. The pre and post lesson plans were analyzed and evaluated using content analysis with pre-set coding and comparison of lesson plans using the TPACK-based coding criteria with percentage comparison. Researcher reflections and exit interviews of pre-service teachers were analyzed using content analysis with emergent coding. I found that pre-service teachers’ TPACK knowledge increased in key areas, students’ general understanding of technology integration practices increased, evidenced through pre and post lesson plan submissions, and students’ misconceptions about the way to go about using technology in lesson planning (TPACK) were clarified throughout the course. The teaching strategies and learning activities that supported TPACK development among the pre-service teachers in my science methods course included assigned readings, videos, specific content resources, scaffolding of class activities, and the introduction of the TPACK lesson plan format. These and other resources guided students to revise previous lesson plans and develop new lesson plans as they put the TPACK components together. Students interacted collaboratively through peer reviews and also recommended strategies for strengthening TPACK development in future courses.

These results have implications that reach beyond my science methods classroom for pre-service teachers. Applicable in many education settings, the recommendations for TPACK development can benefit other courses within the school of education that this course was taught, as well as schools of education elsewhere who are working to prepare teachers for today’s classroom.

Making research-informed decisions about changes in technology integration practices is an urgent issue in our education systems. With such an emphasis on the use of technology for

instruction, it is vital that teachers be knowledgeable about ways to maintain research-based pedagogy amidst the infusion of technology in the classroom.”

Manos, E. (2018). *Technology integration and use in elementary mathematics methods courses for pre-service teachers* (Doctoral dissertation). Retrieved from https://scholarworks.umass.edu/cgi/viewcontent.cgi?article=2279&context=dissertations_2

Abstract: “According to the National Educational Technology Plan 2010, technology should be incorporated into teaching methods courses and field experiences and not just in stand-alone technology courses. The teacher preparation programs would provide technology-based learning experiences to prepare pre-service teachers to effectively use technology to improve learning, assessment, and instructional practices. However, the problem is that graduate pre-service teacher preparation programs do not adequately prepare pre-service teachers to incorporate technology into their teaching. Furthermore, the teacher preparation programs lacked opportunities for the pre-service teachers to experience technology as learners beyond the stand-alone course in technology. Research shows the need for pre-service teachers to experience technology as learners so that they can use their knowledge to create learning environments of greater understanding in their future classrooms, specifically in the area of mathematics. Technological pedagogical content knowledge is knowledge of how to incorporate technology into the teaching of content to promote student learning (Koehler & Mishra, 2009). This study investigated the ways in which math methods courses that provide technology-based learning experiences for pre-service teachers enable them to gain the technological pedagogical content knowledge necessary for effective teaching. This study investigated two elementary methods courses where technology integration was in place. Informants included the instructors and pre-service teachers in each course. A qualitative multiple case study methodology utilizing observations of methods courses, interviews with faculty and pre-service teachers, and collection of teaching and learning artifacts was used. Additionally, this study focused on both the faculty and the students’ use of instructional technology for enhancing the teaching and learning.

Furthermore, Massachusetts has a technology self-assessment tool that can be utilized by teachers to assess their own technology proficiency (Massachusetts Department of Elementary and Secondary Education, 2010). The criteria in Standard 3, Teaching and Learning with Technology, was used to assess the instructors. The analysis also described how faculty used and modeled instructional technology in the methods courses to enhance teaching and learning.”

Marshall, D. D. (2018). *Blended learning as an instructional strategy to improve academic performance* (Doctoral dissertation). Available from ProQuest Dissertations & Theses Global database. (UMI No. 10830542)

Abstract: “Higher education institutions in Barbados have introduced blended learning as a strategy to improve students’ academic performance and achievement. Despite the implementation of blended learning, the poor student performance and outcomes persist. The

purpose of this qualitative case study was to explore how teaching processes and practices at the institution have influenced blended learning to improve student achievement. A social constructivist framework was used to guide the study. The research question addressed the practices and processes used by teachers to increase student learning and performance in a blended learning environment. Data collection involved semistructured interviews with 6 teachers from the study site. Lean coding analysis yielded 4 themes: student engagement, student success, pedagogical and technological challenges, and teacher professional development. Findings were used to create a teacher professional development program for local stakeholders with an emphasis on pedagogical best practices and processes for creating and sustaining an effective blended learning environment. Findings may be used to improve student engagement and academic success at the study site.”

Martin, C. L. (2018). *Correlational analysis of self-efficacy and technological pedagogical content knowledge of board certified teachers* (Doctoral dissertation). Available from ProQuest Dissertations & Theses Global database. (UMI No. 10786764)

Abstract: “The purpose of this quantitative, correlational study determined if and to what extent there were a relationship between self-efficacy and the four-integrated technological, pedagogical and content-area knowledge competencies (TPACK) for NBCTs in the state of Arizona. Self-efficacy theory and transformative learning theory grounded this study. The study sample consisted of 84 NBCTs. Spearman’s ρ , Kendall’s τ_B and Pearson’s r were used to analyze the data. The first research question determined a statistically non-significant relationship between self-efficacy and technological knowledge: $r_t = 0.136$, $r_s = 0.197$ and $r = 0.106$, $p > 0.05$. The second question demonstrated a small statistically significant positive correlation between self-efficacy and technological pedagogical knowledge: $r_t = 0.212$, $r_s = 0.301$ and $r = 0.242$, $p < 0.05$. The third question showed small to medium statistically significant positive correlation between self-efficacy and technological content-area knowledge; $r_t = 0.251$, $r_s = 0.332$ and $r = 0.268$, $p < 0.05$. The fourth question showed a small to medium statistically significant positive correlation between self-efficacy and technological, pedagogical, content-area knowledge; $r_t = 0.247$, $r_s = 0.356$ and $r = 0.265$, $p < 0.05$. This study provided additional information to help school administrators, professional development leaders, university curriculum designers and the NBPTS organization strengthen and understand effective teacher technological training and professional development for NBCTs.”

Mayled, L. H. (2018). *Low SES student achievement: A quantitative study of technology-enabled courses active learning in secondary STEM courses* (Doctoral dissertation). Available from ProQuest Dissertations & Theses Global database. (UMI No. 10838919)

Abstract: “This retrospective, quantitative, causal-comparative study was conducted to understand if there was a statistically significant difference in student achievement (gain scores and pass/fail rates) between low SES STEM students who received increased technology-enabled active learning (TEAL) instructional techniques and low SES STEM students who did not. To answer the study questions, student gain scores and pass/fail reports were reviewed for 343 high school students at an Urban Title One High School in the Southwestern United States.

The results from an independent-samples t-test on student gains scores showed that the control group scored lower on the Galileo gain scores ($M = 6.58$, $SD = 8.28$) than the intervention group ($M = 10.67$, $SD = 8.04$), a statistically significant difference, $M = -4.09$, 95% CI [-5.84 to -2.35], $t(341) = 4.61$, $p < .001$. The results of a chi-square test on the cohort group and pass/fail rates demonstrated a statistically significant association between the cohort group (control or intervention) and the pass/fail rates of students $\chi^2(1) = 4.157$, $p = .041$. The results suggest that implementation of TEAL instructional techniques could be beneficial in improving academic achievement for low SES STEM students and support the theoretical frameworks of TPACK and Constructivism pedagogy in low SES STEM classrooms.”

Sedique, A. N. (2018). *School district technology awareness: A descriptive study identifying implications for the 21st century teaching and learning* (Doctoral dissertation). Available from ProQuest Dissertations & Theses Global database. (UMI No. 10823761)

Abstract: “Preparing students for 21st-century learning is a great responsibility and a challenge for many school districts across the country. A large body of research suggests that a school district’s level of awareness with regards to education technology and particularly those technologies that are on a positive trend correlates with a successful technology implementation program. District Administrators that lead the charge of developing technology policies and oversee the various aspect of the technology implementation must possess a solid awareness of modern education technologies and their interplays with curriculum and pedagogy. In addition, district Administrators must have the technological skill to overcome network infrastructure capabilities constraints as well as the leadership skill to prioritize technology.

This study used a survey as its main method of data collection; the survey was guided by three research questions that helped gain valuable insight about California K12 school district Administrators’ familiarity with most relevant modern technologies and strategies for educating students in the 21st-century, knowledge of intermediation between (technology, pedagogy, curriculum), as well as what Administrators perceive as constraints that impede effective technology implementation. The data shows that majority of district Administrators reported to having insufficient knowledge of modern and emerging technologies or digital strategies that are most reliant on technology, in addition, the data suggest that district Administrators are finding funding, training, and infrastructure as main factors that impede implementation of technology appropriate for a 21st-century education. The results of this study propose recommendations that have implications for K12 school districts’ technology awareness, knowledge acquisition for technology preparedness, district technology plan, and minimum technology readiness requirement for school district Administrator positions for the 21st-century.”

Throop, M. E. (2018). *Introducing digital educational tools into the traditional liberal arts education program: An exploratory case study* (Doctoral dissertation). Available from ProQuest Dissertations & Theses Global database. (UMI No. 10750055)

Abstract: “A liberal arts education prepares students for a successful career by providing the tools for critical thinking, performance in a team setting, and drawing awareness of and connections to different social, economic, political, and demographic differences in the larger society (Weis, et al. 2002). Traditionally, the delivery of a liberal arts education has been a face-to-face lecture/discussion/research format with little to no incorporation of technology. With the availability of digital tools for teaching and learning and the pervasiveness of digital tools in the lives of the students that colleges serve, liberal arts faculty over time have been presented with an opportunity to introduce digital tools into their instruction and assessment. However, the degree to which faculty members incorporate digital tools into their liberal arts classrooms and the perceptions of faculty members regarding how this process impacts their teaching and students’ learning remains unclear (Georgina & Olson, 2008, p. 2). In this context, the purpose of this descriptive case study was to explore the experiences of liberal arts faculty at a private, Midwest College as they incorporate digital tools into their teaching and to document how faculty members and administrators made sense of how to use digital tools and related pedagogies to impact student success.”

4. Recent TPACK Presentations

Birel, G. K., & Cakiroglu, E. (2018, July). Preservice mathematics teachers’ TPACK development in statistics teaching: A microteaching lesson study. In M. A. Sorto, A. White, & L. Guyot (Eds.), *Proceedings of the Tenth International Conference on Teaching Statistics* (pp. 1–4). Retrieved from https://iase-web.org/icots/10/proceedings/pdfs/ICOTS10_C102.pdf.

Abstract: “This study examined the development of technological pedagogical content knowledge (TPACK) of preservice mathematics teachers in statistics teaching that involves virtual manipulatives, in the context of a microteaching lesson study (MLS). Theoretical framework was based on the TPACK framework (Koehler & Mishra, 2009). MLS group which consists of 5 participants studied on a research lesson and implemented it. How TPACK of preservice elementary mathematics teachers was supported regarding the teaching statistics through virtual manipulatives (VM) and how their knowledge domains were affected by MLS are the research questions of this study. The findings showed that preservice mathematics teachers’ TPACK changed and developed through MLS. They were observed to have significant developments regarding some TPACK knowledge domains.”

Essonnier, N., & Trglova, J. (2018, September). Design principles supported by the collaborative design of mathematical digital resources within a CoI. In H-G Weigand, A. Clark-Wilson, A. Doveska-Todorova, E. Faggiano, N. Gronbaek, & J. Trgalova (Eds.), *Proceedings of the Fifth ERME Topic Conference on Mathematics Education in the Digital Age* (pp. 75–82). Retrieved from https://www.math.ku.dk/english/research/conferences/2018/meda/proceedings/MED_A_2018_Proceedings.pdf#page=191

Abstract: “In this contribution we report on the collaborative design of mathematical digital resources within a community of interest in a specific socio-technical environment established in the framework of the MC Squared European project. We bring to the fore that the design of these resources requires technological, pedagogical and mathematical knowledge. Through the analysis of the process of design of one such resource, we show how the professional knowledge, the teachers’ practice and the socio-technical environment have oriented the design choices.”

Kritz, M., & Shonfeld, M. (2018, June). Promoting satisfaction in online courses. In T. Bastiaens, J. Van Braak, M. Brown, L. Cantoni, M. Castro, R. Christensen, ...O. Zawacki-Richter (Eds.), *Proceedings of EdMedia: World Conference on Educational Media and Technology* (pp. 2263–2270). Retrieved from <http://www.learntechlib.org/p/184591/>

Abstract: “This paper is a report on the findings of a study conducted on online courses in a teacher education college. It analyzes the contribution of online courses for undergraduate and graduate students. This study examines the attitudes and perceptions of students in various courses in several areas: the teaching process, the contribution of online tools, self-study, satisfaction, contribution to the learning, implementing different learning tasks, and the use of technology for teaching and learning. The findings show that the teacher, the online environment, the students accountability and self-learning ability as well as his TPACK level explain the satisfaction. It was found that the teacher affect satisfaction when the online environment is user friendly.”

Meaney, T. & Pajic, R. (2018, September). Minecraft in mathematics classrooms: A teacher’s perspective. In H-G Weigand, A. Clark-Wilson, A. Doveska-Todorova, E. Faggiano, N. Gronbaek, & J. Trgalova (Eds.), *Proceedings of the Fifth ERME Topic Conference on Mathematics Education in the Digital Age* (pp. 179–186). Retrieved from https://www.math.ku.dk/english/research/conferences/2018/meda/proceedings/MEDA_2018_Proceedings.pdf#page=191

Abstract: “In this paper, one teacher’s experiences of using Minecraft in her mathematics classroom over several years is explored to determine the professional knowledge she drew on. The Technological Pedagogical Content Knowledge (TPACK) model is used to describe the different professional knowledges that the teacher used in bringing a digital game into her mathematics teaching. Insights from this teacher can inform other educators about the types of knowledge that need to be blended if digital games are to be used to support students’ learning of mathematics.”

Valtonen, T., Sointu, E., Kukkonen, J., & Makitalo, K. (2018, June). Best of Finland: Perspectives for the pre-service teachers’ readiness to take advantage of ICT in education. In T. Bastiaens, J. Van Braak, M. Brown, L. Cantoni, M. Castro, R. Christensen, ...O. Zawacki-Richter (Eds.), *Proceedings of EdMedia: World Conference on Educational Media and Technology* (pp. 667-674). Retrieved from <https://www.learntechlib.org/primary/p/184260/>

Abstract: “This paper focuses on first-year pre-service teachers’ readiness to use Information and Communication Technology (ICT) in education. Readiness to use ICT in education is studied as part of 21st century skills, where the role of ICT is emphasised. This study re-visits parts of three previously published articles providing a wider perspective on the topic by examining the results from the different papers together. The main theoretical frameworks used are Technological Pedagogical Content Knowledge (TPACK) and the Theory of Planned Behavior (TPB). The target group consists of 267 pre-service teachers from three Finnish universities. The results indicate variation among pre-service teachers’ readiness to use ICT in education. Overall, technological knowledge was found in an assessment to be low compared to pedagogical or content knowledge. In addition, as a group, the pre-service teachers are more unified in relation to their pedagogical knowledge and content knowledge than they are in relation to technological knowledge. Despite these differences and the low assessments related to technological knowledge, respondents were well aware of the expectations related to the use of ICT in education. Results also show that the use of ICT in education is a rather separate area from other 21st century skills, in this case learning skills.”

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 (6th edition) of the *Publication Manual of the American Psychological Association* suggests that the citation should look like this:

Harris, J., & Wildman, A. (Eds.). (2018, September 30). TPACK newsletter issue #38: September 2018 [Electronic mailing list message]. Retrieved from <http://bit.ly/TPACKNewslettersArchive>

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>
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- Access three tested TPACK assessment instruments at: <http://activitytypes.wm.edu/Assessments>
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If you have a news item that you would like to contribute to the newsletter, send it along to: 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. 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, with the following text in the subject line: unsubscribe tpack.news

- Judi & Amelia

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