



TPACK Newsletter, Issue #37: June 2018

Welcome to the 37th 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 Knowledge

"As we acquire more knowledge, things do not become more comprehensible, but more mysterious."

- Albert Schweitzer

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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 1231 subscribers currently. Subscription numbers have held steady (+ or – 1% to 3%) since October 2011.

2. Recent TPACK Publications

Below are recent TPACK publications that we know about: 57 articles, 24 chapters, and 32 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

Abrahami, L. N., & Chuku, B. J. (2018). Application of information and communication technology (ICT) in teaching geography in secondary schools in Obio/Akpor, River state, Nigeria. *International Journal of Scientific Research in Education*, 11, 28–50.

Abstract: “This study—‘Application of Information and Communication Technology (ICT) in teaching Geography in Secondary Schools in Obio/Akpor, Rivers state, Nigeria’ is aimed at portraying Information and Communication Technology (ICT) as a key resource in the effectual teaching of Geography in Secondary Schools. In doing this, the researchers employed a descriptive survey research design. The study was guided by four (4) research questions. The population of the study comprised 240 Geography teachers drawn from all the public and private Senior Secondary Schools in Obio/Akpor, Rivers State. It was later sampled to 60 Geography teachers using proportionate stratified random/probability sampling technique. The researchers in the course of the study employed the use of a sixty (60) item questionnaire as the instrument for data collection. The instrument was validated, having a reliability index of 0.83. It was then administered and the data collected analyzed using mean and percentage. At the end of the analysis, it was revealed that Information and Communication Technology (ICT) can be best applied in teaching virtually all areas in Geography; that Information and Communication Technology (ICT) applied in teaching Geography in secondary schools has enormous and positive effects; that its application is not without a challenge, but that the challenges can be resolved with some measures, among which are inclusion of Information and Communication Technology (ICT) in Geography curriculum and more especially, Geography teachers’ education curriculum; training and retraining of Geography teachers on the application of Information and Communication Technology (ICT) in Geography education; engagement of only trained, certified and qualified Geography teachers in teaching Geography; provision of enough fund for the procurement and maintenance of Information and Communication Technological (ICT) tools and facilities; motivation of teachers through prompt remuneration, allowances, incentives, aids and grants; etc.”

Akyuz, D. (2018). Measuring technological pedagogical content knowledge (TPACK) through performance assessment. *Computers & Education*, 125, 212–225.
doi:10.1016/j.compedu.2018.06.012

Abstract: “Despite many studies conducted on TPACK, the relationships between the components of the framework and how to perform TPACK assessment remain to be important research questions. The aim of this study is to shed light on these two questions by analyzing lesson plans collected from 138 preservice mathematics teachers obtained from a technology-integration course over a period of five years. An instrument that describes each component of the TPACK framework was developed and applied to performance-assessment of preservice

teachers. The analysis is augmented by a self-assessment survey to compare and contrast the differences between the two. According to the results, four knowledge domains within the TPACK framework could be distinguished, which are denoted as Core, Tech, TPACK-P, and TPACK-C. The performance- and self-assessment based measures were found to yield similar results except for pedagogy related knowledge domains, in particular for pedagogical knowledge (PK), technological pedagogical knowledge (TPK), and the TPACK.”

Al-Harthi, A. S. A., Campbell, C., & Karimi, A. (2018). Teachers’ cloud-based learning designs: The development of a guiding rubric using the TPACK framework. *Computers in the Schools, 35*(2), 134–151. doi:10.1080/07380569.2018.1463033

Abstract: “This study aimed to develop, validate, and trial a rubric for evaluating the cloud-based learning designs (CBLD) that were developed by teachers using virtual learning environments. The rubric was developed using the technological pedagogical content knowledge (TPACK) framework, with rubric development including content and expert validation of its items and levels. The rubric was revised based on various types of input including content validity and expert review. After many iterations of rubric implementation using two raters, the final version of the rubric was found to be reliable with high and substantial inter-rater reliability. This study provides a methodological contribution by developing and validating a rubric for teachers' cloud-based learning designs. It also provides a useful tool for evaluating the quality of teachers' CBLD, and assessing training needs.”

Bakac, E., & Ozen, R. (2017). Examining preservice teachers' material design self-efficacy beliefs based on their technological pedagogical content knowledge competencies. *Journal of Kirsehir Education Faculty, 18*(2), 613-632.

Abstract: "The aim of this study is to provide a framework for the study of the concept of self-efficacy. The fourth year preservice teachers (n = 159) are located in the northwestern Black Sea region of the United States in the spring semester of the 2015-2016 academic year formed the study group. In the study, the quantitative data were collected by Means of Material Design Self-Efficacy Belief Scale and Technopedagogical Education Competency Scale. For the analysis of the data collected descriptive statistics and One-Way ANOVA was used. At the end of the study, a meaningful, positive and moderate level of relationship preservice teachers' material design self-efficacy beliefs levels and their technopedagogical content knowledge levels were found."

Banerjee, G., & Murthy, S. (2018). CUVIS: An interactive tool for instructors to create effective customized learning designs with visualization. *Australasian Journal of Educational Technology, 34*(2), 95–116. doi:10.14742/ajet.3773

Abstract: “Instructors face difficulty in creating student-centred, customized learning designs (LDs) for teaching with information and communication technology (ICT) tools such as visualizations (animations, simulations or videos). This problem is compounded for tertiary-level instructors teaching in instructor-mediated classrooms. In such classrooms, common in many

parts of the developing world, students may not have 1:1 access with the visualization and have to interact with it via the instructor. Here, the instructors' pedagogy becomes an important factor determining effective learning with the visualization. To address this problem, a set of design impediments faced by instructors in this context were first identified. Design guidelines were created to address these impediments. These guidelines evolved into the Customized Visualization Integration System (CuVIS). It is a wizard-like interactive tool that provides guidelines to instructors on how to create effective LDs that incorporate the principles of constructive alignment and meaningful learning with ICT, and is customized to instructors' requirements. The effectiveness of CuVIS has been tested with instructors along multiple dimensions: usefulness and usability, impact on instructors' pedagogical practice and impact on student learning when taught with CuVIS-generated LDs."

Baz, E. H., Balcikanli, C., & Cephe, P. T. (2018). Introducing an innovative technology integration model: Echoes from EFL pre-service teachers. *Education and Information Technologies*, 23, 1–22. doi:10.1007/s10639-018-9711-9

Abstract: "Information and Communication Technologies (ICT) has been considered an important component to integrate into teacher education programs in the twenty-first century. However, neither faculty members nor the pre-service teachers seem to benefit from ICT efficiently throughout the 4-year teacher education program in Turkey. This study was designed to find out the experiences of Turkish EFL (English as a Foreign Language) pre-service teachers about their practice-based training on ICT integration into language learning and teaching. The junior pre-service teachers were given training about ICT integration based on SAMR model (Substitution, Augmentation, Modification, Redefinition) throughout 4 weeks. Data were collected via semi-structured interviews and observations. The findings show that the participants found SAMR model beneficial and held positive attitudes towards using SAMR in their future classes."

Blau, I., Grinberg, R., & Shamir-Inbal, T. (2018). Pedagogical perspectives and practices reflected in metaphors of learning and digital learning of ICT leaders. *Computers in the Schools*, 35, 32–48. doi:10.1080/07380569.2018.1427960

Abstract: "This study examines the meaning attributed to the contribution of technology to pedagogical practices from the perspective of school ICT leaders. While previous studies use metaphors for bottom-up exploration, this study employs an innovative combination of bottom-up and top-down metaphor analysis based on two frameworks: (a) metaphors of general learning (Paavola, Lipponen, & Hakkarainen, 2004)—acquisition, participation, and knowledge creation, and (b) metaphors of digital learning (Shamir-Inbal & Blau, 2016)—toolbox, active player, creative mind, shared desktop, and inter-connected world. Semi-structured interviews were conducted with 13 ICT leaders, including eight elementary school ICT coordinators and five regional ICT coordinators. All three metaphors of general learning and five digital learning metaphors were found in perspectives and pedagogical practices reported by the interviewees. However, the prevalence of each metaphor and the intersections of general and digital learning metaphors were quite different. The analysis based on metaphors

shed light on the perspectives of ICT leaders regarding the meaning and nature of learning processes and on pedagogical practices in their schools.”

Budiharti, R., & Waras, N. S. (2018). Analysis of student’s scientific attitude behaviour change effects blended learning supported by I-spring suite 8 application. *Journal of Physics: Conference Series 1022*, 1–10. doi:10.1088/1742-6596/1022/1/012024

Abstract: “This article aims to describe the student's scientific attitude behaviour change as treatment effect of Blended Learning supported by I-Spring Suite 8 application on the material balance and the rotational dynamics. Blended Learning models is learning strategy that integrate between face-to-face learning and online learning by combination of various media. Blended Learning model supported I-Spring Suite 8 media setting can direct learning becomes interactive. Students are guided to actively interact with the media as well as with other students to discuss getting the concept by the phenomena or facts presented. The scientific attitude is a natural attitude of students in the learning process. In interactive learning, scientific attitude is so needed. The research was conducted using a model Lesson Study which consists of the stages Plan-Do-Check-Act (PDCA) and applied to the subject of learning is students at class XI MIPA 2 of Senior High School 6 Surakarta. The validity of the data used triangulation techniques of observation, interviews and document review. Based on the discussion, it can be concluded that the use of Blended Learning supported media I-Spring Suite 8 is able to give the effect of changes in student behaviour on all dimensions of scientific attitude that is inquisitive, respect the data or fact, critical thinking, discovery and creativity, open minded and cooperation, and perseverance. Display e-learning media supported student worksheet makes the students enthusiastically started earlier, the core until the end of learning.”

Bueno-Alastuey, M. C., Villarreal, I., & Garcia Esteban, S. (2018). Can telecollaboration contribute to the TPACK development of pre-service teachers? *Technology, Pedagogy and Education*. Advance online publication. doi:10.1080/1475939X.2018.1471000

Abstract: “This study examines the suitability of telecollaboration practices to enhance ICT integration in Content and Language Integrated Learning (CLIL)-based units by analysing the number and type of episodes related to students’ technological pedagogical content knowledge (TPACK) produced in a telecollaboration whose aim was the design of a technology-enhanced CLIL unit. Results revealed a high number of episodes focusing on the domains and intersections of the TPACK framework, that pedagogical content knowledge was the main focus of attention and prompted most of the suggestions for change in the unit and that telecollaboration promoted collaboration and made participation more equal. Consequently, telecollaboration showed a great potential for directing students’ attention to their TPACK even though the scarcity of episodes focusing on the TPACK intersection also indicated there is ample room for more teacher training efforts to prepare pre-service teachers for technology integration.”

Chai, C. S., & Koh, J. H. L. (2018). Changing teachers' TPACK and design beliefs through the scaffolded TPACK lesson design model (STLDM). *Learning: Research and Practice*, 3(2), 114–129. doi:10.1080/23735082.2017.1360506

Abstract: “This study investigates the change in teachers' design beliefs and their development of technological pedagogical content knowledge (TPACK) through a course designed with the Scaffolded TPACK lesson design model. To achieve these aims, an adapted scale for teachers' design beliefs and TPACK is created and validated. The study reveals significant changes in the teachers' TPACK with large effect size and changes in teachers' design beliefs with medium or small effect size. Further investigation also reveals that the teachers' design beliefs that are constituted by the factors of Beliefs about New Culture of Learning (BNCL), Teachers as Designer (TAD), and their Design Dispositions (DD) predict their TPACK both in first- and second-order structural equation models. The findings may suggest that it is advisable to develop teachers' design beliefs as teacher educators attempt to develop preservice teachers' TPACK.”

Chen, Y. H., & Jang, S. J. (2018). Exploring the relationship between self-regulation and TPACK of Taiwanese secondary in-service teachers. *Journal of Educational Computing Research*. Advance online publication. doi:10.1177/0735633118769442

Abstract: “Although self-regulation (SR) has been regarded as an important factor of teachers' learning and professional development, its relationship with teachers' knowledge for teaching (Technological, Pedagogical, and Content Knowledge, TPACK) remains unclear. The purpose of this study was to explore the interrelationship between Taiwanese secondary in-service teachers' SR and TPACK in the national context ($N = 386$). Descriptive analysis, Pearson's bivariate correlation, and canonical correlational analysis were used to examine the interrelationship between the two sets of variables. Results showed that teachers scored highest on monitoring capability and controlling capability (MC/CC) but lowest on Information and Communications Technology (ICT)-related SR. Moreover, the participants scored greatest on Content Knowledge (CK) but lowest on Technology Knowledge (TK) and Technological Pedagogical Content Knowledge (TPCK). In-service teachers' MC/CC and Reflection Capability correlated higher with CK and pedagogical content knowledge (PCK) but lower with TK and TPCK. Conversely, ICT was associated more significantly with TK and TPCK but less significantly with CK and PCK. Implications of this study were provided along with suggestions.”

Cheng, K. H. (2018). A survey of native language teachers' technological pedagogical and content knowledge (TPACK) in Taiwan. *Computer Assisted Language Learning*, 30(7), 692–708. doi:10.1080/09588221.2017.1349805

Abstract: “An increasing amount of research has focused on the exploration of English as a Foreign Language teachers' technological pedagogical and content knowledge (TPACK). However, in the field of native language teaching, such as Taiwanese, Hakka, Aboriginal languages in Taiwan, few studies have paid attention to understanding the teachers' perceptions of TPACK. A survey was therefore conducted to examine 172 in-service Hakka language teachers' perceptions of TPACK in Taiwan. The survey framework includes seven

constructs: content knowledge (CK), pedagogical knowledge (PK), technological knowledge (TK), pedagogical content knowledge (PCK), technological pedagogical knowledge (TPK), technological content knowledge (TCK), and TPACK. According to the results, although the native language teachers were satisfied with their TPACK on average, they had relatively low confidence in CK, TK, and TPK. While the older male teachers tended to be more confident in their CK, the older female teachers were inclined to have less confidence in their TK. Teaching experience was positively related to the teachers' perceived CK, PK, and PCK. Particularly, the importance of the teachers' TCK, PK, and TK in their synthesized TPACK was identified. This study also provides suggestions for native language teacher training program design in the future."

Cheng, S. L., & Xie, K. (2018). The relations among teacher value beliefs, personal characteristics, and TPACK in intervention and non-intervention settings. *Teaching & Teacher Education, 74*, 98–113. doi:10.1016/j.tate.2018.04.014

Abstract: "The purpose of this study is to examine the relations among teacher value beliefs, personal characteristics, and Technological Pedagogical Content Knowledge (TPACK) in both intervention and non-intervention settings. One-hundred and nine in-service teachers from elementary to high schools participate in this study. Our findings reveal that compared to personal characteristics, teacher value beliefs are the only variable that can significantly predict TPACK across both settings. In addition, in the non-intervention setting, the relations between personal characteristics and TPACK are also moderated by teacher value beliefs. How to foster teacher value beliefs around technology integration is discussed."

Chuang, H. H., Ho, C. J., Weng, C. Y., & Liu, H. C. (2018). High school students' perceptions of English teachers' knowledge in technology-supported class environments. *The Asia-Pacific Education Researcher, 27*(3), 197–206. doi:10.1007/s40299-018-0378-1.

Abstract: "This study used a structural equation model to investigate the endogenous structure of high school students' perceptions of the knowledge possessed by English teachers who handle technology-supported classes in Taiwan. We developed a validated survey composed of four constructs, namely, subject matter knowledge (SMK, 5 items), knowledge of students' understanding (KSU, 4 items), technological knowledge (TK, 6 items), and technological pedagogical content knowledge (TPACK, 6 items). The survey was administered to 287 respondents from four target English teachers' classes at the end of the semester in January 2015. Further analysis based on the structural equation model indicates that students' perceptions of teachers' TK and KSU directly affect TPACK. SMK and KSU are indirectly related to TPACK with the association significantly mediated by TK."

Coban, G. U., Akpinar, E., Baran, B., Saglam, M. K., Ozcan, E., & Kahyaoglu, Y. (2016). The evaluation of "technological pedagogical content knowledge-based augmentation practices" training science teachers. *Education and Science, 41*, 1–33.

Abstract: “In science education, creating learning environments supported with technology and students’ use of theory-evidence coordination when expressing their ideas is emphasized regarding the development of students’ scientific reasoning, critical thinking, decision making skills, and etc. In this process, great responsibilities are fallen to teachers as planner and designer of a learning environment. In this study, it is aimed to assess the training which aims the development of science teachers’ technological pedagogical content knowledge (TPACK) through argumentation practices. In this context; this study evaluated the science teachers’ argumentation skills, self-efficacy perceptions towards TPACK and the teachers’ views about the training. 37 science teachers working at different cities in Turkey participated in the one group pre-test post-test experimental training study, which was lasted 54 hours during a week. The training is composed of both hand and minds on argumentation practices based on TPACK. The participants joined different activities such as collaborative group works, drama, modeling, thematic games, art activities, problem-based learning, field trips, observation and workshops. In the study, Argumentation Test, TPACK Self-Efficacy Belief Scale were used as data collection tools. At the end of the training written views of science teachers towards activities were taken. In the light of the findings, this training was effective on the participants’ self-efficacy levels towards technological pedagogical content knowledge. Moreover, this training resulted in a positive change in the participants’ views about how a statement could be accepted as an argument. However, the increase in scores of argumentation skills was not significant. Additionally almost all of the participants stated that they found the activities useful and can use in their classes. By considering these results, some suggestions were given.”

Cubeles, A., & Riu, D. (2018). The effective integration of ICTs in universities: The role of knowledge and academic experience of professors. *Technology, Pedagogy and Education*. Advance online publication. doi:10.1080/1475939X.2018.1457978

Abstract: “Despite the fact that investment in information and communication technologies (ICTs) in universities has increased dramatically, there is no clear evidence that ICTs have been incorporated effectively in the process of teaching and learning. This article investigates the knowledge that university professors need in order to integrate ICTs into their teaching practices. The Technological Pedagogical Content Knowledge (TPACK) model has been frequently used for this purpose, but its application in higher education has been limited. The objectives of the study are both the confirmation of the applicability of the model in universities, and the study of the key variables of professors for effective technology integration. A self-assessment questionnaire was administered to 113 professors of three different university schools. The results of this study confirm the usefulness of the model and revealed significant differences regarding the previous academic experience of the teacher. The investigation thus contributes to studies that aim to foster the effective integration of technology in teaching and learning.”

Davids, M. N. (2017). Student responses to an ICT-based e-assessment application for the teaching practicum/teaching practice module. *International Journal of Information & Communication Technology Education*, 13(3), 15–26. doi:10.4018/IJICTE.2017070102

Abstract: “Situated within the context of Initial Teacher Education (ITE) in South Africa, this study introduces the notion of an interactive Teaching Practicum E- Assessment application: e-assessment application for the teaching practicum/Teaching Practice module to replace the current model of assessment. At present students enrolled for an Initial Teacher Education qualification have to complete a compulsory Teaching Practice module. The successful completion of the module arguably provides evidence of students' readiness for professional practice. The assessment of the teaching practicum is often riddled with anxiety on the part of the students and conflict between students and their supervisor. Two interrelated research questions guided this study: What are students' experiences of the current teaching practicum assessment? and What were students' responses to the ICT-based assessment proposal? Data were collected from a sample of Teaching Practice students (N = 40) and a focus group discussion conducted with eight (8) students. Technological pedagogical content knowledge (TPCK) and critical connectivity theory provided the study with analytical and conceptual lenses. Findings are discussed in response to the research questions posed in preparation of the software development stage of the project.”

Demirer, V., Dikmen, C. K. (2018). Investigation of teachers' opinions concerning FATİH project in the context of technological pedagogical content knowledge. *Ilkogretim Online*, 17, 26–46. doi:10.17051/ilkonline.2018.413735

Abstract: “With the rapid advancement of technology, several countries initiate new projects to integrate technology into education. Similarly, Turkey launched "Movement of Enhancing Opportunities and Improving Technology Project (FATİH Project)" in 2010. Teachers as the practitioners of the project have great responsibility for the successful implementation of the project. Therefore, in this qualitative case study; opinions of teachers about FATİH Project were collected through a semi-structured interview form. The study group was identified by convenience sampling method and it is consisted of 32 teachers (19 male, 13 female) from various branches who work at high schools in which FATİH Project is implemented. Content analysis method was used in order to analyze the data collected in the study and to find out the necessary concepts and relationships. The obtained data were analyzed in the context of Technological Pedagogical Content Knowledge (TPACK) and discussed based on the literature. The results of the study show that the FATİH Project is inadequate in terms of implementation, infrastructure and information activities while showing ease of access to resources, enriching learning environments, and helping learners to make learning easier. The study results and findings are thought to contribute to achievement of the objectives of the FATİH Project, and it is expected to shed light on the works to be conducted in literature thereafter.”

Dockendorff, M., & Solar, H. (2018). ICT integration in mathematics initial teacher training and its impact on visualization: The case of GeoGebra. *International Journal of Mathematical Education in Science & Technology*, 49, 66–84. doi:10.1080/0020739X.2017.1341060

Abstract: “This case study investigates the impact of the integration of information and communications technology (ICT) in mathematics visualization skills and initial teacher education programmes. It reports on the influence GeoGebra dynamic software use has on

promoting mathematical learning at secondary school and on its impact on teachers' conceptions about teaching and learning mathematics. This paper describes how GeoGebra-based dynamic applets – designed and used in an exploratory manner – promote mathematical processes such as conjectures. It also refers to the changes prospective teachers experience regarding the relevance visual dynamic representations acquire in teaching mathematics. This study observes a shift in school routines when incorporating technology into the mathematics classroom. Visualization appears as a basic competence associated to key mathematical processes. Implications of an early integration of ICT in mathematics initial teacher training and its impact on developing technological pedagogical content knowledge (TPCK) are drawn."

Efendioğlu, A. (2018). Teachers' use of Facebook and teacher quality: developing a 'Facebook effect scale on teacher quality (FESTQ)' from the perspective of PCK, TPACK, and lifelong learning frameworks. *Educational Technology Research and Development*. Advance online publication. doi:10.1007/s11423-018-9586-x

Abstract: "The main purpose of the study is to develop a Facebook Effect Scale on Teacher Quality (FESTQ) based on the pedagogical content knowledge, technological pedagogical content knowledge and lifelong learning frameworks. Study participants comprised 556 teachers. Explanatory factor analysis and confirmatory factor analysis were conducted in the development and testing of the FESTQ. The results showed that the FESTQ is reliable and valid to measure Facebook effect on teacher quality. The FESTQ consists of 40 positive six-point Likert-type items along with six factors, instructional knowledge for in-class applications, general culture knowledge, individual characteristics, instructional knowledge related to student characteristics, instructional knowledge for preparing an assessment tool and special content area knowledge. The psychometric properties of the FESTQ, the study limitations and suggestions for future studies are discussed."

Felix, A., Condy, J., & Chigona, A. (2018). Using technology to enhance pedagogies in rural geography primary classroom in the twenty-first century. *Africa Education Review*. Advance online publication. doi:10.1080/18146627.2017.1323556

Abstract: "The purpose of this research was to explore how two rural primary teachers used technology to enhance their pedagogical and content knowledge of Geography in their everyday teaching and learning. Hence the theory of Koehler and Mishra's Technological, Pedagogical and Content Knowledge (TPACK) framed this research. Although the Intermediate Phase curriculum provides a general education experience, teachers need to adopt teaching strategies that deliver Geographical knowledge, skills and values which enable learners to function effectively and responsibly. A qualitative research design was employed for this study using interviews and observations. Two teachers were purposively selected for this study. The findings indicate that the two teachers used technology, to varying extents, to enhance their pedagogy."

Genc, M. (2018). The investigation of pre-service science teachers' self-efficacy toward technological pedagogical content knowledge. *Turkish Online Journal of Educational Technology, 16*, 451–457.

Abstract: "Technological developments in the international arena have affected many countries' education systems, as well as being in many areas. As a result of the integration in the education of technological developments, it has caused the change of the professions in the field of education and training, especially in the institutions that educate teachers. The purpose of this study was to investigate pre-service science teachers' self-efficacy toward technological pedagogical content (TPACK) throughout one academic term. The research was carried out with a total of 41 pre-service science teachers from Duzce University in 2016-2017 fall academic years. The study employed an experimental method, namely the pre-test / post-test pattern used with a single group. The data were collected by using the "Technological pedagogical content knowledge (TPACK) self-efficacy scale for pre-service science teachers on material development" developed by Balçın and Ergün (2016). The collected data was analyzed using paired-samples t-test. Also, data are evaluated on 0.05 level relevance and its percentage, frequency, average and standard deviation levels are calculated. When 41 pre-service science teachers' self-efficacy level toward TPACK was evaluated, it was found that their level increased at the end of fall semester (when compared to the beginning of that semester). According to the findings obtained in the research, gender did not affect the TPACK self-efficacy for pre-service science teachers on material development."

Havard, B., Nguyen, G.-N., & Otto, B. (2018). The impact of technology use and teacher professional development on U.S. national assessment of educational progress (NAEP) mathematics achievement. *Education and Information Technologies*. Advance online publication. doi:10.1007/s10639-018-9696-4

Abstract: "The purpose of this study was to determine the impact of technology use and teacher professional development on students' mathematics academic achievement. The U.S. Department of Education National Assessment of Educational Progress (NAEP) published results for mathematics assessments for Grade 4 from the years 2005–2015 served as the dependent variable. Specific items related to technology use and professional development selected from both student and mathematics teacher questionnaires served as the independent variables. The Technological Pedagogical and Content Knowledge (TPACK) was used as a framework to guide this research. Data analyses revealed significant differences across multiple variables and multiple years."

Holmberg, J., Fransson, G., & Fors, U. (2018). Teachers' pedagogical reasoning and reframing of practice in digital contexts. *International Journal of Information & Learning Technology, 35*(2), 130–142. doi: 10.1108/IJILT-09-2017-0084

Abstract: "Purpose - The purpose of this paper is to advance the understanding of teachers' reframing of practice in digital contexts by analysing teachers' pedagogical reasoning processes as they explore ways of using information and communication technologies (ICT) to create added pedagogical value. Design/methodology/approach - A design-based research (DBR)

approach is employed, in which the on-site researcher collaborates with eight teachers of English as a foreign language in four Swedish schools over a period of two years. Multiple data sources are included for thematic coding and analysis. The technological pedagogical content knowledge (TPACK) framework is used as a conceptual construct in the analysis. Findings - The findings show that teachers' pedagogical reasoning is a complex and multidimensional process and is closely integrated with teachers' reframing of practice. Common characteristics in the teachers' reframing of practice are identified. The results highlight the reciprocal relationship between developments in teachers' pedagogical reasoning and TPACK development and the need for a distinction between general and specific, theoretical and practical TPACK. Research limitations/implications - An increased focus on TPACK research on teachers' pedagogical reasoning is required. DBR is a relevant approach for this. Practical implications - The pedagogical uses of ICT identified as adding value could benefit teachers in other contexts. Originality/value - Rich data from multiple design contexts are collected and analysed over time through DBR. The paper contributes new knowledge about the process of pedagogical reasoning and its relation to teachers' reframing of practice. The paper also contributes to TPACK theory development."

Irmak, M., & Yilmaz Tuzun, O. (2018). Investigating pre-service science teachers' perceived technological pedagogical content knowledge (TPACK) regarding genetics. *Research in Science & Technological Education*. Advance online publication. doi: 10.1080/02635143.2018.1466778

Abstract: "Understanding pre-service science teachers' (PSTs) perceived knowledge on a subject and teaching that subject is important to better prepare these teachers for their future career. In this study, PSTs' perceived Technological Pedagogical Content Knowledge (TPACK) on genetics and the contribution of the dimensions of perceived TPACK on PSTs' subject matter knowledge of genetics were investigated. Moreover, the differences in the perceived TPACK with regard to gender and grade level were examined further. 1530 PSTs from eight public universities located in Central Anatolia in Turkey participated to the study. Perceived TPACK on Genetics Questionnaire (MaKinster, Boone, and Trautmann 2010) and Test of Basic Genetic Concepts (Sadler and Zeidler 2005) were used. Regarding perceived TPACK eight sub-dimensions were emerged, namely; Educational Technology Knowledge (ETK), Genetic Technology Knowledge (GTK), Project Specific Technology Knowledge (PSTK), Content Knowledge (CK), Pedagogical Knowledge (PK), Pedagogical Content Knowledge (PCK), Technological Content Knowledge (TCK), and TPACK. Descriptive analysis, multiple linear regression analysis, and MANOVA analyses were conducted to provide answers to research questions. The students were surveyed before and after the program using open-ended and Likert scale items, and were asked to complete a nuclear science version of the Draw-A-Scientist-Test. The participants' mean value of total TPACK is 4.15 out of 6. Pre-service science teachers perceived themselves most knowledgeable on PK and least knowledgeable on PSTK dimensions. The content-related perceived TPACK dimensions significantly contributed to PSTs' subject matter knowledge of genetics. The mean scores of male and female PSTs were found significantly different in PSTK, PK, PCK, TCK and TPACK dimension. ETK, GTK, PSTK, and CK scores of participants were also found to be significantly different with regard to grade level.

This study provided descriptive information about PSTs' levels of TPACK. Moreover, this study also showed the contribution of content-related perceived TPACK dimensions on subject matter knowledge of genetics. This study showed that female PSTs and PSTs, who took courses in which science, technology, and pedagogy are taken as an integrated manner, had better perceived TPACK. We can conclude that PSTs' perceived TPACK knowledge is situated in a particular subject matter area. Therefore, instead of seeking for TPACK in a general domain, focusing on specific subject matter areas can give us more insight into the nature of the TPACK and better development of PSTs' TPACK."

Jimenez, J. D., & Moorhead, L. (2017). Recasting the history textbook as an e-book: The collaborative creation of student-authored interactive texts. *History Teacher, 50*(4), 565–595.

Abstract: "The article discusses technology integration into the high school history classroom through the use of e-textbooks (electronic textbooks). A framework for teacher knowledge for technology integration called Technological Pedagogical Content Knowledge (TPCK) that encourages the use of technology as a tool for students to discover and examine content sources independently, student created interactive digital history textbooks, and templates provided in textbook authoring software are also discussed."

Kale, U., Akcaoglu, M., Cullen, T., Goh, D., Devine, L., Calvert, N., & Grise, K. (2018). Computational what? Relating computational thinking to teaching. *Tech Trends*, Advance online publication. doi: 10.1007/s11528-018-0290-9.

Abstract: "Computational thinking is one of the skills critical for successfully solving problems posed in a technology driven and complex society. The limited opportunities in school settings to help students develop computational thinking skills underscores the need for helping teachers integrate it in their practices. Besides developing the knowledge of technology, content, and pedagogy, teachers need to recognize the relevance of computational thinking to their teaching, a factor influencing their future practice with it. Drawing from the literature on problem-solving and TPACK framework, this paper discusses strategies, including content-specific examples, problem-solving nature of computational thinking, and the methods of teaching problem-solving for enabling teachers to make the connections between computational thinking and their practices."

Kartal, T., & Afacan, O. (2017). Examining Turkish pre-service science teachers' technological pedagogical content knowledge (TPACK) based on demographic variables. *Journal of Turkish Science Education, 14*, 1–22.

Abstract: "Technological pedagogical content knowledge (TPACK) can be viewed as a new concept for the educational technology world. However, there are many studies related to TPACK and TPACK cannot be considered out of context. Instead, researchers should have a deep understanding about how the results of a TPACK study may change due to its context. This study demonstrates the importance of context. The Survey of TPACK was utilized to identify

591 pre-service science teachers' (PSTs) TPACK levels and examine the validity and reliability of data obtained from 591 PSTs. Exploratory and confirmatory factor analyses were conducted for validity. After factor analyses a TPACK model with four factors (technological knowledge, content knowledge, knowledge of pedagogy, knowledge of teaching with technology) were obtained. There were, however, seven factors in the original form of the survey. This change was interpreted as the effect of the context, because the participants in the original survey and in this survey were different in terms of their teacher preparation programs and the opportunities that the teacher preparation programs provided for them. In addition, pre-service science teachers' TPACK levels were investigated on the basis of demographic variables (gender, owning computer, computer usage level and grade level). An important result obtained from the demographic variables is that pre-service science teachers' TPACK levels develop in direct proportion to their grade level. This finding supports the idea that experiences with technology and in teaching have a positive impact on TPACK.”

Kim, D., & Kim, W. (2018). TPACK of faculty in higher education: Current status and future directions. *Educational Technology International*, 19, 153–173.

Abstract: “The purpose of this study was to investigate teaching competence of faculty members based on TPACK which should be examined to ensure high quality in higher education for the era of the Fourth Industrial Revolution. This study was conducted with a focus on TPACK, which integrate technology knowledge (TK), content knowledge (CK), and pedagogy knowledge (PK). 105 faculty members from a large private university at Incheon, Korea participated in this study. Except insincere responses data from a total of 85 participants were used for data analysis. K-mean cluster analysis method was used to distinguish type of faculty members depending on TPACK. The study results showed that there were three different type of groups. Each type of group named well-balanced competence type, development required competence type, and lack of technology competence type respectively. First faculty members defined as well balanced competence type were more than the average level in 7 subscales in TPACK. Second, faculty members belonged to development required competence type reported below the average level in TPACK. Thus, faculty members in this type were required to increase teaching competence. Finally, faculty members in lack of technology competence type were needed to enhance competence related to technology because their overall TK level was relatively low. This study examined what distinctive characteristics existed in each type depending on gender, teaching career, nationality, and age. This study suggested how TPAKC of faculty member in higher education could be enhanced.”

Kiray, S. A., Celik, I., & Colakoglu, M. H. (2018). TPACK self-efficacy perceptions of science teachers: A structural equation modeling study. *Education and Science*. Advance online publication, 1–16. doi:10.15390/EB.2018.7538

Abstract: “The purpose of this study is to reveal the relation between Technological Pedagogical Content Knowledge (TPACK) sub-dimensions of science teachers in Turkey. For this purpose, relations between the elements forming the TPACK have been investigated with a model. This research was carried out with 563 science teachers working in 81 schools to represent science

teachers in Turkey. The scale developed by Kiray (2016a) to measure TPACK self-efficacy perceptions of teachers and teacher candidates was used as data collection tool in the research. The data obtained in the study were analyzed by structural equation modeling. The direct and positive effects of Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK) and Pedagogical Content Knowledge (PCK) from external variables consisting of binary knowledge domains of the study are seen on TPACK. These variables account for 65% of the change in TPACK. PCK is the variable that affects TPACK the most. According to this finding, PCK has a critical importance in teachers' technology integration. Another important finding in this study is that teachers' CK directly and positively influences TCK and PCK, and this effect is greater than the effect of TK and PK. When considered in the context of the results of this research, a gradual model covering CK and PCK can be proposed instead of a direct technology-based approach to professional development programs developed to increase TPACK self-efficacy of teachers."

Kirikcilar, R. G., & Yildiz, A. (2018). Technological pedagogical content knowledge (TPACK) craft: Utilization of the TPACK when designing the geogebra activities. *Acta Didactica Napocensia*, 11, 101–116. doi:10.24193/adn.11.1.8

Abstract: "There are many studies with a focus on examining and developing individuals' Technological Pedagogical Content Knowledge (TPACK). When examining these studies, one can recognize that these studies are usually conducted with preservice teachers. Nevertheless, examining teachers' preparation processes of classroom activities constitutes an important area for the improvement of instruction. In this respect, it is important to examine the preparatory process of computer assisted activities that mathematics teachers include in their lessons. Hence, in this study, middle school mathematics teachers' utilizations of the TPACK when designing classroom activities, which they prepared by using the GeoGebra software, were investigated. Participants of the study consisted of three mathematics teachers who have been working in a middle school. The data was collected by using an observation form, which was developed by the authors, and by conducting semi-structured interviews with the participants. The quantitative and qualitative data analysis methods were used in analyzing the collected data. The findings showed that teachers had difficulty integrating their pedagogical knowledge into the technology throughout the activity design processes and had deficiencies in terms of the TPACK."

Krause, J. M., & Lynch, B. M. (2018). Faculty and student perspectives of and experiences with TPACK in PETE. *Curriculum Studies in Health and Physical Education*, 9(1), 58–75. doi:10.1080/25742981.2018.1429146

Abstract: "Physical education teacher education (PETE) students are required to use technology to enhance planning and implementation, instructional delivery and management, and professional responsibility (Society of Health and Physical Educators America. (2017). *National Standards for Initial physical education teacher education*. Retrieved from <http://www.shapeamerica.org/accreditation/upload/National-Standards-for-Initial-Physical-Education-Teacher-Education-2017.pdf>). However, there are issues with technology integration

competence and barriers in physical education and PETE [Gibbone, A., Rukavina, P., & Silverman, S. (2010). Technology integration in secondary physical education: Teachers' attitudes and practice. *Journal of Educational Technology Development and Exchange*, 3(1), 27–42; Jones, E. M., Bulger, S. M., Illg, K., & Wyant, J. (2012). Modified delphi investigation of instructional technology in PETE. *Global Journal of Health and Physical Education in Pedagogy*, 1(4), 295–310]. Effective integration demands the incorporation of pedagogy around subject content, delivered with appropriate technology, known as technological, pedagogical, and content knowledge (TPACK). The purpose of this study was to investigate TPACK-related experiences of 13 faculty and 32 students among three PETE programs through a multiple case study design. Semi-structured interview and focus group guides were employed and thematic analysis was used to code data from within and across the three cases [Boyatzis, R. E. (1998). *Transforming qualitative information: Thematic analysis and code development*. Thousand Oaks, CA: Sage Publications; Fereday, J., & Muir-Cochrane, E. (2006). Demonstrating rigor using thematic analysis: A hybrid approach of inductive and deductive coding and theme development. *International Journal of Qualitative Methods*, 5(1), 80–92]. Results indicated varying experiences with instruction in TPACK, faculty modelling of technology, and integration of technology into field experiences. Recommendations for PETE programs based on the results of this study include the pursuit of funding for technology for use in pedagogical content courses and field experiences, development of a strategic curriculum map of where and when technology is incorporated across program coursework, and strategic placement of students in technologically advanced schools.”

Krauskopf, K., & Forssell, K. (2018). When knowing is believing: A multi-trait analysis of self-reported TPCK. *Journal of Computer-Assisted Learning*. Advance online publication. doi:10.1111/jcal.12253

Abstract: "In an effort to understand teachers' technology use, recent scholarship has explored the idea of technological pedagogical content knowledge (TPCK or TPACK). Many studies have used self-reports to measure this knowledge (SR TPCK). Several studies have examined the construct validity of these assessments by analysing the internal relationships of the knowledge domains, but little attention has been paid to how SR TPCK relates to external criteria. We tackled this question of discriminant validity by reanalysing 2 data sets. We used correlation and multiple regression analyses to explore whether conceptually related constructs explain any variance in participants' SR TPCK. In Study 1, we applied this strategy to German pre-service teachers using technology use, attitudinal variables, and objective measures of teachers' knowledge of technology and pedagogy as external criteria. In Study 2, we examined measures of technology knowledge, experience, and pro-technology beliefs for in-service teachers in the United States. Across both studies, a sizeable amount of the variance in SR TPCK is explained by teachers' prior technology use and pro-technology attitudes. In contrast, fact-based tests of technology and pedagogy are distinct from SR TPCK. We discuss implications for these findings and argue that researchers should gather complementary measures in concert."

Krauskopf, K., Foulger, T. S., & Williams, M. K. (2018). Prompting teachers' reflection of their professional knowledge. A proof-of-concept study of the graphic assessment of TPACK

instrument. *Teacher Development*, 22(2), 153–174.
doi:10.1080/13664530.2017.1367717

Abstract: “Many educational technology proponents support the Technological Pedagogical Content Knowledge (TPACK) model as a way to conceptualize teaching with technology, but recent TPACK research shows a need for empirical studies regarding the development of this knowledge. This proof-of-concept study applies mixed-methods to investigate the meta-cognitive awareness produced by teachers who participate in the Graphic Assessment of TPACK Instrument (GATI). This process involves creating graphical representations (circles of differing sizes and the degree of their overlap) that represent what teachers understand to be their current and aspired TPACK. This study documented teachers’ explanations during a think-aloud procedure as they created their GATI figures. The in-depth data from two German teachers who participated in the process captured the details of their experience and demonstrated the potential of the GATI to support teachers in reflecting about their professional knowledge and in determining their own professional development activities. These findings will be informative to future pilot studies involving the larger design of the GATI process, to better understand the role of teachers’ meta-conceptual awareness, and to better ascertain how the GATI might be used to support professional development on a larger scale.”

Lock, J., Kim, B., Koh, K., & Wilcox, G. (2018). Navigating the tensions of innovative assessment and pedagogy in higher education. *The Canadian Journal for the Scholarship of Teaching and Learning*, 9, 1–18. doi:10.5206/cjsotl-rcacea.2018.1.8

Abstract: “Innovative practice in a classroom adds challenges and tensions to programs and institutional structures in higher education. With the recent emphasis on curricula reform, there is a great focus on assessment and pedagogical practices to support student learning. To illustrate the tensions arising from these efforts, we present four pedagogical and assessment innovation approaches using both Shulman’s (2005) Signature Pedagogies and Tatar’s (2007) Design Tensions frameworks. The four approaches include problem-based learning, game-based learning, case-based learning, and technology-enhanced learning. A narrative for each approach examines and addresses tensions using Shulman’s (2005) surface, deep and implicit structures. We argue that there is an interconnected complexity and conflicting visions among the micro- (e.g., classroom or practicum), meso- (e.g., program), and macro- (e.g., institution) levels. We acknowledge that dynamic tensions continually exist and needs to be thoughtfully navigated in support of innovative assessment and pedagogies in higher education.”

Lovett, J., & Lee, H. (2018). Incorporating multiple technologies into teacher education: A case of developing preservice teachers' understandings in teaching statistics with technology. *CITE Journal*, 17(4), 440-457. Retrieved from <https://www.learntechlib.org/primary/p/173254/>

Abstract: "The purpose of this paper is to present a multitechnology-enabled lesson used with secondary preservice mathematics teachers to develop their technological pedagogical statistical knowledge. This lesson engages preservice teachers in a statistics lesson aimed at

developing their reasoning about the measurement units of data using TinkerPlots and then engages them in reasoning about students' approaches to the task. A description of the lesson, preservice teachers' approaches, and how they reasoned about sixth graders' strategies are included. The authors further discuss the affordances of the specific technologies used in creating the learning opportunities for these preservice teachers and implications for teacher education."

Macrides, E., & Angeli, C. (2018). Investigating TPCK through music focusing on affect. *The International Journal of Information and Learning Technology*, 35(3), 181–198. doi:10.1108/IJILT-08-2017-0081

Abstract: "The purpose of this paper is to address the lack of a theoretical framework for the integration of technology in music teaching and learning, and explores, within the framework of Technological Pedagogical Content Knowledge (TPCK or TPACK), the importance of affect in instructional design. The authors reviewed relevant literature related to the fields of music education, instructional design, and technology integration. Accordingly, they developed guidelines for designing technology-enhanced learning for the activities of music composition and listening. The authors propose a set of design principles based on the TPCK framework through the subject matter of music focusing on the affective domain, and identify interrelations among musical content, emotions, and technology. The design guidelines were tested in an empirical investigation and the results showed statistically significant differences between the control and the experimental groups in favor of the experimental group. Further investigation is necessary to test the effectiveness of the proposed design principles. Including affect in the design process is a complicated and mostly uncharted area, and, thus, further research toward this direction is fully justified. The research has practical significance, addressing a gap in the field of music education, as it provides teachers with explicit guidance about how to design music lessons with technology while incorporating affect. The study extends the theoretical framework of TPCK to a design framework and proposes instructional design guidelines that address both the cognitive and the affective domains of learning, a focus that is currently missing from the existing TPCK or TPACK literature as well as the music education literature."

Macrides, E., & Angeli, C. (2018). Domain-specific aspects of technological pedagogical content knowledge: Music education and the importance of affect. *Tech Trends*, 62(2), 166–175. doi:10.1007/s11528-017-0244-7

Abstract: "The present study addresses the lack of a theoretical framework for the integration of technology in music teaching and learning, and explores, within the framework of Technological Pedagogical Content Knowledge (TPACK), the importance of affect in the instructional design of music lessons. The purpose of this study is twofold: (a) to extend the theoretical framework of TPACK to a design framework by enriching it with domain-specific design guidelines for the teaching of music, and, (b) to identify and propose design guidelines, which can facilitate associations of affect with cognition in learning music with technology. The research has practical significance for teachers and practitioners as it provides explicit

instructional design guidance of how music lessons can be designed based on TPACK principles that address both the cognitive and the affective domain.”

Onal, N., & Alemdag, E. (2018). Educational website design process: Changes in TPACK competencies and experiences. *International Journal of Progressive Education*, 14, 88–104. doi:10.29329/ijpe.2018.129.7

Abstract: “The number of technological pedagogical and content knowledge (TPACK) studies has been increasing day by day; however, limited number of studies has provided both quantitative and qualitative findings based on teachers' learning by design experiences. This study aimed to reveal the changes in pre-service teachers' TPACK competencies in the educational website design process and their experiences in the design process within the scope of a course based on TPACK framework and the learning by design approach. Designed as an embedded mixed design research, the study was conducted with 28 pre-service teachers. The data were collected through the TPACK-deep scale, a survey and e-mails sent to the instructors. The research concluded that the learning by design approach brings pre-service teachers' TPACK competencies in highly effective significant contributions. Moreover, it was revealed that the design process expands pre-service teachers' schemas regarding the properties which digital instructional materials should possess. The research also enlightened the motivating factors such as receiving support and the challenging factors such not being able to use software for the pre-service teachers in the design process. Finally, the findings were interpreted within the framework of TPACK and the learning by design approach and recommendations were made for future practices and studies.”

Pacheco, V. M. S., & Lopez, J. F. B. (2018). Análisis de la percepción de docentes, usuarios de una plataforma educativa a través de los modelos TPACK, SAMR y TAM3 en una institución de educación superior. *Apertura: Revista de Innovación Educativa*, 10, 116–131. doi:10.18381/Ap.v10n1.1162

Abstract: “This paper presents the results of the research that analyzed the perception of the educational benefit of users of the Learning Management System (LMS) Blackboard that is used at the Autonomous University of the State of Hidalgo (UAEH), taking as a central axis the question: What is the benefit of the learning management system as a technological tool in the educational process of UAEH? For this, the analysis was performed based on the models: TPACK by Mishra & Koehler (2006), SAMR model developed by Puentedura (2006) and TAM3 developed by Venkatesh & Bala (2008). Methodologically it is a multiple case study, where several cases are used simultaneously to explore and describe a reality. Three teachers of the Campus Tlahuelilpan of the UAEH participated in the semistructured interview, which constituted the technique for obtaining data. The results indicate the need for an adequate training, not only in the technological, but also in the pedagogical and curricular; adequate infrastructure and changes in institutional policies, among others. This responds to the theoretical models mentioned above. It is suggested that Higher Education Institutions take into account this results when implementing a Learning Management System as a support in the educational process.”

Rahman, A. S. A., & Harun, R. N. S. R. (2018). TESL pre-service teachers' TPACK: A review. *International Journal of Academic Research in Business and Social Sciences*, 8(2), 795–804. doi:10.6007/IJARBSS/v8-i2/3986

Abstract: “The TPACK framework represents a significant role in fostering pedagogical improvement of education in the twenty-first century learning. The use of ICT in twenty first century classroom requires a level of knowledge and expertise of teachers in achieving the learning objectives. A systematic literature review about technology integration and TPACK of 20 journal articles, published between 2011 and 2018 were studied. The purpose of the review is to investigate the technology integration among pre-service teachers and also TPACK Framework among ESL/EFL in teacher education programs. Expected finding shall serve as an improvised integrated model that covers the gap and enhance the TPACK Curriculum framework. Based on the reviews, it provides a number of integral suggestions on for the betterment of TPACK Framework for pre–service teachers in teacher education programs and institutions.”

Ramma, Y., Bholoa, A., Watts, M., & Nadal, P. S. (2018). Teaching and learning physics using technology: Making a case for the affective domain. *Education Inquiry*, 9(2), 210–236. doi:10.1080/20004508.2017.1343606

Abstract: “Even though its importance is underscored in many research pursuits, attention to the affective domain in learning is often neglected at the expense of the cognitive development of students studying science, in particular physics. In this paper we propose a framework, the pedagogical technological integrated medium (PTIM) founded on the TPACK model, that builds on the existing premises of pedagogy, content and technology to make space for the affective domain where these three premises intersect with each other. We operationalize the PTIM framework through a multi-loop model that explores the affective dimension as an overarching space for interaction among learners, teachers and parents through a series of stages encompassing home tasks, as well as classroom and out-of-school activities. Within the qualitative paradigm, we substantiate from two case studies, an exploratory and an evaluative one in two different schools, that a succinct synchronisation of these various interactive elements promotes knowledge construction springing from the affective domain in terms of motivation, interest and values and also from their inter-relationships.”

Rocha Fernandes, G. W., Rodrigues, A. M., & Ferreira, C. A. (2018). Professional development and use of digital technologies by science teachers: A review of theoretical frameworks. *Research in Science Education*. Advance online publication. doi:10.1007/s11165-018-9707-x

Abstract: “This article aims to characterise the research on science teachers' professional development programs that support the use of Information and Communication Technologies (ICTs) and the main trends concerning the theoretical frameworks (theoretical foundation, literature review or background) that underpin these studies. Through a systematic review of the literature, 76 articles were found and divided into two axes on training science teachers and

the use of digital technologies with their categories. The first axis (*characterisation of articles*) presents the category *key features* that characterise the articles selected (major subjects, training and actions for the professional development and major ICT tools and digital resources). The second axis (*trends of theoretical frameworks*) has three categories organised in theoretical frameworks that emphasise the following: (a) the digital technologies, (b) prospects of curricular renewal and (c) cognitive processes. It also characterised a group of articles with theoretical frameworks that contain multiple elements without deepening them or that even lack a theoretical framework that supports the studies. In this review, we found that many professional development programs for teachers still use inadequate strategies for bringing about change in teacher practices. New professional development proposals are emerging with the objective of minimising such difficulties and this analysis could be a helpful tool to restructure those proposals.”

Rubadeau, K. (2018). Internal and external forces: Technology use among English language teacher educators in South Korea. *Australasian Journal of Educational Technology*, 34(5), 44–57. doi:10.14742/ajet.3369

Abstract: “Surprisingly little has been written about the technology-related roles and practices of teacher educators. Even less is known about the adoption of technologies by teacher educators in the field of teaching English to speakers of other languages (TESOL), even in the technology-rich nation of South Korea. The purpose of the present in-depth instrumental multiple case study was to explore internal and external forces in the integration of digital technologies into the pedagogical practices of TESOL teacher educators at a university in South Korea. Data collected over 20 weeks included four rounds of semi-structured interviews and two sets of classroom observations for each of the five focal participants, interviews with an administrator, written reflections, field notes, photographs, and document review. Five key forces were identified that worked in tension with voluntary use of technologies to mediate their extensive use in the teacher educators’ practice. This study contributes to research gaps on the roles and technology-related practices of TESOL teacher educators. TESOL program administrators and teacher educators will particularly benefit from the light shed on teacher educator cognitions and praxis in this study.”

Rubio, J. C. C., Serrano, J. S., & Martinez, J. C. B. (2018). Digital competence in future teachers of social sciences in primary education: Analysis of the TPACK framework. *Educatio Siglo XXI*, 36(1), 107-108. doi:10.6018/j/324191

Abstract: "The present study describes the use of digital competence in the treatment of Social Science contents in future teachers. 153 primary Education Degree students were asked to complete a questionnaire which was analyzed through TPACK (Technological Pedagogical Content Knowledge). The conclusions confirm a greater self-knowledge of pedagogical or technological contents, as opposed to disciplinary ones, which makes it impossible, following the model application, to develop digital teaching competence for the development of a critical didactics in Social Sciences."

Sanagavarapu, P. (2018). From pedagogue to technogogue: A journey into flipped classrooms in higher education. *International Journal on E-Learning*, 17(3), 377–399.

Abstract: “Despite a growing body of research and resources on flipped classrooms, the voices and transformative journeys of tertiary educators—their perspectives, practices, challenges, and adaptations to flipped teaching in higher education have been missing. To address this gap, in this paper, I chronicled my journey into flipped classrooms, in two early childhood units/courses in the pre-service teacher education program at an Australian university. Using a self-study approach, I provide an insight into my subjective and intellectual perspectives of flipping, challenges in promoting students’ engagement and self-discipline in online spaces, and how I triumphed those challenges using a holistic pedagogical design, incorporating ‘TPACK’ and ‘Scaffolding’. Furthermore, I chronicle my transformations in my teaching identity, from a traditional, embodied ‘pedagogue’ to a ‘technogogue’ within virtual teaching spaces. My intention is to provide insights into the realities of flipped learning and suggest pointers to other academics who may be embarking on a journey into flipped classrooms in higher education.”

Sensoy, O., & Yildirim, H. I. (2018). The effect of technological pedagogical content knowledge-based on training programs used in astronomy classes on the success levels of science teacher candidates. *Universal Journal of Educational Research*, 6(6), 1328–1338. doi:10.13189/ujer.2018.060624

Abstract: “The aim of this study is to examine the impact of the Technological Pedagogical Content Knowledge (TPCK) based educational practices in astronomy lectures on prospective science teachers’ success levels. The study was conducted on 4th-grade prospective science teachers of a public university and lasted for 14 weeks. In the study, quasi-experimental method and pre-test post-test control group experimental design were employed. The study was conducted in 2015-2016 Academic Year, in the Astronomy Course. In total, 72 students (control group=35, experimental group=37) participated in the study. “Astronomy Success Test” was used as data collection tool. The KR-20 reliability coefficient of the test was calculated as 0.81. During the research process, the instruction was carried out by following the current Astronomy Course Curriculum in both groups. In addition to this, in the instruction process of the experimental group TPCK based educational practices were applied. In the research, it was determined that an improvement has occurred in success levels at a significant level of the students in the experimental group. In addition, it was also determined that the post-test astronomy success scores of the students in the experimental group are significantly higher than the scores of the students in the control group.”

Simsek, O., & Yazar, T. (2018). Analyzing technology integration self-efficacy of prospective teachers: The case of Turkey. *Electronic Journal of Social Sciences*, 17(66), 744–765.

Abstract: “The purpose of this research is to examine the technology integration self-efficacy of prospective teachers in the framework of technological pedagogical content knowledge determined in the context of International Society for Technology in Education Standards

(TPAB-ISTE) and to investigate whether the predictors of preparing pre-service teachers for technology use predicted the TPACK-ISTE self-efficacy significantly and how well those values predicted the TPACK-ISTE self-efficacy. Correlational and causal-comparative research designs of quantitative research methods were used in this research. The sample consists 3932 prospective teachers who study at undergraduate programs' senior class level and pedagogical formation certificate programs at 18 different state universities in Turkey. In this research, a scale of which theoretical framework depends on TPACK and based on ISTE's standards is used for data collection. According to the results of the research, significant difference was seen in favor of male teacher candidates in terms of technological knowledge. Also the prospective teachers who took computer courses based on a certificate had significantly higher technological knowledge and TPACK-ISTE self-efficacy scores than the others. The results indicated no significant difference in all dimensions and general scores of TPACK-ISTE self-efficacy in point of the type of program that prospective teachers attended. The predictors of preparing pre-service teachers for technology use more significantly predicted technological knowledge and TPACK-ISTE self-efficacy dimensions than the other dimensions."

Soomro, S., Soomro, A. B., Ali, N. I., Bhatti, T., Basir, N., & Gill, N. P. (2018). TPACK adaptation among faculty members of education and ICT departments in University of Sindh, Pakistan. *International Journal of Advanced Computer Science and Applications*, 9(5), 203–209. doi:10.14569/IJACSA.2018.090526

Abstract: "Technological Pedagogical Content Knowledge (TPACK) framework has been to investigate the technological and instructive knowledge of teachers. Many researchers have found this framework a useful tool to explore teachers' awareness regarding TPACK and how do they are relating it in learning and teaching process in different educational settings. During its first generation time period which was from year 2006 to year 2016, TPACK constructs took a decade to get explained and interpreted by researchers. Now, it has entered in its second generation but still contextual aspect yet not being explored in detail. This study addresses two areas; firstly, to measure the TPACK of faculty members of ICT and Education departments of University of Sindh; and secondly, to unfold the impact of four circumstantial/contextual factors (Technological, Culture of Institute, Interpersonal, and Intrapersonal) on the selected faculty members in using TPACK into their own subject domains. The results showed that both faculties are already taking in technology along with their teaching practices instead of limited technological resources. Besides this, they were found collaborative in teaching and open to the technology. This study reports the TPACK framework adaptation among higher education faculty members at University of Sindh. It also helped in understanding the intrapersonal beliefs of faculty members regarding technology integration with pedagogical and content knowledge."

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.

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.”

Teo, T., Milutinovic, V., Zhou, M., & Bankovic, D. (2018). Traditional vs. innovative uses of computers among mathematics pre-service teachers in Serbia. *Interactive Learning Environments*, 25(7), 811–827. doi:10.1080/10494820.2016.1189943

Abstract: “This study examined pre-service teachers' intentions to use computers in traditional and innovative teaching practices in primary mathematics classrooms. It extended the technology acceptance model (TAM) by adding as external variables pre-service teachers' experience with computers and their technological pedagogical content knowledge (TPCK). Data collected from 226 participants revealed that the proposed model had a good fit for both traditional and innovative uses of computers. Structural equation modelling suggested that the established TAM variables, together with TPCK and experience, were significant determinants of pre-service teachers' intentions to use computers in teaching mathematics at both levels. The most dominant determinant of behavioural intention was TPCK, followed by attitude. The proposed model explained 22.7% of the variance in the use of computers in traditional teaching practices and 27.6% of the variance in the use of computers in innovative teaching practices. The implications for mathematics teaching are discussed in the final section.”

Tisdell, C. C. (2018). Pedagogical alternatives for triple integrals: Moving towards more inclusive and personalized learning. *International Journal of Mathematical Education in Science & Technology*, 49(5), 792–801. doi:10.1080/0020739X.2017.1408150

Abstract: “This paper is based on the presumption that teaching multiple ways to solve the same problem has academic and social value. In particular, we argue that such a multifaceted approach to pedagogy moves towards an environment of more inclusive and personalized learning. From a mathematics education perspective, our discussion is framed around pedagogical approaches to triple integrals seen in a standard multivariable calculus curriculum. We present some critical perspectives regarding the dominant and long-standing approach to the teaching of triple integrals currently seen in hegemonic calculus textbooks; and we illustrate the need for more diverse pedagogical methods. Finally, we take a constructive position by introducing a new and alternate pedagogical approach to solve some of the classical problems involving triple integrals from the literature through a simple application of integration by parts. This pedagogical alternative for triple integrals is designed to question the dominant one-size-fits-all approach of rearranging the order of integration and the privileging of graphical

methods; and to enable a shift towards a more inclusive, enhanced and personalized learning experience.”

Tsai, P. S., & Tsai, C. C. (2018). Preservice teachers' conceptions of teaching using mobile devices and the quality of technology integration in lesson plans. *British Journal of Educational Technology*. Advance online publication. doi:10.1111/bjet.12613

Abstract: “This study explored the relationships among preservice teachers' conceptions of teaching using mobile devices and the quality of technology integration in lesson plans. A total of 47 preservice teachers in Taiwan who had experienced designing their own lesson plans and teaching materials (ie, eBooks and applications) for teaching using mobile devices (ie, smart phones and tablet PCs) participated in this study. The results showed that four qualitatively different conceptions of teaching using mobile devices were identified, namely “technology support,” “knowledge transmission,” “learning facilitation,” and “supporting students to learn.” This study also found that the teachers who had more constructivist perceptions of teaching using mobile devices, such as facilitating students' understanding in a convenient way or supporting student learning in a more active way, appeared to attain better quality technology integration in their lesson plans than those teachers with traditional conceptions.”

Tseng, J. J. (2018). Exploring TPACK-SLA interface: Insights from the computer-enhanced classroom. *Computer Assisted Language Learning*, 31(4), 390–412. doi:10.1080/09588221.2017.1412324

Abstract: “Technological pedagogical content knowledge (TPACK) proposed by Mishra and Koehler is a theoretical construct of teacher knowledge that describes how teachers teach subject matter content using certain instructional methods with specific technology in particular contexts. This study aims to explore the interface between TPACK and SLA, intending to examine (a) how a Taiwanese English teacher enhanced L2 interaction and (b) how her students perceived such teaching. While data regarding the teacher's TPACK-SLA knowledge was collected through lesson plans, classroom observations, and interviews, data associated with students' perceptions was obtained through a questionnaire survey and focus-group interviews. The findings suggest that the teacher enhanced L2 interaction by (a) drawing students' attention to grammatical patterns through annotated animations, (b) consolidating vocabulary use through image-based exercises and a bilingual concordancer, and (c) evaluating the use of sentence patterns through text-chatting with a chatbot. While the students could improve learner-computer interaction through obtaining enhanced input, they could also develop inter-personal communication competency through negotiating meaning. In addition, the students appreciated the ways their teacher taught English using *Cool English*. This study contributes some empirical insights into how EFL teachers can draw upon practices explored in instructed SLA to develop TPACK.”

Urban, E. R., Navarro, M., & Borron, A. (2018). TPACK to GPACK? The examination of the technological pedagogical content knowledge framework as a model for global

integration into college of agriculture classrooms. *Teaching and Teacher Education*, 73, 81–89. doi:10.1016/j.tate.2018.03.013

Abstract: “Faculty in U.S. colleges of agriculture are encouraged to internationalize their classroom curricula, but further research is needed to determine how to best prepare faculty. This study explores the transferability of the technological pedagogical content knowledge model (TPACK), originally used for technology integration, to our proposed model, the global pedagogical content knowledge model (GPACK), for the effective integration of global concepts into content-specific courses. Interviews from eight program participants of a yearlong faculty development program imply combined faculty training in global issues, pedagogy, *and* content, rather than in an exclusive knowledge area, may more adequately prepare faculty for classroom internationalization.”

Vickrey, T., Golick, D., & Stains, M. (2018). Educational technologies and instructional practices in agricultural sciences: Leveraging the technological pedagogical content knowledge (TPACK) framework to critically review the literature. *NACTA Journal*, 62, 65–76.

Abstract: “Instructional technologies, such as interactive simulations and mobile devices, have become more common in higher education. We present a systematic review of the agricultural sciences literature (N=53) to characterize the kinds of instructional technologies that have been used and identify the extent to which agricultural sciences studies investigating instructional technologies have addressed the components of a broader Technology Pedagogical Content Knowledge (TPACK) framework targeting the meaningful integration of technology in instructional practices. Instructional technologies in the agricultural sciences typically consist of modular, multimedia resources (55%) and have been used to support learning diverse content areas. This literature emphasizes understanding and assessing students' perceptions of learning technologies (82%) as well as utilizing affordances of technology, such as the ability to communicate from remote locations in real-time, to support collaboration among students. However, less attention has been given to understanding which technologies best support which specific agricultural science content. Finally, we identified important constructs, such as students' perception of technology, that are addressed in the agricultural sciences literature but not currently represented within the TPACK framework. We suggest considerations for future use of the TPACK framework, as a means to guide researchers investigating the integration of technology in postsecondary courses.”

Yildirim, B., & Sidekli, S. (2018). STEM applications in mathematics education: The effect of STEM applications on different dependent variables. *Journal of Baltic Science Education*, 17(2), 200–214.

Abstract: “The purpose of the research is to analyze the effect of STEM applications on mathematics pre-service teachers' mathematical literacy self-efficacy, technological pedagogical knowledge and mathematical thinking skills and their views on STEM education. This research has been carried out by 29 mathematics pre-service teachers who are schoolers at the educational faculties of Mus Alparslan University. The research was completed in 10

weeks (3 hours per week) in spring semester of 2016-2017 academic year. Mixed research approach was used in the study. "Mathematical Literacy Self-Sufficiency Scale", "Mathematical Thinking Scale", "Technological Pedagogical Area Information Scale" and "STEM Interview Form for Mathematics Pre-service Teachers" were used as data collection instruments. The collected data were analyzed, and it was certain that the STEM applications positively affected the pre-service teachers' mathematics literacy self-efficacy and technological pedagogical content knowledge. However, STEM applications were not seemed to have a positive effect on mathematical thinking. Moreover, when the opinions of the pre-service teachers were examined, it was identified that the STEM applications changed positively the opinions of the pre-service teachers about the mathematical literacy, and that they lacked many subjects such as field knowledge and pedagogy knowledge about STEM education. Suggestions were made in the direction of the findings obtained."

Chapters

Asik, A. (2018). Digital storytelling and its tools for language teaching: Perceptions and reflections of pre-service teachers. In Information Resources Management Association (Ed.), *Teacher training and professional development: Concepts, methodologies, tools, and applications* (pp. 1005-1020). Hershey, PA: IGI Global. doi:10.4018/978-1-5225-5631-2.ch045

Abstract: "This paper presents the analysis of the self-reported reflections of pre-service English teachers about the use of digital storytelling and its tools in terms of Technological Pedagogical Content Knowledge. Through the reflection reports of 78 pre-service English teachers and a focus-group interview after implementing a digital storytelling project, the present study investigated the perceptions and reflections of pre-service English teachers regarding the use of digital storytelling to teach English to young learners. The data were analysed through mixed (qualitative and quantitative) methods. The results revealed that pre-service English teachers reflected positive perceptions towards to the use of digital storytelling. Their reflections are significant in terms of the tools to be used for digital storytelling, the viewpoints regarding young learners and the improvement in their Technological Pedagogical Content Knowledge. The findings should be of interest to teacher education programs in supporting pre-service teachers to integrate technology into language classrooms."

Bernal, E. V., & Farmer, L. S. J. (2018). Evaluating a professional development program for course redesign with technology: The faculty end-user experience. In Information Resources Management Association (Ed.), *Teacher training and professional development: Concepts, methodologies, tools, and applications* (pp. 476-497). Hershey, PA: IGI Global. doi:10.4018/978-1-5225-5631-2.ch021

Abstract: "This study evaluated a California State University Course Redesign Professional Development program, focusing on the user experience of STEM faculty as they learned about technology and applied their learning to develop technology-enriched instructional strategies

that enhanced students' own educational experiences. Data were collected from the first two academic years of the professional development program. A conceptual framework that melded andragogy, Technological, Pedagogical, and Content Knowledge (TPACK), Diffusion of Innovation, and Communities of Practice theories were used to analyze archived professional development training content and faculty-produced electronic portfolios. The findings demonstrate that faculty collaborative processes in the online training and in site-based collaborative efforts were the main aspect of the course redesign program that facilitated technology integration, instructional development, and positive student learning outcomes."

Connell, M. L., & Abramovich, S. (2018). STEM teaching and learning via technology-enhanced inquiry. In Information Resources Management Association (Ed.), *Teacher training and professional development: Concepts, methodologies, tools, and applications* (pp. 595-619). Hershey, PA: IGI Global. doi:10.4018/978-1-5225-5631-2.ch026

Abstract: "This chapter aims to address several limitations of Technological Pedagogical Content Knowledge (TPACK) – a theoretical model used in the application of technology when teaching STEM disciplines. To this end, a supplement to TPACK drawn from the Action on Objects (AO) framework (Connell, 2001) is suggested. To illustrate the value of the proposed enhancement of TPACK, an example integrating science, technology, and mathematics is provided. The Texas College and Career Readiness Standards are used to demonstrate the relationship between the proposed theoretical modification of the leading model and the current teaching practice involving such scientific activities as measuring, record keeping, analyzing, conjecturing and evaluating. Additional suggestions and applications of the TPACK/AO model are provided."

de Groot, C., Fogleman, J., & Kern, D. (2018). Using mobile technologies to co-construct TPACK in teacher education. In Information Resources Management Association (Ed.), *Teacher training and professional development: Concepts, methodologies, tools, and applications* (pp. 889-913). Hershey, PA: IGI Global. doi:10.4018/978-1-5225-5631-2.ch039

Abstract: "How student teachers might benefit from using their mobile technologies during teaching experiences is a timely question for teacher educators. This chapter describes efforts to use the TPACK framework (Mishra & Koehler, 2006) to investigate how students use iPad computers during their student teaching and design appropriate supports. A design-based approach (Sandoval & Bell, 2004) was used over two years with two cohorts of student teachers (N=60). Descriptions of the use of the TPACK framework in this endeavor and findings from surveys and field notes about how and to what degree mobile technology can facilitate activities and interactions in planning, teaching, reflecting, and sharing are included. The case is made for co-learning and co-constructing by student teachers and teacher educators of the various TPACK domains of teacher knowledge in the context of mobile technology. Implications for developing supportive learning environments for 21st century student teachers are also discussed."

Dreon, O., Shettel, J., & Bower, K. M. (2018). Preparing next generation elementary teachers for the tools of tomorrow. In Information Resources Management Association (Ed.),

Teacher training and professional development: Concepts, methodologies, tools, and applications (pp. 2224-2240). Hershey, PA: IGI Global. doi:10.4018/978-1-5225-5631-2.ch106

Abstract: "This chapter examines the results from ongoing research of an authentic, problem-based learning (PBL) project. Embedded in an instructional technology course, the project was designed to help preservice teachers develop technological pedagogical content knowledge (TPACK) necessary to successfully incorporate digital tools and applications in elementary classrooms (Harris, Mishra, & Koelher, 2009). The project partnered the preservice teachers with local elementary school classrooms where they served as instructional designers to develop digital media in support of a flipped classroom initiative. Results indicate that the semester-long PBL-based assignment significantly impacted the preservice teachers' TPACK development in several critical areas and can serve as a model for advancing next generation teacher education. Overarching themes that emerged and recommendations for future research are offered as well."

Driskell, S. O., Bush, S. B., Ronau, R. N., Niess, M.L., Rakes, C. R., & Pugalee, D. K. (2018). Mathematics education technology professional development: Changes over several decades. In Information Resources Management Association (Ed.), *Teacher training and professional development: Concepts, methodologies, tools, and applications* (pp. 115-144). Hershey, PA: IGI Global. doi:10.4018/978-1-5225-5631-2.ch006

Abstract: "The effective use of digital technologies in school settings calls for appropriate professional development opportunities that will transform inservice teachers' knowledge for integrating technologies as effective mathematics learning tools. To inform such opportunities, this study examined the contents of published mathematics education technology professional development papers over several decades using Sztajn's (2011) standards for high quality reporting in mathematics professional development research studies, the Technological Pedagogical Content Knowledge framework, and the Comprehensive Framework for Teacher Knowledge. Both the Professional Development Implementation and Evaluation Model and Education Professional Development Research Framework are recommended for further guidance on reporting key features of mathematics education technology professional development."

Farmer, L. S. J. (2019). The role of librarians in blended courses. In J. Keengwe (Ed.), *Handbook of research on blended learning pedagogies and professional development in higher education* (pp. 122–138). Hershey, PA: IGI Global. doi:10.4018/978-1-5225-5557-5.ch007

Abstract: "This chapter investigates the intersection of instructional design and implementation, blended learning, ICT literacy, and academic librarians within higher education. Using the TPACK, pedagogy 2.0, and community of inquiry models, the chapter explains how librarians can help academic instructors design blended courses that effectively

address physical and intellectual access to a wide variety of resources, especially digital materials, in order to optimize student learning.”

Filipi, Z., & Rohlikova, L. (2018). Preservice teachers and active learning in technology-enhanced learning: The case of the University of West Bohemia in the Czech Republic. In A. Misseyanni, M. D. Lytras, P. Papadopoulou, & C. Marouli (Eds.), *Active learning strategies in higher education: Teaching for leadership, innovation, and creativity* (pp. 211–245). Bingley, UK: Emerald Publishing.

Abstract: “This chapter presents innovative approaches to active learning that were introduced into the teaching of preservice teachers at the Faculty of Education of University of West Bohemia, Pilsen, in the Czech Republic. Over the last three years, the Technology-Enhanced Learning course has seen substantial innovations in both the content and use of teaching strategies designed to prepare the students for their professional lives. The whole update of the course was implemented using the results of action research – all individual changes were rigorously tracked and analyzed. The state of the art in the active learning domain in education of preservice teachers is presented in this chapter.

There is a description of the procedure to update the course, based on the reflections of teachers and feedback from students, gathered during action research. Detailed evaluations of particular methods of active learning that have been proven in teaching are provided.

Besides practical activities with tablets and smartphones, during which students familiarize themselves with various types of applications and reflect on their use in teaching, the course was extended by the use of practical aids for the efficient inclusion of mobile technologies for teaching – the Czech version of Allan Carrington’s Padagogy Wheel. This aid is derived from the revised Bloom’s taxonomy and SAMR model and helps the systematic reflection of preservice teachers when preparing for technology-enhanced teaching.

A significant part of the teaching consists of cooperative projects between preservice teachers and pupils of elementary schools – for example, the preservice teachers help elementary school pupils discover possibilities of virtual reality during Google Cardboard activities, or preservice teachers in teams with elementary school pupils create digital stories together on the topic of Internet safety.

The innovative approach to active teaching in the Technology-Enhanced Learning course is apparent even during the exam. In the course of the exam, students process, present, and defend a lesson plan for the implementation of an activity using digital technologies. Throughout the learning, as well as at the end, preservice teachers are encouraged to reflect on the teaching in the Technology-Enhanced Learning subject.”

Finger, G. (2018). Improving initial teacher education in Australia: Solutions and recommendations from the teaching teachers for the future project. In Information Resources Management Association (Ed.), *Teacher training and professional development: Concepts, methodologies, tools, and applications* (pp. 45–66). Hershey, PA: IGI Global.

Abstract: “Initial teacher education (ITE) programs are subject to agencies which shape and define them through regulatory accreditation processes (Lloyd, 2013a, 2013b). This chapter argues that the design of ITE programs needs to build the Technological Pedagogical Content Knowledge (TPACK) capabilities (Mishra & Koehler, 2006, 2008) of future teachers. After establishing that there are both accountability and improvement agendas, this chapter outlines the Teaching Teachers for the Future (TTF) Project, which involved all 39 Australian Higher Education Institutions providing ITE programs in Australia. The TTF Project was a 15 month long, \$8 million project, funded by the Australian Government’s ICT discussed in terms of the TPACK conceptualization guiding the project, and the research and evaluation of that project. The TTF Project’s key outcomes are summarized, and these inform the presentation of solutions and recommendations.”

Fraga, L. M., Guzman Foster, S. L., & Falcon, L. (2019). Model for my students? I’m not sure how to integrate technology either. In J. Keengwe (Ed.), *Handbook of research on blended learning pedagogies and professional development in higher education* (pp. 274–289). Hershey, PA: IGI Global. doi:10.4018/978-1-5225-5557-5.ch015

Abstract: “This chapter discusses two case studies that examined tenure/tenure track faculty who participated in a consultative support model of professional development at one private university in South Texas. The professional development was faculty driven and focused on improving faculty technology skills and classroom use of technology tools. This pilot study was the result of a unique situation where two faculty members were given the opportunity to work with a technology consultant on an individual and weekly basis. Influences such as lack of time, faculty load, student skill level, and rapid changes in technology all contributed in shaping the roles and practices of higher education faculty's use of technology. However, utilizing participatory action research both professors surmised that the consultative approach allowed for all participants to engage as learners, which assisted higher education faculty's development in the use of technology.”

Gandolfi, E. (2018). Virtual reality and augmented reality. In R. E. Ferdig & K. Kennedy (Eds.), *Handbook of research on K-12 online and blended learning* (pp. 545–561). Pittsburgh, PA: ETC Press.

Abstract: “This chapter provides a wide overview of Augmented Reality (AR) and Immersive Virtual Reality (IVR) in education. Even though their role in K-12 online learning and blended environments is still at an early stage, significant efforts have been made to frame their core affordances and constraints, and potential future developments are outlined. Therefore, in the following pages AR and IVR are introduced along with significant research and highlights from scholars and practitioners. Furthermore, a reflection about current challenges and next steps in terms of policies and integration is provided. Additionally, suggestions to help inform further investigations and inquiries are shared. Despite high costs, inadequate pedagogies, and continuously developing technology, these tools can provide a significant opportunity for immersion and will play a key role in future educational settings; therefore, scholars and practitioners need to be properly involved and trained.”

Lock, J. V., Johnson, C., Altowairiki, N., Burns, A., Hill, L., & Ostrowski, C. P. (2019). Enhancing instructor capacity through the redesign of online practicum course environments using universal design for learning. In J. Keengwe (Ed.), *Handbook of research on blended learning pedagogies and professional development in higher education* (pp. 1–20). Hershey, PA: IGI Global. doi:10.4018/978-1-5225-5557-5.ch001

Abstract: “A current trend in practicum or field experience programs is online and blended learning approaches being implemented alongside traditional classroom experiences. Principles of Universal Design for Learning (UDL) should be integrated in the design of these online environments in order to better support learning needs of all students. Instructors must also have confidence and competence in designing and facilitating learning within technology-enabled environments. This chapter reports on research conducted using design-based research to support instructor capacity development within field experience in a Bachelor of Education program. Three strategies are identified and discussed to enhance instructor's capacity: scaffolded support, modeling UDL practice in the online environment, and coaching to foster developing capacity using UDL. The chapter concludes by reporting on a new study that emerged as a result of this work, along with recommendations for practice.”

Meletiyou-Mavrotheris, M, Mavrou, K., Stylianou, G., Mavromoustakos, S., & Christou, G. (2014). Teaching mathematics with tablet PCs: A professional development program targeting primary school teachers. In A. Heejung, S. Alon, & D. Fuentes (Eds.), *Tablets in K-12 education: Integrated experiences and implications* (pp. 175-197). Hershey, PA: IGI Global. doi:10.4018/978-1-4666-6300-8.ch012

Abstract: "Declining interest in mathematics and the need to raise the educational standards of youth in this discipline set a critical agenda for the revision of pedagogical practices. Tablet PCs and other mobile devices hold a lot of promise as tools for improving education at all levels. The research discussed in this chapter comes from an ongoing, multifaceted program designed to explore the potential of tablet technologies for enhancing mathematics teaching and learning at the primary school level. The program is taking place within a private primary school in Cyprus and aims at the effective integration of one-to-one tablet technologies (iPads) into the mathematics school curriculum. It has adopted a systemic approach to the introduction of iPads in the school setting that focuses on the broad preparation and on-going engagement of all key stakeholders involved in the educational process. In the chapter, the authors report on the main experiences gained from Phase 1 of the program, which involved the design and organization of a professional development workshop targeting the school teachers. The authors describe the content and structure of the workshop and discuss its impact on teachers' knowledge, skills, and confidence in incorporating tablet technologies within the mathematics curriculum."

Niess, M. L. (2018). Applying the TPACK learning trajectory in blending practical teaching experiences with online community of learners' explorations. In Information Resources Management Association (Ed.), *Teacher training and professional development:*

Concepts, methodologies, tools, and applications (pp. 1346-1366). Hershey, PA: IGI Global. doi:10.4018/978-1-5225-5631-2.ch061

Abstract: "Inservice teacher preparation balances theory with practical experiences to support teachers in integrate their theoretical knowledge into their teaching practice. Online instruction holds potential for this education but questions how classroom observations are conducted in the teachers' classroom practices, particularly where the teachers are geographically dispersed. This multiple case descriptive study examines an online analogue to traditional classroom observations, where the Scoop Notebook (Borko, Stecher, & Kuffner, 2005) reveals inservice teachers' Technological Pedagogical Content Knowledge (TPACK), more specifically their TPACK-of-practice (Cochran-Smith & Lytle, 1999). The Scoop Electronic Portfolio development process describes teachers' engagement in classroom practices, transitioning their scholarly theoretical knowledge to practical knowledge through in-depth, rich reflections from classroom actions and artifacts. This course blends the practical experiences of the Scoop process with asynchronous community of learners' explorations of instructional strategies. The results describe teachers engaged in action research using Scoop artifacts as objects to think with for transforming their TPACK for integrating technologies in teaching their content, ultimately transforming their TPACK-of-practice."

Niess, M. L. (2018). Introduction to teachers' knowledge-of-practice for teaching with digital technologies: A technological pedagogical content knowledge (TPACK) framework. In Information Resources Management Association (Ed.), *Teacher training and professional development: Concepts, methodologies, tools, and applications* (pp. 145–159). Hershey, PA: IGI Global.

Abstract: "Technological pedagogical content knowledge (TPACK) is a dynamic theoretical description of teachers' knowledge for designing, implementing, and evaluating curriculum and instruction with digital technologies. TPACK portrays the complex interaction among content knowledge, pedagogical knowledge and technological knowledge for guiding teachers in the strategic thinking of when, where, and how to direct students' learning with technologies. Teacher educators' and educational researchers' acceptance of the TPACK construct mirrors the acceptance of its parent construct of pedagogical content knowledge (PCK). The importance of teachers' continued practice in integrating technologies is essential for extending and enhancing their TPACK. Connections with the knowledge-of-practice (Cochran-Smith & Lytle, 1999) construct suggests calling TPACK as TPACK-of-practice to more accurately describe the process of the knowledge development efforts for guiding inservice and preservice teachers in gaining, developing, and transforming their knowledge for teaching as new and more powerful technologies emerge for integration in education."

Niess, M. L. (2018). Looking to the future in transforming inservice teachers' TPACK through online continued learning. In Information Resources Management Association (Ed.), *Teacher training and professional development: Concepts, methodologies, tools, and applications* (pp. 2163-2176). Hershey, PA: IGI Global. doi:10.4018/978-1-5225-5631-2.ch103

Abstract: "The design and empirical support for the online TPACK learning trajectory emerged through a multi-year research process that provided a thorough, in-depth description of how the tools (community of learners and reflection) and processes (shared/individual knowledge development and inquiry) support the scaffolding of TPACK content as an integration of subject matter content, pedagogy, and technologies, thus modeling the knowledge teachers need for teaching with technology. The learning trajectory, framed with a social metacognitive constructivist lens, engaged inservice teachers in knowledge-building communities using inquiry-based, problem-based learning, guiding them in reframing their knowledge for designing student-directed, problem-based learning with the integration of technologies. Limitations and future research extend the understanding of TPACK through online teacher education continued learning in graduate programs and other professional development programs designed to support teachers in rethinking and reframing their knowledge for teaching with technologies. Multiple factors frame the thinking about future designs for these online programs aimed at transforming inservice teachers' TPACK. Future challenges include whether and how online programs might be designed for developing preservice teachers' TPACK."

Niess, M. L. (2018). Online learning trajectory for knowledge-building communities to reframe inservice teachers' TPACK. In Information Resources Management Association (Ed.), *Teacher training and professional development: Concepts, methodologies, tools, and applications* (pp. 839-862). Hershey, PA: IGI Global. doi:10.4018/978-1-5225-5631-2.ch037

Abstract: "Knowledge-building communities facilitate learning through collaborative explorations and investigations using today's technologies as learning tools. Such communities support teachers in developing their Technological Pedagogical Content Knowledge (or TPACK) so they are able to rearrange educational experiences using a systems pedagogical approach for engaging students in communication, collaboration and inquiry-oriented technologies. A current educational setting for reframing inservice teachers' knowledge involves online instruction. A researcher conjectured, empirically supported online TPACK learning trajectory provides guidelines for teacher educators as they design new online coursework for guiding teachers in enhancing their TPACK. Using a design-based research methodology, a social metacognitive constructivist instructional lens frames this online learning trajectory for organizing the course content development by interweaving descriptive tasks with specific pedagogical strategies towards reframing inservice teachers' knowledge through knowledge-building communities. The resulting trajectory describes a dynamic interaction of key tools and instructional processes for scaffolding the content towards an enhanced TPACK understanding."

Niess, M. L. (2018). Online TPACK learning trajectory tools and processes. In Information Resources Management Association (Ed.), *Teacher training and professional development: Concepts, methodologies, tools, and applications* (pp. 987-1004). Hershey, PA: IGI Global. doi:10.4018/978-1-5225-5631-2.ch044

Abstract: "A multiple case, descriptive study provides research insights for illuminating the tools and processes in the online TPACK learning trajectory situated in a social metacognitive constructivist instructional framework for graduate coursework. In this course, inservice K-12 teachers relearn, rethink, and redefine teaching and learning for developing a 21st century literacy significantly influenced by the proliferation and societal acceptance of multiple digital technologies. The research examination identifies insights about the incorporation of the key tools (community of learners and reflection) and processes (shared/individual knowledge development and inquiry) in the online learning trajectory for reframing teachers' Technological Pedagogical Content Knowledge (TPACK). Three themes reveal how the online learning trajectory relies on these tools and processes for enhancing the participants' learning: the tools and processes are needed for constructing knowledge, for transitioning the participant's thinking as a student to that of a teacher, and for recognizing the value of pedagogical strategies for teaching and learning with technologies."

Niess, M. L. (2018). Scaffolding subject matter content with pedagogy and technologies in problem-based learning with the online TPACK learning trajectory. In Information Resources Management Association (Ed.), *Teacher training and professional development: Concepts, methodologies, tools, and applications* (pp. 914-931). Hershey, PA: IGI Global. doi:10.4018/978-1-5225-5631-2.ch040

Abstract: "This research-based application of an online inservice teacher education course highlights how scaffolding subject matter content, pedagogy, and technologies in a problem-based learning approach reframes teachers' TPACK for integrating digital image and video technologies with 21st century inquiry thinking skills: critical thinking, creative thinking, communicating and collaborating. The course design takes advantage of knowledge-building communities through the application of the online TPACK learning trajectory. The participants' products, interactions, and reflections demonstrate how the scaffolding engages them in high levels of thinking and learning in mathematics and science with digital image and video technologies. The result is an explanatory framework for how the scaffolding of the subject matter content, pedagogy, and technologies in problem-based learning with the online TPACK learning trajectory guides teachers in rethinking, relearning and reframing their TPACK knowledge for engaging students 21st century inquiry thinking with digital image and video technologies."

Niess, M. L., & Gillow-Wiles, H. (2018). Innovative instructional strategies for an online community of learners: Reconstructing teachers' knowledge. In Information Resources Management Association (Ed.), *Teacher training and professional development: Concepts, methodologies, tools, and applications* (pp. 542-565). Hershey, PA: IGI Global. doi:10.4018/978-1-5225-5631-2.ch024

Abstract: "This qualitative, design-based research identifies innovative instructional practices for teacher professional development that support an online community of learners in reconstructing their technological pedagogical content knowledge (TPACK) for teaching mathematics. This analysis describes instructional practices that guide inservice teacher

participants in inquiring and reflecting to confront their knowledge-of-practice conceptions for integrating multiple technologies as learning tools. The research program describes an online learning trajectory and instructional strategies supporting the tools and processes in steering the content development in a social metacognitive constructivist instructional framework towards moving from “informal ideas, through successive refinements of representation, articulation, and reflection towards increasingly complex concepts over time” (Confrey & Maloney, 2012). The results provide recommendations for online professional development learning environments that engage the participants as a community of learners."

Ouyang, F., & Scharber, C. (2018). Adapting the TPACK framework for online teaching within higher education. In Information Resources Management Association (Ed.), *Teacher training and professional development: Concepts, methodologies, tools, and applications* (pp. 1103-1121). Hershey, PA: IGI Global. doi:10.4018/978-1-5225-5631-2.ch051

Abstract: "There are ongoing obstacles in accurately assessing and effectively applying TPACK within online higher education contexts. In this study, we adapt the original TPACK constructs for application within online higher education, and share the results of a case study using this adapted analytical framework. This qualitative case study investigates and describes one experienced instructor's practice within a graduate-level online course. The instructor enacted a high-level of TPACK proficiency through combining content, pedagogy, and technology as well as masterfully using these knowledges within her online teaching practices. This research demonstrates one way the TPACK framework can be used as an analytical tool by researchers to investigate instructors' online teaching practices. In addition, the modified TPACK descriptions and evaluation criteria can be used to better assess TPACK and further support higher education faculty's online pedagogy development."

Papanikolaou, K. A., Makrh, K., Magoulas, G. D., Chinou, D., & Roussos, P. (2018). Synthesizing technological and pedagogical knowledge in learning design: A case study in teacher training on technology enhanced learning. In Information Resources Management Association (Ed.), *Teacher training and professional development: Concepts, methodologies, tools, and applications* (pp. 1021-1035). Hershey, PA: IGI Global. doi:10.4018/978-1-5225-5631-2.ch046

Abstract: "Based on a design rational for constructivist pre-service teacher training on Technology Enhanced Learning (TEL), in this paper the authors consider teachers as designers of innovative digital educational content. Under this lens, the selection of appropriate technologies is considered as a threefold process that concerns the availability of technological tools for implementing a virtual classroom that facilitates communication, collaboration, and administration, the enabling technologies for serving specific learning purposes, and the technologies or tools that support trainees to design effective TEL-based courses. A number of questions emerge as the authors are looking for the most appropriate technologies for cultivating certain competences related to class operation, learning design and student engagement in a constructive manner. As a first step, in this paper, they investigate how trainees combine particular technologies with pedagogical tools to cultivate specific

competences i.e. certain types of Technological Pedagogical Content Knowledge. Lastly, factors that trainees perceive as influential when adopting TEL tools in practice are revealed by their study."

Parkison, P., & Thomas, J. A. (2018). Using web 2.0 tools to engage content, promote self-efficacy, and implications for intentional student learning. In R. C. Sharma (Ed.), *Innovative applications of online pedagogy and course design* (pp. 42-62). Hershey, PA: IGI Global. doi:10.4018/978-1-5225-5466-0.ch003

Abstract: "This chapter defines Web 2.0 tools, their use in student learning, results from a study with university undergraduate students, and their implications for intentional student learning. Treatment subjects used a discussion board style site called TitanPad® to respond to a journal prompt after reading an article and before attending a subsequent class to discuss the journal article. Results are discussed for likelihood to read the assignment, amount of time spent reading, perception about being ready to discuss the material, perceived contribution to in-class work, and comprehension of the material. One inference was that with no additional time investment, instructors might increase student in-class participation using a Web 2.0 tool and students' self-efficacy with material in their profession. This has important implications for the manner in which students interact with text and content as significant intersubjective actors in the learning process."

Reyes, V., Reading, C., Rizk, N., Gregory, S., & Doyle, H. (2018). An exploratory analysis of TPACK perceptions of pre-service science teachers: A regional Australian perspective. In Information Resources Management Association (Ed.), *Teacher training and professional development: Concepts, methodologies, tools, and applications* (pp. 1968-1983). Hershey, PA: IGI Global. doi:10.4018/978-1-5225-5631-2.ch093

Abstract: "Four distinct constructs were identified from a survey of a sample of pre-service science teachers at a regional Australian University. The constructs emerged after employing Exploratory Factor Analysis (EFA) on respondents' perceptions of pedagogical practices incorporating the use of Information Communication and Technology (ICT). The key components of the survey were derived from a Technological Pedagogical and Content Knowledge (TPACK) survey developed for a national project. For future investigations of TPACK application in university contexts, a four-construct configuration of pre-service teacher TPACK perceptions is proposed requiring empirical confirmation. This inquiry depicts a portrait of emerging domains of TPACK. The relevance of the findings and their implications for universities that rely heavily on ICT in the delivery of are discussed, especially in relation to improving teaching practices."

3. Recent TPACK-Related Dissertations and Theses

Blue, G. C. (2017). *Teachers of students with visual impairments in five North Carolina rural school districts and barriers to assistive technology implementation: An examination of*

their experiences and perceptions (Doctoral dissertation). Available from ProQuest Dissertations and Theses Global database. (UMI No. 10758833)

Abstract: “Visually impaired students, despite access to technology resources, experience difficulties in succeeding in higher education due to ineffective technology resource implementation and a lack of adequate assistive technology instruction. The purpose of this qualitative interview-based study was to determine barriers to assistive technology implementation by examining the experiences and perceptions of a diverse sample of teachers of visually impaired students in rural school districts in selected North Carolina Counties. Technological pedagogical content knowledge (TPACK) was the theoretical structure of this study, which is comprised of content, pedagogical, and technological knowledge in a technologically enhanced learning environment. The sample consisted of five TVIs from five North Carolina Rural County School Districts, whom the researcher interviewed using a semi-structured interview guide. The researcher performed the modified van Kaam methods of phenomenological analysis using NVivo 11 software. The major themes that resulted were building relationships with parents, need for full commitment from stakeholders, and the need for continuous training and improvement. Concerning the technology itself, participants voiced the importance of a classroom environment that facilitates technological use. These findings support the current study’s justification for proposing a TPACK theory for understanding the interrelated domains of technological pedagogical content knowledge and to address diverse teacher needs, student needs, and technology resource conditions.”

Bruner-Timmons, J. (2018). *Teachers’ participation in learning by design activities, their technological, pedagogical and content knowledge, and technology integration in an inner-city school* (Doctoral dissertation). Retrieved from <https://scholarworks.waldenu.edu/cgi/viewcontent.cgi?article=6338&context=dissertations>

Abstract: “Students at an inner-city school have low test results despite making progress. The study examines the problem that technology plans implemented by the Board of Education could not improve student achievement. Educational policy recommends to increasingly sustain teaching by educational technology. Therefore, this research examines the teacher knowledge necessary for technology integration in classes, and the ways this knowledge can be fostered. The theoretical framework of this study integrates 2 prominent theories of instructional science: learning by design (LBD) and technological, pedagogical, and content knowledge (TPACK). The relationship between LBD, TPACK, and technology integration in the classroom was examined. The assumption was made that LBD and TPACK predict technology integration, and that TPACK mediates the relationship between LBD and technology integration. A correlational study was carried out with a sample of N = 109 in-service, secondary, mathematics teachers from an inner-city school. The data were collected using a previously validated questionnaire survey and initially analyzed by multiple regression analysis. However, the measured variables displayed nonlinear relationships, suggesting that, while TPACK partially mediates the LBD-TI relationship as hypothesized, technological knowledge had a saturation effect on TI, and thus high scores of both LBD and TPACK decreased TI. The study shows at a

theoretical level how teachers can benefit from LBD experiences resulting in TPACK and how likely they combine technology with teaching. For the practice of teacher leadership, this study will suggest effective forms of professional development, thus improving teaching quality and enabling positive social change.”

Daughtry, B. A. (2018). *Investigation middle and high school algebra 1 teachers' technology self-efficacy, training, usage, and commonalities* (Doctoral dissertation). Available from ProQuest Dissertations and Theses Global database. (UMI No. 10811028)

Abstract: “Algebra teachers who confidently use technology in their classrooms understand the effectiveness in improved student learning; however, teachers who lack confidence do not use technology. The problem addressed in this study was twofold: 1) middle and high school Algebra 1 teachers' technology self-efficacy, training, and current use of technology to teach algebra are not fully known and, 2) teaching commonalities between middle school and high school teachers to ensure a seamless transition of student learning have yet to be identified and addressed. The purpose of this qualitative multiple-case study was two-fold: 1) identify middle and high school Algebra 1 teachers' technology self-efficacy, training, and use of technology to teach algebra; and 2) to identify any commonalities between the two groups to ensure a seamless transition of student learning from middle school to high school. The sample was four Algebra 1 teachers comprised of one middle school and three high school study participants in a rural school district in a southeastern state in the United States. Data were collected using open-ended interviews and direct observations. Findings suggested that high computer training lead to higher levels of classroom use of computers; and teachers were likely to build technology self-efficacy and technological content knowledge following their participation in distributed professional develop (technology training). Further, findings showed that 100% of the participants desired a course on available district technology and a formal training course or workshops on how to use advanced features of technological devices that they used daily. Recommendation for future research include duplicating this study with algebra teachers in small and large school districts across the United States.”

Dede, E. (2017). *Turkish pre-service secondary mathematics teachers: An examination of TPACK, affect, and their relationship* (Doctoral dissertation). Available from ProQuest Dissertations and Theses Global database. (UMI No. 10607510)

Abstract: “Pre-service teachers' knowledge, beliefs or attitudes gained during their undergraduate education is one of the most influential factors shaping their future teaching in their field. Technological Pedagogical Content Knowledge framework (TPACK; Mishra & Koehler, 2006) identifies the knowledge domains needed by teachers to effectively integrate technology into teaching their field. Due to the fact that pre-service teachers' TPACK domains cannot be directly measured, most of research studies in the literature addressed developing a TPACK survey instrument in order to indirectly measure teachers' TPACK in terms of their perceptions. However, there were rare research studies focusing on development a TPACK survey instrument for pre-service secondary mathematics teachers, especially in Turkey too. Therefore, the main goal of this study is to examine Turkish pre-service secondary mathematics

teachers' perceptions regarding TPACK domains, as well as adapting TPACK survey instrument, developed by Zelkowski and his colleagues (2013), into Turkish language and context. Another purpose of this study is to investigate the relationships among TPACK components, and the relationships of pre-service teachers' attitudes towards use of technology in education with their TPACK components. This study also aims to explore the effects of demographics differences (gender and year of enrollment) on their perceptions regarding TPACK domains and attitudes.

Survey, correlational and causal-comparative research designs were used in this study. To adapt the TPACK survey instrument into Turkish, the following processes were used: forward translation, backwards translation, comparison of original TPACK survey with backward translation, expert reviews and cognitive interviews. The data were collected in terms of two studies, the pilot and main studies, during the fall semester of 2016 in Turkey. Two survey instruments, the Turkish TPACK and Attitude scale towards Computer-Aided Education (Arslan, 2006), were used to collect the data. The total of 778 pre-service secondary mathematics teachers participated in this study as volunteer. The pilot study data was used to examine translation of the Turkish TPACK survey instrument and to determine its hypothesized factor structure. The main study data was utilized to validate its factor structure and to conduct further statistical analysis related to the research questions.

The results of factor and reliability analysis showed that the Turkish TPACK survey instrument is valid and reliable for five factors (TK, CK, PK, TPK, and TPACK) including 29 items. The findings of correlations analysis indicated that there were significant positive correlations among five TPACK components with small or moderate effect sizes. In addition, the relationships of pre-service teachers' attitudes with TPACK components were positive and significant, with small or moderate effect sizes. The results of MANOVA displayed that the linear combination of TPACK components differentiated with respect to pre-service teachers' gender and year of enrollment. According to findings of MANOVA, male pre-service teachers had significantly better perceptions about TK and CK than females. Furthermore, fifth grades showed significantly higher perceptions related to CK and TPACK than first and second grades, as well as third grades had greater perceptions on CK than first grades. The findings of ANOVA revealed that there were no statistically differences of pre-service teachers' attitudes towards use of technology with respect to gender, although they had significantly mean differences in regard to year of enrollment. According to the results of ANOVA, five grades had more positive attitudes than first and second grades, as well as third grades had more positive attitudes than first grades. Regarding of finding in this study, future research may focus on which factors influence the development of pre-service teachers' TPACK by means of experimental research studies; and on why male and female pre-service teachers' perceptions in associated with some of TPACK components become different."

Diacopoulos, M. M. (2018). *Understanding technological, pedagogical, and content knowledge in an educational technology course: A case study of social studies preservice teachers' beliefs and dispositions* (Doctoral dissertation). Available from ProQuest Dissertations and Theses Global database. (UMI No. 10808716)

Abstract: “As beliefs and dispositions form the foundation of practice, the situations in which teachers develop belief is an important factor in their development (Roth, 1999). One aspect shaping the beliefs of teacher candidates is their experience with education. Lortie (2002) refers to this as the problem of “apprenticeship of observation”, the learning that occurs from watching teachers in the 12 or more years spent in school as a student. School experiences greatly affect the preconceptions teacher candidates have about teaching and learning. Richardson and Placier (2001) state most preservice teacher beliefs consist of unexamined assumptions. These views tend to focus on the affective quality of teachers they experienced, favorite teaching styles, and what certain children do. Teacher candidates tend not to think about the social contexts, subject matter, or pedagogy involved. Thus, preconceptions left unexplored are difficult to change later. This qualitative case study investigates how a new iteration of an educational technology class influences the preconceptions, beliefs, and dispositions of five secondary social studies teacher candidates’ implementation of Technological, Pedagogical, and Content Knowledge framework (Mishra & Koehler, 2006). The suitability of this class as a space to challenge teacher candidate preconceptions is discussed. Through interview, survey data, class observations, and student produced artefacts, issues of teacher candidate preconceptions, belief, and disposition toward their future teaching are examined. How aspects of the class influenced participants’ developing understanding of TPACK as well as challenging their beliefs about teaching social studies are discussed. Implications for teacher educators regarding teacher candidate belief, the learning of meaningful educational technology integration, and programmatic issues concerning appropriate course placement also arise because of this study.”

Eaglen Bertrando, S. L. (2017). *Rethinking workplace learning in the digital world: A case study of open badges* (Doctoral dissertation). Available from ProQuest Dissertations and Theses Global database. (UMI No. 10603608)

Abstract: “The purpose of this collective case study was to explore digital badging in educational institutions as support for K-12 practitioners struggling to integrate technology into pedagogical practices. The researcher conducted a mixed-method study that captured perceptions about digital badges and follow-up interviews with selected badge users to explore their viewpoints further. The goal was to generate a detailed case description, identify participants’ self-assessment of technological pedagogical content knowledge (TPACK), and define those attributes that are deemed important or not useful to *Open Badge Course* earners that participated in the study.

Ten individuals from a Northern California region completed the survey and four participated in an interview process. Results from the survey found that participants highly valued the convenience, accessibility, and ability to self-pace afforded by the course. They valued being able to set their own learning goals and to begin and work at their own level of expertise. The game-like features and personal achievement were motivating factors to earn and complete badges. The course experience allowed time for cumulative study to learn and implement technology into teaching. The course experience supported their understanding of technological pedagogical content knowledge (TPACK).

The interviews provided detailed information regarding perceptions and experience with the Open Badge Course. Six themes emerged from thematic analysis of the interview data: affordances of course content and course design, recommendations to sustain and improve the course, challenges of course content and course design, ways experience impacted/changed teaching, motivation for learning, and ways experience impacted/changed learning. Participant responses indicated that modifications were necessary for the course to be effective. The areas of challenge included: a lack of timely assessment of learning, constraints from rigor and management of badge levels, lack of relevant or meaningful badges related to the grade level taught, and difficulties with mechanical/operational procedures to access and complete required activities.

Facing obstacles are not unique to digital badge project developers. The challenges identified in this collective case study provide valuable information for developers in redesigning future iterations of digital badge systems. Recommendations include how development of similar systems for informal professional learning within formal institutions of learning can be effective.”

Fedon, A. M. (2017). *The process of learning to integrate technology: A grounded theory of Nebraska preservice teachers' experiences* (Doctoral dissertation). Available from ProQuest Dissertations and Theses Global database. (UMI No. 10682357)

Abstract: “Teacher education programs have been grappling with how best to prepare preservice teachers to integrate technology since the early 1990s. Past research has focused on preservice teachers’ attitudes towards technology in the classroom, intention to integrate, and the impact of specific instructional strategies. Much research has also been dedicated to the development and measurement of preservice teachers’ Technological Pedagogical Content Knowledge (TPACK). Little research has explored the process of learning to integrate technology within the context of the entire teacher education program, including the instructional technology course, methods courses, and field experiences. The goal of this constructivist grounded theory study was to illuminate this process from the perspective of the preservice teacher. Data were collected through interviews with 12 preservice teachers attending five higher education institutions in the state of Nebraska. A theoretical framework representing the process of learning to integrate technology was developed based on the participants’ perspectives. The theoretical framework provides insight into the preservice teacher’s experience, identifies areas that teacher education programs can target in order to potentially improve their learning process, and contributes new ideas for future research.”

Hardisky, M. (2018). *TPACK: Technology integration and teacher perceptions* (Doctoral dissertation). Available from ProQuest Dissertations and Theses Global database. (UMI No. 10787472)

Abstract: “As one considers the impact that technology has had on society as a whole, one might also question these changes as they pertain to the teaching and learning environment. The transformative nature of educational technologies has profoundly changed pedagogical thinking and looks to revolutionize our educational system, but are teachers really utilizing

these technologies to their full potential? The TPACK framework considers three distinct areas in a teacher's ability to integrate technology and improve the effectiveness of their instruction: content, the information that is to be taught; pedagogy, the way in which the content is to be taught; and the technological, the digital tool or vehicle with which the pedagogical methodology will be delivered.

This study examined the ways ten teachers utilize technology in their lesson planning and classroom activities for variety and frequency. Additionally, comparisons were made between years of experience, with consideration of the amount of formal and informal technology training received. The purpose of this embedded mixed methods study is to inform and improve technology professional development for teachers. This study found that veteran participants displayed a reluctance to change, providing statements concerning investing time into new pedagogical practices when they consider their current practices to be sound. Novice participants, who as a group were more open to incorporating technology into pedagogical practices, needed to be afforded an opportunity to explore other emerging methods for technology implementation. The perceptions derived from this study concerning frequency of use, and the need for more available resources, only serve to underscore the importance of improving aspects of professional development design.”

Harsma, E. (2018). *A qualitative case study of Spanish teaching assistants and online language instruction* (Doctoral dissertation). Available from ProQuest Dissertations and Theses Global database. (UMI No. 10745323)

Abstract: “The purpose of this case study was to explore the perceptions and experiences of Spanish foreign language graduate teaching assistants in online language instruction through the lens of two theoretical models and their intersections, Teacher Efficacy and Technological Pedagogical Content Knowledge. The final purposive sample included two Spanish foreign language graduate teaching assistants from a Midwestern public university who participated in a semi-structured interview and shared documents related to their online Spanish teaching experience. Pattern matching coding was used to identify four emergent themes that were concomitant across research questions 1, 2, and 3: (a) Organization and lesson planning in an online environment bolstered confidence, (b) Vicarious experiences modeled online course structure and organization, (c) Reports of positive student experience boosted teacher self-efficacy, and (d) Technology challenges negatively impacted teacher confidence. Two minor themes were found specific to research question 2: (a) Development of communication strategies in a technological environment, and (b) Technology use to help students master challenging concepts. Recommendations for practice were Foreign Language Graduate Teaching Assistant training programs should (a) differentiate preparation for classroom versus online instruction and (b) should include an assistant teaching opportunity prior to their own teaching assignment. Three recommendations for future research included (a) a qualitative narrative study to examine these themes in different educational contexts, (b) a mixed methods study to investigate change in FLTA teacher self-efficacy and TPACK over time, and (c) a quantitative correlation study to examine FLTA teacher self-efficacy, TPACK, and student achievement.”

Hoye, S. R. (2017). *Teachers' perceptions of the use of technology in the classroom and the effect of technology on student achievement* (Doctoral dissertation). Available from ProQuest Dissertations and Theses Global database. (UMI No. 10616975)

Abstract: "As the educational system continually battle the needs of the 21st century workforce, technology has caused great tension with pedagogical practices in education (Bellanca & Brandt, 2010). With the advancements in technology, teachers are struggling to personalize instruction in part because of the learning styles of the digital natives (Prensky, 2001). Recent studies have shown a significant gap between teachers' perception of the use of technology and their actually use of technology in the classroom. Teacher self-efficacy towards the use of technology is thought to be more important than content knowledge and skills in the implementation of technology in the k-12 curriculum. Mandated by the ESSA (2015), information and communication technology has been shown to enhance student learning experiences in the classroom, but teachers are still hesitant to incorporate it into their instructional practices. As a result, the Mississippi Department of Education established a rigorous accountability system to measure students' academic growth; heightening the focus on teachers' instructional practices and these practices' effects on individual student test scores.

The study examines teachers' perceptions of the use of technology in the secondary curriculum and the effect of technology on student achievement. Data was generated utilizing a survey questionnaire that examined obstacles that might prevent teachers from integrating technology into the classroom. An independent T-test was performed to test the hypothesis that males and females have no statistically significant differences in teacher self-efficacy, teacher-student instructional practices, and openness to change toward the use of technology in the classroom among gender. Furthermore, an ANOVA was used to provide a single answer to the multi-comparison to reveal differences among the school level groups. The means, values of F, and significance level revealed a statistically significant difference in the number of hours of technology training between school levels; specifically, in teacher efficacy between the training hours of 1–5 and 6–10 hours. The multiple comparison of school levels for characteristics such as teacher-student instructional practices, and openness to change revealed no significant statistically difference in number of hours of technology training.

Due to the increasing shift in technology advancements, the study reveals the relationship of teachers' perceptions, specifically self-efficacy, and the effective implementing of technology due to adequate technological training. Teachers with adequate hours of technology training are more likely to build a greater confidence level with the use of technology. Therefore, technological training has shown to have a positive effect on teacher self-efficacy towards technology integration in the classroom."

Huzzie-Brown, A. (2018). *Beliefs vs. behavior of elementary teachers integrating technology into mathematics* (Doctoral dissertation). Available from ProQuest Dissertations and Theses Global database. (UMI No. 10743866)

Abstract: "Many elementary students struggle to meet expectations on mathematics assessments despite an increase in science, technology, engineering, and math instructional

strategies. The purpose of this qualitative case study was to explore elementary math teachers' technology integration self-efficacy, their level of technology adoption, and their actual technology integration behavior. The conceptual framework used in this study included Bandura's social cognitive theory, which is often used in the investigation of self-efficacy. Additionally, the International Society for Technology Education Classroom Tool, which is in alignment with the National Educational Standards for Teachers, was used to gauge the level of technology integration in the classroom. Nine volunteer teachers in Grades 3-5 participated in surveys, observations, and follow-up interviews. Data were analyzed using open coding to identify themes and patterns. The findings from this study indicated that the teachers' perceptions were positive as they believed technology could have positive implications for the teaching and learning process. However, findings also indicated that not all the teachers in the study felt confident with using technology in their practice. These teachers indicated that there was a need for onsite support, peer mentoring and professional development geared towards effectively aligning content, pedagogy, and technology. The information from this study may add more to the body of knowledge on information and communications technologies adoption and integration. The social change potential in this study is that through confident teachers in mathematics, and technology integration, students may improve their skills to be competitive for employment and opportunities in a global marketplace."

Jin, Y. (2017). *Longitudinal study of pre-service teachers' development of TPACK in a required educational technology course* (Doctoral dissertation). Available from ProQuest Dissertations and Theses Global database. (UMI No. 10624184)

Abstract: "This dissertation investigated the impact of prior knowledge, course design, and technology preparation on pre-service teachers' development of technological pedagogical content knowledge (TPACK) in a teacher education program at a large Midwestern land-grant university over a span of nine academic years (Mishra & Koehler, 2006). In this study, 1,246 pre-service teachers participated by responding to both pre- and post-TPACK surveys. A series of statistical analyses were used to analyze the quantitative data collected from these pre- and post-surveys. First, descriptive analyses and a two-step cluster analysis were used to group pre-service teachers into different clusters based on their pre-TPACK scores (low and high). A two-group model was found to be the best fit, and thus, pre-service teachers were grouped into these two clusters. Cluster 1 pre-service teachers reported lower pre-TPACK scores compared to cluster 2 pre-service teachers. Paired-sample *t*-tests were run to examine whether there were differences in the post-TPACK and TPACK-development scores. The results revealed that cluster 2 pre-service teachers reported higher post-TPACK scores, while cluster 1 pre-service teachers had higher TPACK-development scores. Second, two-way MANOVA tests were used to investigate the impact of prior knowledge, course design, and technology preparation on pre-service teachers' post-TPACK and TPACK-development scores. All three variables were found to be statistically significant factors. In particular, a content-specific TPACK course design was more effective than the general course design. Cluster 2 pre-service teachers who reported higher pre-TPACK scores still had higher post-TPACK scores. Conceptual and practical implications are discussed. Future research directions are offered."

Johnson, K. E. (2018). *Digital native and digital immigrant professors' self-assessments of instructional technology usage in college classrooms* (Doctoral dissertation). Available from ProQuest Dissertations and Theses Global database. (UMI No. 10748827)

Abstract: "This dissertation research aimed to determine if there was a difference in instructional technology use, in the face-to-face classroom, between digital immigrant faculty members and their digital native colleagues. This study was guided by two research questions: (a) Based on faculty members' HE-TPACK self-assessments, is there a difference between digital native faculty members and digital immigrant faculty members? and (b) Is there a reported difference in instructional technology use between the digital native and digital immigrant faculty members? Literature on digital immigrants and digital natives has focused on digital immigrants as the instructor and digital natives as the student. The study examined digital natives as faculty members, with an original sample of 872 faculty members from a southeastern research university and 223 final participants. Data were collected using an online survey. There was no significant difference in digital immigrants' instructional technology use and their digital native colleagues, except in one area. The results indicated a significant difference in digital immigrants' use of links to online resources and digital natives' use of links to online resources in the face-to-face classroom with digital immigrants using links to online resources more often. The results, implications for practice, and implications for future research are discussed."

Karakaya, O. (2017). *Investigating preservice teachers' TPACK integration into lesson planning* (Master's thesis). Available from ProQuest Dissertations and Theses Global database. (UMI No. 10681517)

Abstract: "This study was situated in an educational technology course, Digital Learning in the PK-6 Classroom. The purpose of the present study was to investigate the relationship between preservice teachers' self-reported TPACK and their performance in integrating educational technology into lesson plans. The relationship between students' self-reported responses to a post-TPACK survey and their graded performance of lesson plans via *TPACK-based technology integration assessment rubric* scores were investigated using a Pearson product-moment correlation analysis. The results of the Pearson correlation indicated that both the survey data and the lesson plan evaluation rubric constructs showed high internal consistency within each instrument, but there was a weak negative correlation between the same constructs assessed via different methods (survey and the rubric). The negative correlations suggest that the students who report high levels on the constructs via the survey are actually receiving lower evaluation/assessment scores on the lesson plan."

King, C. D. (2017). *Un'TPACK'ing athletic therapy education in Canada: An exploration of an innovative case-based learning approach* (Doctoral dissertation). Retrieved from <http://scholar.acadiau.ca/islandora/object/theses:2176>

Abstract: "The purpose of this study was to identify the factors that impacted the use of technology-assisted educational tools in athletic therapy education. Data collection was divided

into three mixed-methods phases, each contributing to the overall research question. Phase 1 used surveys and interviews to reveal AT educators' initial pre-dispositions regarding preferred pedagogies and technology integration. Following an iterative constructivist instructional design, Phase 2 used feedback from Phase 1 to design the Multimedia CBL Sports Injury Assessment Educational Tool to ensure its appropriateness for AT education. The final phase used a case-study to elicit feedback from AT students and educators about the impact of the M-CBLSIAET on the nature of learning and teaching. Students' suggested that the tool contributed to the learning experience by: creating contextually-enriched scenarios; engaging students in critical thinking/reflection; stimulating higher levels of clinical decision-making; organizing peer interactions; and extending learning outside of the classroom. Furthermore, AT educators also considered the tool to positively impact teaching by: highlighting the potential roles for technology in AT education; using technology to empower course content/pedagogy; and promoting critical thinking about different pedagogies in AT education."

Ledbetter, L. S. (2017). *A qualitative content analysis of early algebra education iOS apps for primary children* (Doctoral dissertation). Available from ProQuest Dissertations and Theses Global database. (UMI No. 10602980)

Abstract: "Educational software applications (apps) on multi-touch, mobile devices provide a promising space to help learners work toward long-term educational goals, like *learning with understanding* (Bransford, Brown, & Cocking, 2000). Such goals are particularly relevant in supporting a learner's efforts to become more mathematically literate. Yet, a number of current apps do not appear to be living up to this potential. As such, this study drew upon the theoretical framework of Learning Science and the conceptual framework of TPACK theory (Mishra & Koehler, 2006) to define curricular characteristics that ideally support primary children's potential to learn early algebra concepts with understanding, through multi-touch, mobile, iOS mathematics education apps. Using qualitative content analysis these characteristics, then, were compared to the curricular characteristics of three authentic (i.e., real-world) apps in order to describe the general extent to which the two sets of characteristics aligned. This study found the authentic apps did not align with the majority of curricular characteristics that ideally support learning with understanding. Additionally, a number of qualitative findings emerged from the study that may be used to inform future app design. These ideas include themes related to the kinds of characteristics the authentic apps tended to align with or not, and suggested adaptations to a number of contemporary theories and models related to pedagogical content knowledge and its application toward the goal of learning with understanding. These findings have direct implications for the theory and practice of app design, and suggest revisions to the way in which the field of instructional design, historically, has been approached."

Mallernee, N. (2017). *Exploring the use of iPads for literacy instruction in the 1:1 K-6 classroom* (Doctoral dissertation). Available from ProQuest Dissertations and Theses Global database. (UMI No. 10639002)

Abstract: “This non-experimental correlational quantitative study was designed to explore the effects of specialized professional development, age, gender, and years of teaching experience on the successful integration of iPads into classroom literacy education among K-6 students. The study uses the teachers’ Technological Pedagogical Content Knowledge (TPACK) scores to measure the successful integration of the iPads. Much research has been completed exploring the implementation of various technologies into the classroom. With the advent of the iPad in 2010, and Apple Inc.’s eagerness to include their product in the classroom, it was inevitable that mobile tablet technology would be added to the public school classroom. The researcher chose to study K-6 teachers at three elementary schools in the Coachella Valley Unified School District (CVUSD). The CVUSD implemented a 1:1 iPad integration program throughout in 2012, providing an iPad for every student at every grade level in the district. CVUSD was the first district in the United States to implement such a program. The K-6 teacher population was narrowed to teachers who teach age-appropriate literacy skills regularly in the classroom, removing Art, Music, Physical Education, and English Language Learner (ELL) instructors from the population. The repeatedly validated instrument, The Survey of Preservice Teachers’ Knowledge of Teaching and Technology, was used to find the TPACK of the teachers in the final sample. This instrument has been repeatedly validated for both pre- and in-service teachers. The scores were analyzed using the Pearson’s correlation coefficient to discover whether or not there was a significant positive or negative correlation between the TPACK score and its subdomains and the amount of specialized professional development, the age, the gender, and the years of teaching experience of the teacher. Using the Spearman’s and the Two-Tailed test to cross-check the results, the researcher found no significant positive or negative correlation between the teachers’ TPACK scores and the studied variables. One research and one practical recommendation have been suggested by the researchers. A follow-up study using a school or district that has not instituted a 1:1 iPad program wherein the research team would implement a program and follow the progress of the program for 1 to 3 years and improving professional development programs to include detailed and immersive modules for integrating technology into the classroom and into the lessons.”

Maloney, J. (2018). *Fulbright FLTA CALL knowledge development and enactment: The role of context* (Doctoral dissertation). Available from ProQuest Dissertations and Theses Global database. (UMI No. 10812437)

Abstract: “CALL teacher education (TE) is an important and growing area of CALL research. Teachers are viewed as ‘pivotal’ (Hubbard, 2008) for CALL technology adoption. What teachers know, believe and think, or cognition, has informed most of CALL TE research. Typically, such literature has focused on pre-service training or professional development workshops, and has focused on training effectiveness, teacher attitudes, and identifying necessary competences or knowledge. Less researched is teacher development over time (Arnold & Ducate, 2015) and how participation in an international teaching exchange impacts CALL knowledge and practice. In addition, there is not much work examining whether and how knowledge gained transfers into other teaching contexts (Chao, 2015). As Kubanyiova and Feryok (2015) identify, cognition researchers must engage with what knowledge would be most beneficial to whom. In order to do so, examining what knowledge teachers gain and what factors play a role in development

and the use of knowledge for CALL can provide further direction for improving CALL TE. Finally, work examining the impact of the Fulbright Foreign Language Teaching Assistant (FLTA) program on its participants is limited.”

Morris, L. M. (2018). *Professional development for one-to-one mobile technology programs* (Doctoral dissertation). Retrieved from <https://scholarworks.waldenu.edu/cgi/viewcontent.cgi?article=6510&context=dissertations>

Abstract: “One-to-one mobile technology integration is the goal of increasing numbers of school districts each year, and many factors exist to consider when measuring success. The research problem for this qualitative study focused on one of the critical components for measuring success: the need for effective teacher professional development. The purpose of this study was to examine (a) principles and practices to facilitate the integration of one-to-one mobile technologies into professional learning experiences, and (b) the perceptions of technology instructional coaches regarding changes in teachers’ practice and attitudes following professional development. The conceptual framework included Knowles’s theory of andragogy and Koehler and Mishra’s TPACK framework. In two rounds, 19 interviews were conducted with 13 technology instructional coaches. Thirteen coaches were interviewed in round one and from that data six high level coaches were identified for a second round of interviews. The data from both interview rounds were analyzed and coded to identify themes and categories. The key findings revealed that effective one-to-one mobile technology integration requires supportive leadership; building culture and relationships; instructional design with standards and frameworks; building collaborative, job-embedded teacher agency; and personalized learning with differentiated delivery. All stakeholders could use the key results to make informed decisions for planning and implementing professional learning opportunities. This study may affect positive social change by enhancing how technology is integrated into teaching and learning through increased teacher engagement in professional learning.”

Ontiveros-Karr, K. (2017). *A phenomenological study of first-career millennial elementary school teachers’ use of technology* (Doctoral dissertation). Available from ProQuest Dissertations and Theses Global database. (UMI No. 10624750)

Abstract: “The purpose of this hermeneutic phenomenological study was to describe the attitudes and understandings for millennial first-career novice (FCMN) teachers toward transformational technology integration in the elementary classroom as it relates to the technological, pedagogical, and content knowledge framework (TPACK). Three research questions framed this study: (a) How do millennial first-career novice teachers from the Midwestern United States describe their level of content knowledge, technological knowledge, and pedagogical knowledge (TPACK) to support their teaching practices in the elementary classroom? (b) How do participants describe their approach to instructional decision-making based on their technological knowledge in the elementary classroom? (c) How, if at all, do perceptions as preservice teachers now influence their perceptions as novice teachers in their

current classroom setting? Self-reflective journals, task-based renderings, and semi-structured interviews were counted into the data collection process to achieve triangulation. Themes emerged with the application of the hermeneutic cycle. Line-by-line analysis gave way to descriptive codes along with interpretive reflection, rethinking, rereading, and rewriting to identify patterns of the phenomenon. The four themes were: (a) fluctuating context undermines quality of practice, (b) positive dispositional attitudes and growth experiences stabilize quality of practice, (c) professional support networks develop quality of practice, and (d) relative decision-making enriches the quality of practice. The FCMN teachers' ability to use technology for transformative learning develops only after stabilizing the setting and gaining a depth of content and pedagogical knowledge within the elementary classroom."

Perry, N. (2018). *Teacher attitudes and beliefs about successfully integrating technology in their classroom during a 1:1 technology initiative and the factors that lead to adaptations in their instructional practices and possible influence on standardized test achievement* (Doctoral dissertation). Retrieved from https://etd.ohiolink.edu/!etd.send_file?accession=ysu1522233676292274&disposition=inline

Abstract: "The purpose of this study is to measure factors that may lead to adaptations by teachers in their instructional practices as they relate to technology integration in a 1:1 laptop environment in a Western Pennsylvania school district. Much has been done around the concept of technology integration in schools and the impact or lack of impact on student achievement. Most of the literature on technology use in schools centers around availability and access to technology in the classroom setting. This study looks at the actual integration of technology through instructional delivery in the classroom. Teacher perceptions with regard to their own instructional practices were gathered using the Technological Pedagogical Content Knowledge (TPACK) Framework and measured next to classroom observational practices as gathered by building administrators throughout the school year. If teacher perceptions using TPACK correlate with instructional technology delivery as measured by classroom observation using SAMR and the Charlotte Danielson Framework, then districts may be able to ensure their investment in technology by focusing on factors that increase likelihood of actual use in the classroom. Participants in this study reported above average comfort with regard to technology as related to technology knowledge and technology pedagogy knowledge which may be attributed to the time and investment in teaching staff by the district through ongoing professional development activities. In addition, teachers were observed implementing technology in their classrooms, in some cases at a higher level of implementation on the SAMR scale, as observed through walkthrough observations. Finally, the district in this study saw tremendous gains by first time test takers on state the mandated standardized test since the inception of the 1:1 initiative which might be attributed to the above mentioned professional development activities focused on technology, technology content creation, and instructional technology delivery."

Ross, R. D. (2017). *e-Curriculum and instruction: A case study* (Doctoral dissertation). Available from ProQuest Dissertations and Theses Global database. (UMI No. 10269442)

Abstract: “Electronic learning, or e-Learning, is a growing and complex sector of higher education. This dissertation investigated the lack of understanding surrounding online education’s use of policy to effectively inform curriculum and instruction in synchronous classrooms. Leveraging a conceptual framework that combined literature on higher education accountability with theory on effective teaching with technology, this qualitative case study examined if and how synchronous e-Learning instructional policy and practice intersect in transformative ways by answering the following research questions: (a) how do teacher educators describe the relationship between instructional policy and practice in a synchronous, online, webcam-enabled teacher education program’s core course?; and (b) how, if at all, does a synchronous, online, webcam-enabled teacher education program use instructional policy to guide and foster the development of technological pedagogical content knowledge within the organization? Data collection procedures included interviews with the organization’s chair, course lead, and instructors, observations with the instructors, and document collection. Data analysis involved the constant comparative method. Findings from the study revealed that political, professional, and market forces were present in the target course’s curriculum, explaining why said instructional policy served as a framework for content, a facilitator of pedagogy, and quality assurance for e-Learning. Findings from the study also revealed how the given instructional policy system developed technological pedagogical content knowledge within the organization in a limited fashion. Implications and recommendations for policy, practice, and research are discussed.”

Rybak, M. (2018). *An introduction to implementing technology in the classroom using interactive web-based applications* (Master's thesis). Retrieved from https://digitalcommons.brockport.edu/ehd_theses/1045

Abstract: "Today’s students have grown up in a world where technology is an essential and accessible component of daily life, and it therefore plays an integral role in the modern classroom. Implementing technology into the traditional classroom can be an intimidating task; this curriculum project aims to aid educators in understanding the benefits of using technology, and to simplify its implementation. Desmos and Nearpod are used in this curriculum because they are excellent examples of two user-friendly and adaptable applets that facilitate technology-focused instruction. Each of the two units in this curriculum are designed to assist teachers house a limited amount of technology in understanding both how these applets function, and how they can be adapted for any content. Each lesson is student-paced, includes authentic problems, and has a variety of activities for the students to interact with their peers or with the applets themselves. Technology-focused instruction provides ineffable opportunities in the classroom, and the goal of this curriculum is to help teachers become more comfortable with technology in order to take advantage of those opportunities."

Sabado, K. X. (2018). *Exploring teachers’ perspective of technology pedagogy: Implications for practice* (Doctoral dissertation). Available from ProQuest Dissertations and Theses Global database. (UMI No. 10814079)

Abstract: “Pedagogy has not addressed the literacy shift from reading, writing, and speaking to include cognitive digital literacy skills. Teachers lack the technological pedagogical content knowledge to integrate digital literacy skills into student learning. Using a digital literacy framework with 6 essentials skills, the purpose of this qualitative case study was to investigate teachers’ (a) current understanding, knowledge and skills; (b) current integration of digital literacy skills; (c) challenges they face in integration; and (d) supports needed in shifting pedagogical practices to address change. Participants were 13 teachers from high school content areas. Data were gathered through focus groups interviews, observations, and artifacts. Data were coded with MAXQDA software, compared, organized, and refined based on the 4 research questions. Findings revealed high levels of knowledge for the terms digital literacy and photovisual literacy. Integration levels of digital literacy skills varied with more evidence in photovisual and reproduction literacy. Five minor challenge themes (critical thinking; time; information and technology literacy; infrastructure and access; and behavior and attitude) and 4 minor support themes (professional development; planning and preparation time; observation and feedback; and schoolwide focus and routines) emerged. Analysis of findings revealed 4 major themes: critical thinking, integrated professional development, effective use of time, and infrastructure and schoolwide routines. Findings may affect positive social change by engaging teachers in critical reflection through professional development leading to improvements in teacher pedagogical practices related to furthering the digital literacy skills of youth.”

Silva, B. A. M. (2017). *Utilização de recursos tecnológicos na consolidação do código ortográfico* (Doctoral dissertation, Polytechnic Institute of Viana do Castelo, Viana do Castelo, Portugal). Retrieved from http://repositorio.ipvc.pt/bitstream/20.500.11960/1992/1/Barbara_Silva.pdf

Abstract: “This study integrates the Master’s degree in Preschool Education and Teaching of the 1st Cycle of Basic Education. The presented work includes the description of what was developed during the Supervised Teaching Practice, as well as the research that took place in the same period. The research focused on the curricular area of the Portuguese language due to the difficulties detected in a 3rd and 4th grade class. Its main objective was to understand how technological resources can be used for orthography consolidation. In order to guide the study, two research questions were defined: 1) What difficulties do students have at the level of orthographic competence?; 2) What technological resources are suitable for performing orthographic tasks? For the development of this research, it was taken as a reference the theoretical framework Technological Pedagogical Content Knowledge (TPACK) and in the accordance with the problem and the questions of the study, was privileged a qualitative methodology and the data were collected through participant observation, audiovisual records, textual productions of students and questionnaires. For the analysis of data, we defined categories of orthographic errors and indicators that allowed us to determine the student’s involvement in the tasks. The data analysis allowed to verify that the greatest difficulties are related to the irregularities of the orthographic code and that the adequacy of technological resources for the performance of orthographic tasks implies a previous exercise of reflection and planning by the teacher, articulating technological, didactic and pedagogical knowledge.

This work suggests intervention proposals sustained in the digital educational resources, that contribute to the learning through the thought, understanding, memorization and reflection.”

Szabo, M. R. (2018). *Teachers’ pedagogical practices, shift, and professional growth in online courses* (Doctoral dissertation). Retrieved from <https://scholarworks.uni.edu/cgi/viewcontent.cgi?article=1477&context=etd>

Abstract: “This phenomenological study aims to understand the faculty member’s technological and pedagogical challenges when they teach an online course. The participants of the study were eight faculty members from a Midwestern university. All the participants had attended at least one Quality Matters workshop that was intended to help them design their online courses. While the workshops that the participants attended were similar, they were not the same. Some had participated in the workshop five or six years ago, and some had attended a more recent one. The faculty members then worked with instructional developers at the same university to design and develop their online course before it was offered to students. The study findings are categorized based on the emerging themes resulting from these interviews. Results of this study will inform the decision making that influences online teaching as well as professional development opportunities offered to the faculty who teach online courses.”

Tachau, E. M. (2017). *Professional development for transformational technology integration: An experimental study of in-service teachers’ self-perceptions of technological pedagogical and content knowledge* (Doctoral dissertation). Available from ProQuest Dissertations and Theses Global database. (UMI No. 10742883)

Abstract: “The rapid advancement of technology tasks K-12 schools with providing professional development for technology integration. This study sought to address the effectiveness of a TPACK-aligned professional development model in preparing in-service teachers to use technology in ways that transform teaching and learning. Through a single-subject, experimental mixed methods design, this study investigated the relationship between a TPACK-aligned professional development intervention and teacher self-assessment of the following TPACK framework constructs: technological knowledge (TK), technological content knowledge (TCK), technological pedagogical knowledge (TPK), and technological, pedagogical and content knowledge (TPACK) in a rural, K-12 public school district. The following question guided this research: How does a TPACK- aligned professional development model influence teacher self-assessment of TPACK?”

The findings of this study contribute to existing literature on the design of professional development for technology integration in technology-rich learning environments and address a gap in the literature on TPACK-aligned, in-service teacher professional development for transformational technology integration.”

Towne, T. N. (2018). *Exploring the phenomenon of secondary teachers integrating the LMS canvas in a blended-learning course* (Doctoral dissertation). Retrieved from <http://digitalcommons.liberty.edu/cgi/viewcontent.cgi?article=2747&context=doctoral>

Abstract: “Online learning has become fully ingrained within the educational environment and extensive LMS use in higher education settings is challenging secondary education institutions to keep pace with the growing trend to offer LMS resources to their teachers and students; however, schools that have chosen to implement an LMS face multiple challenges in motivating teachers and students to accept and integrate the new technology into their course curriculum. The purpose of this phenomenological study was to investigate teachers’ experiences integrating the LMS Canvas within a blended-learning course in a rural high school district located in the Southeastern United States. The study integrated the theoretical frameworks of the unified theory of acceptance and use of technology (UTAUT) and technological pedagogical content knowledge (TPACK) and draws primarily from a postpositivism framework. The study sought to understand teachers’ motivational and attitude factors for integrating the LMS Canvas into their blended-learning course and involved: distributing a questionnaire for descriptive purposes, conducting individual and focus group interviews, and evaluating course materials. Qualitative data analysis was conducted using NVivo, and coding was utilized to develop an interpretation of the phenomenon. Based on data analysis, four themes developed: (1) motivation and attitude, (2) training and technology support, (3) teaching effectiveness, and (4) student benefits, which along with their related categories, supported the central research question and subsequent sub-research questions. In the final analysis process, in which the essence of the phenomenon is formulated, a central concept for why teachers use Canvas was reduced to adaptability.”

Travers, A. L. (2018). *Ed-ventures in wonderland: Creating an innovative curriculum for integrating iPads in religious education* (Doctoral dissertation). Retrieved from <http://doras.dcu.ie/22173/>

Abstract: “One of the aims outlined in the National Digital Strategy for Schools 2015-2020 is to develop and promote examples of effective integration of ICT in teaching, learning and assessment (Department of Education and Skills 2015). This qualitative action research study provides an example of effective integration of ICT for teaching religious education in a 1:1 iPad environment. Using the Educational Entrepreneurial Approach to Action Research (Crotty 2014) an innovative curriculum that focused on promoting student collaboration and moved students from being consumers of content to creators of content was developed. Through the Educational Entrepreneurial Approach to Action Research (Crotty 2014), my educational values became my guiding principles and the questions raised in the literature were aligned with my own practice. Literature regarding the role of technology in education was examined. The TPACK framework (Koehler and Mishra 2012) for integrating technology, pedagogy and content was chosen to guide the research and curriculum development. A research journal was kept throughout this study and cycles of implementation, performance, and feedback from colleagues and peers informed and validated the creation of the curriculum. Evidence is presented to show the transformative impact of the research process on me personally, professionally and in the wider context. Transformations that occurred as a result of this research include improved knowledge and skills in the field of eLearning, enhanced collaboration and creativity within my work context, and the creation of a curriculum on places of religious significance called ‘Wonderlands’ with an accompanying guide for teachers. This

curriculum successfully integrates technology, pedagogy and content and through it students collaborate to create their own iBook using a variety of apps and websites that enhance their digital literacy skills.”

Walker, R. X. (2017). *Assessing teachers’ technological, pedagogical, and content knowledge in elementary schools* (Doctoral dissertation). Available from ProQuest Dissertations and Theses Global database. (UMI No. 10621442)

Abstract: “TPACK, originally conceived by Mishra and Koehler (2006), was developed as a framework to better understand the knowledge and competencies required for teachers to effectively integrate technology in the classroom (Koehler & Mishra, 2009; Koh, Chai, & Tay, 2014; Olofson, Swallow, & Neumann, 2016). Although the literature on pre-service teachers’ TPACK and teacher characteristics is prolific, research within the context of in-service K-5 learning workforce is limited (Howley, Wood, & Hough, 2011; Koh et al., 2014; Olofson et al., 2016; Rosenberg & Koehler, 2015). Additionally, TPACK instructional practices are highly contextualized, individualized, uniquely and experientially formed by teachers (Harris, 2016). Due to this phenomenon, more studies are needed to fill the gap in the literature on TPACK competences among the western elementary school teacher landscape. This quantitative descriptive study describes the Brandywine School District’s K-5 teachers’ competencies, in the areas of content knowledge, pedagogical knowledge, and technological knowledge. A total of 330 in-service K5 teachers were invited to participate in this study, by completing an online survey on a voluntary basis. Of the 330 invited, 120 teachers participated with a 37.52% completion rate. The study found that all teachers were more confident in their content and pedagogical knowledge than their technological knowledge, technology pedagogical knowledge, technological content knowledge, and their technological pedagogical content knowledge.”

Wallace, J. N. (2018). *The nature of university-led technological, pedagogical, and content knowledge (TPACK) professional development: A multi-perspective phenomenological study* (Doctoral dissertation). Available from ProQuest Dissertations and Theses Global database. (UMI No. 10751708)

Abstract: “The use of technology has become customary for many faculty teaching in institutions of higher education. And, many institutions provide professional development (PD) for integrating instructional technology into the classroom. But, research shows that many PD opportunities emphasize the use of specific technology tools and are inefficient at teaching faculty how to approach technology integration that is particular to their discipline. The objective of this study was to explore instructional technology administrators’ lived experiences creating technology-integration profession development opportunities for education faculty and education faculty’s experiences participating in these opportunities. The rationale for this study emanates from the researcher’s aspiration to create PD opportunities for education faculty that enhance the effectiveness of their teaching.

This study utilized a qualitative transcendental phenomenological methodology to explore the lived experiences of instructional technology administrators and education faculty.

The central question to guide this study was the following: Using the Technological, Pedagogical, and Content Knowledge (TPACK) framework, what are instructional technology administrators' lived experiences on creating technology-integration professional development opportunities for education faculty, and what are education faculty's lived experiences engaging in technology-integration professional development?

Purposeful and snowball sampling methods were used for selecting three instructional technology administrators and eight education faculty. The primary data collection method was an in-depth interview; supportive methods included non-participant observations and document analysis. The data were coded through initial and focused coding. Through analysis and interpretation, data were organized into themes that emerged in the data.

This study revealed many experiences associated with creating and engaging in technology-integration PD. These experiences showed that PD is created for large audiences and covers broad topics; however, education faculty are interested in support for a specific task. TPACK professional development is infrequent. However, based on the one-to-one nature of support that is often given to education faculty, there is potential to offer TPACK PD in alternative settings outside of the traditional large-group environments. Recommendations are offered for instructional technology administrators, university leaders, and further research opportunities. Given the various resources available in each instructional technology department, the recommendations put forth should be considered for its appropriateness on an individual university basis."

Zack, D. H. (2018). *Professional learning sessions to support teachers incorporating technology to update their lessons and assessments* (Doctoral dissertation). Available from ProQuest Dissertations and Theses Global database. (UMI No. 10681417)

Abstract: "The primary focus of this Executive Leadership Portfolio (ELP) is to investigate whether teachers who actively participate in professional development designed to model best practices and explore digital technology would incrementally change their instructional moves to include these practices and technologies. The literature presented within this ELP provided a framework to design nine Professional Learning Sessions (PLSs) intended to support teachers in their efforts to prepare students for 21st Century Learning at Garnet Valley School District (GVSD). Each PLS was designed to include the topics, structures or characteristics, and strategies suggested by the research for teaching teachers how to emphasize creating learner-centered lessons, infuse content, learning theories and pedagogy with knowledge of technology (TPACK). The literature, rationale for the design, and an evaluation of the PLSs are presented. Quantitative and qualitative data were collected for an evaluation of the PLSs through four instruments—a district feedback form, teacher proposed lessons, periodic surveys, and teacher interviews. Guskey's Framework on the Five Levels for Evaluating Professional Development was used to analyze the collected data. Analysis suggested that participants were satisfied with the sessions and did demonstrate an acquisition of knowledge and the intent to create lessons and assessments using the digital tools and best practices modeled during the sessions. Participants did make subsequent changes to their instructional moves to include integrating digital tools; however, participants did not consistently create student-centered lessons."

4. Recent TPACK Presentations

Amo, D., Valls, A., Alier, M., Canaleta, X., Garcia-Penalvo, F., Fonseca, D., & Redondo, E. (2018, March). Using web analytics tools to improve the quality of educational resources and the learning process of students in a gamified situation. In L. Gómez Chova, A. López Martínez, & I. Candel Torres (Eds.), *INTED 2018: Proceedings of 12th annual International Technology, Education and Development Conference* (pp. 5824-5829). doi:10.21125/inted.2018.1384

Abstract: “Learning media such images, videos or audios has been increasing since the apparition of new pedagogical approaches as the learning model Flipped Classroom or other technological ones. The consumption, comprehension and utility of this learning media is crucial to students in order to learn the available concepts and success in their learning process. The easiness of video and audio registering, powered by the vast available media publication and sharing platforms, contrasts with the difficulty of analyzing their impact in the learning process. In this paper we have a businessification proposal for students and teachers benefits. Businessification is the idea of applying business rules to any no business context. Web analytics tools are mainly a business approach to enhance business incomes, but used as a student behavior tracking tool could improve their learning (academic analytics or learning analytics). The proposal consists of treating the learning media container, such as a Learning Management System (LMS), as a business website in order to track and comprehend students behaviour for learning media enhancing.

Web analytics tools used in business offers a perfect analytical framework to analyse learning media in any formal education. Web analytics can be understood as the measurement, collection, analysis and visualization of web data for visitors behaviour understanding and web experience optimizing. Thus, track URLs traffic of a website is the main aim of such tools. However, this website tracking technology can be used to track not only URLs but objects inside the URLs document. Images, videos and audios are the most common media used in websites. Web analytics can track its use and understand the behaviour of the visitors in the interaction with these media objects. Actions such as play, stop, rewind, forward or repeat video visualizations can be tracked with web analytics tools resulting in a profound comprehension of visitors behaviour. Currently the teaching-learning methods enhance the use of digital tools, tools for learning themselves properly or for learning other disciplines. The TPACK model is a framework that allows the technology to fit perfectly into this learning context. This framework plus the addition of business oriented web analytics tools ensures to learning media creators new enhancing ways in order to improve students learning.

The proposed analytical businessification could also been extended its application to other learning processes situations such as computational thinking or robotics to validate some TPACK oriented activities. Within the TPACK model, the use of didactic resources in computational thinking is based on the student’s greater autonomy in the learning process. The analysis of the evolution in the learning of computational thinking, understood as one more discipline of the school curriculum, is one of the fundamental ideas of this paper.

In the current educational context, the use of analytical tools such as analytical businessification can be of great help in favoring the best attention in the learning process of all students and to advise a more effective and meaningful learning. Given that computational thinking is acquiring great relevance in curriculums, this tool will be useful for its application in many of the educational stages.”

Dempsey, M., Brennan, A., & O’Dea, M. (2018, March). Re-boot learning: Providing an e-tivity scaffold for engagement for early research activity through blog technology embedded within teaching and learning. In L. Gómez Chova, A. López Martínez, & I. Candel Torres (Eds.), *INTED 2018: Proceedings of 12th annual International Technology, Education and Development Conference* (pp. 7046–7052). doi:10.21125/inted.2018.1648

Abstract: “Efforts to guide educators and researchers in their technology integration has resulted in developed standards, frameworks, models, and theories that may be used to inform research and practice”. Hamilton points to the International Society for Technology in Education (ISTE) (2015) who developed standards “to support students/educators/leaders with guidelines for the skills, knowledge and approaches they need to succeed in the digital age” raising the question of how learners can benefit from the effective use of technology. The structured use of frameworks (such as technology, pedagogy, and content knowledge (TPACK)) facilitates the integration and effectiveness of technology in teaching. The authors assert that appropriate technology and engagement in teaching can act as a scaffold for deeper research activity, weaving through paradigms such as active learning, constructivism etc to encourage students to spend quality time in what is known as the liminal space (identified as the process of mastering a threshold concept). Proposed approaches will be used to encourage and foster engagement in both formal and informal settings to allow more opportunities for dialog, which can result in greater learner engagement. Notwithstanding, it is easy for students to fall into a passive role, leaving the educator bearing this responsibility. Embedded technology teaching has many challenges but these challenges can be overcome with educators and students working in partnership with a common focus.

The authors present their use of a technological framework of engagement to provide a scaffold for research activity embedded in teaching and learning. In order to assess the effectiveness of this informal technological space (in this example a blog), 93 Masters and Undergraduate students are surveyed.

The aims of this survey were to:

- (1) determine the impact this technological space has on their research activity and
- (2) elicit whether or not classroom based learning through discussion was supported by the online blog or vice versa and an overall assessment of whether or not the blog met their expectations and facilitated them in easing their transition through liminal spaces in the mastery of related threshold concepts.

The authors will also outline the effectiveness of blog technology as a portals or learning thresholds. Anecdotal comments from the students will also be used to relate aspects of their journey through the liminal space.”

Na, R., Zhang, H., Wang, Y. [Yining], Wang, Y. [Yaqin], & Yoneda, T. (2017, December). A study of TPACK structure of outstanding English teacher. In J. Liu, S. Nishimura, H. Zhang, & Q. Jin (Eds.), *Proceedings EITT 2017: Sixth International Conference of Educational Innovation through Technology* (pp. 299–302). doi:10.1109/EITT.2017.78

Abstract: “In order to promote excellent teaching resource sharing and provide a reference for the training of high school English teachers, this research mainly explores the structure and characteristics of outstanding high school English teachers, In this article, outstanding high school English teachers has been selected as research object, and award-winning English teachers of Hundred Flowers Award held by a high school are selected as the example. Based on the strategy of high school English teachers' TPACK, this paper has carried out mainly the following aspects of work developed: firstly, based on the framework of TPACK, design teaching event record chart, teaching activity record chart, teaching event TPACK coding schedule and classroom behavior code schedule, formulate the TPACK encoding rules of high school English teachers, and also determine the encoding rules of classroom behavior. Secondly, based on encoding rules above, record teaching events and learning activities in detail. Thirdly, statistic the frequency and time length of both the TPACK elements in the teaching events and classroom behaviors using data analysis methods below: frequency statistics, time length statistics, comparison step by step and deep analysis. Depending on the results above, the author also explored the relationship between the TPACK elements and the classroom teaching behavior based on the specific teaching activities and teaching material analysis.”

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, June 28). TPACK newsletter issue #37: June 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>
- Subscribe to the tpack.research, tpack.teaching, tpack.grants and/or tpack.future discussion lists at: <http://site.aace.org/sigs/tpack-sig/>

- Access the TPACK Learning Activity Types taxonomies at: <http://activitytypes.wm.edu/>
- Access three tested TPACK assessment instruments at: <http://activitytypes.wm.edu/Assessments>
- Access and/or adapt TPACK online short courses at: <http://activitytypes.wm.edu/shortcourse/>

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

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

Standard End-Matter

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- Judi & Amelia

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