**TPACK Newsletter, Issue #11: October 2011**

Welcome to the eleventh edition of the (approximately quarterly) TPACK Newsletter! TPACK work is continuing worldwide, and is appearing in an increasing diversity of publication, conference, and professional development venues. This document contains recent updates to that work that we hope will be interesting and useful to you, our subscribers.

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

## Gratuitous Quote About Technology

"Is it a fact - or have I dreamt it - that, by means of electricity, the world of matter has become a great nerve, vibrating thousands of miles in a breathless point of time?"
- Nathaniel Hawthorne

## In This Issue



## 1. TPACK Newsletter Update

The TPACK newsletter currently has 1191 subscribers! This represents an 8% increase during the last five months and a 68% increase since the March SITE 2010 conference.

## 2. Recent TPACK Publications

Below are recent TPACK publications that we know about: 43 articles and 10 chapters(!). If you know of others that were published within the past several months, please let us know (tpack.news.editors@wm.edu).

***Articles***

Abbitt, J. T. (2011). An investigation of the relationship between self-efficacy beliefs about technology integration and technological pedagogical content knowledge (TPACK) among preservice teachers. *Journal of Digital Learning in Teacher Education, 27*(4), 134–143.

Abstract:
"This exploratory study investigated the relationship between measures of Technological Pedagogical Content Knowledge (TPACK) and the self-efficacy beliefs of preservice teachers about technology integration. Within a single-group, pretest–posttest design, a correlational analysis identified several knowledge domains in the TPACK model that the researcher found to have a significant and positive correlation with self-efficacy beliefs about technology integration. A multiple regression analysis of pretest and posttest data indicated a change over time in the predictive relationship between the measures of knowledge in TPACK domains and self-efficacy beliefs. Findings from the study illustrate the changing nature of the complex relationship between knowledge and self-efficacy beliefs and highlight the potential areas of knowledge in TPACK domains that influence preservice teachers' beliefs about technology integration."

Abbitt, J. (2011). Measuring technological pedagogical content knowledge in preservice teacher education: A review of current methods and instruments. *Journal of Research on Technology in Education, 43*(4), 281–300.

Abstract:
"Many research efforts are underway that focus on developing the Technological Pedagogical Content Knowledge (TPACK) framework (Koehler & Mishra, 2007; Mishra & Koehler, 2006) as a lens through which to observe the role of technology in teacher knowledge. This review of literature examines the development of the TPACK framework with a particular focus on assessing TPACK in the context of preservice teacher preparation programs. In an effort to highlight the emerging instruments and methods currently available for use with this specific group, this study provides an overview of instruments and methods as well as a discussion of the challenges, purposes, and potential uses of these tools for TPACK-based evaluation of preservice teacher preparation experiences."

Adcock, L. & Bolick, C. (2011). Web 2.0 Tools and the evolving pedagogy of teacher education. *Contemporary Issues in Technology and Teacher Education, 11*(2), 223-236. Retrieved from http://www.editlib.org/p/35970

Abstract:

“Teacher educators are constantly revisiting and revising their teacher education programs. Historically, research, educational policy, and accreditation requirements have been the impetus for renewal in teacher education. For the past 20 years, technology innovation has played an increasingly significant role in rethinking teacher education. This paper discusses recent changes in a social studies teacher education program and the role Web 2.0 tools played in helping to rethink pedagogy.”

An, H., Wildera, W. & Limb, K. (2011). Preparing elementary pre-service teachers from a non-traditional student population to teach with technology. *Computers in the Schools, 28*(2), 170-193. doi: 10.1080/07380569.2011.577888

Abstract:
“This article documents the development of a two-stage curriculum intended to improve elementary teacher candidates’ understanding of technology integration. Most students in the program came from low-income districts and lacked technology experience. The first stage of the curriculum consisted of a prerequisite basic technology skills course offered by the Computer Science Department. This was then followed by an online educational technology course offered by the College of Education. The objectives of the authors in this article are twofold. The first is to describe the rationale, procedures, and design of a two-stage curriculum, as a pedagogical model for teaching elementary teacher candidates to teach with technology, with the goal of preparing a new generation of teachers who are capable and comfortable applying a broad range of advanced technologies to meet the learning needs of their students. The second objective is to share the authors' findings from the evaluation, which employed mixed methodologies, after the students completed the online educational technology course. The results showed that an online educational technology course contributed to the candidates’ development of Technological Pedagogical Content Knowledge and improved their attitudes and beliefs on their technology integration practices.”

Archambault, L. (2011). The practitioner's perspective on teacher education: Preparing for the K-12 online classroom. *Journal of Technology & Teacher Education, 19*(1), 73-91.

Abstract:
“Little is known about the population of educators who teach online, especially with relationship to preparation from their teacher education programs. This article discusses the results of a national survey of K-12 online teachers from across the nation to ascertain how prepared they felt they were with regard to three key areas: technology, pedagogy, and content, including combinations of these domains, as described by the technological pedagogical content knowledge framework (Mishra & Koehler, 2006). Overall, K-12 online teachers indicated that they felt the most prepared in the areas of pedagogy, content, and

pedagogical content. They felt least prepared in the areas of technology, including technological pedagogical knowledge, technological content knowledge, and technological pedagogical content knowledge. Implications for the field of teacher education are discussed, including the need to more fully integrate technology within the coursework and field experiences of teacher candidates, and the need to create courses, or specific modules within existing courses, to address topics of importance to virtual teaching."

Bos, B. (2011). Professional development for elementary teachers using TPACK. *Contemporary Issues in Technology and Teacher Education*, *11*(2). Retrieved from http://www.citejournal.org/vol11/iss2/mathematics/article1.cfm

Abstract:
"Teacher preparation for the 21st century deserves a front-end approach to addressing the use of technology in the learning environment. To study the effect of instructing with technology, pedagogy, and content knowledge (TPACK), teachers were asked to apply pedagogical, mathematical, and cognitive fidelity to technology used in an instructional unit they were designing. Initial results indicated that teachers were conflicted by a conceptual approach to technology use. Through clarifying and defining pedagogy, mathematics, and cognitive fidelity within the TPACK framework, teachers became more aware of the misuse of instructional technology, what attributes of technology lead to conceptual development, and integration of meaningful technology into instructional units. TPACK, with fidelity carefully defined, creates a research-based model by adding the qualifying features needed to maximize the potential of technology in the classroom. The purpose of this study is to look at the knowledge structures of TPACK and examine them in designing instruction units."

Bower, M., Hedberg, J. G., & Kuswara, A.(2010). A framework for Web 2.0 learning design. *Educational Media International, 47*(3), 177-198.

Abstract:
"This paper describes an approach to conceptualising and performing Web 2.0-enabled learning design. Based on the Technological, Pedagogical and Content Knowledge model of educational practice, the approach conceptualises Web 2.0 learning design by relating Anderson and Krathwohl's Taxonomy of Learning, Teaching and Assessing, and different types of constructive and negotiated pedagogies to a range of contemporary Web 2.0-based learning technologies. The learning design process can then be based upon the extent to which different Web 2.0 technologies support the content, pedagogical, modality and synchronicity requirements of the learning tasks. The model is resilient to the emergence of new Web 2.0 tools, as it views technology as only a mediator of pedagogy and content with attributes to fulfill the needs of the learning episode. A range of possible use cases, categorisations and examples are offered to illustrate the learning design concepts and processes, in order to promote more

savvy and expedient application of Web 2.0 technologies in learning and teaching contexts."

Bowers, J. & Stephens, B. (2011).Using technology to explore mathematical relationships: A framework for orienting mathematics courses for prospective teachers. *Journal of Mathematics Teacher Education, 14*(4), 285-304.

Abstract:
"The technological revolution that has finally permeated K-12 education has direct implications for modern teacher educators whose 'Hippocratic oath' is to best prepare future teachers for twenty-first-century classrooms. The goal of this article is to suggest that the heart of sound technological implementation is to encourage students to use whatever tools are available to explain the mathematical relations that underlie what they observe on the screen. We suggest ways in which Mishra and Koehler's construct of Technological Pedagogical Content Knowledge may be customized to provide a framework for guiding prospective teachers' efforts to develop and assess lesson plans that use technology in novel and effective ways. Data are presented in the form of two contrasting case studies to illustrate the differing degrees to which prospective mathematics teachers leveraged technology to teach themselves and their future students to explain the mathematics behind various topics."

Chuang, H-H, & Ho, C-J. (2011). An investigation of early childhood teachers' Technological Pedagogical Content Knowledge (TPACK) in Taiwan. *Journal of Kirsehir Education Faculty, 12*(2), 99-117. Retrieved from http://www.doaj.org/doaj?func=abstract&id=782294&recNo=6&toc=1&uiLanguage=en

Abstract:
"This study aimed to investigate technological pedagogical content knowledge (TPACK) of early childhood teachers in Taiwan. Quantitative Data was collected from a sample of 335 in-service early childhood teachers in Taiwan. The instrument was translated and adapted from Schmidt et al. (2009) TPACK survey instrument with added items to fit the early educational context in Taiwan. Data analysis methods included descriptive statistics, Pearson correlation, and MANOVA. Findings from the study were summarized as follows: (a) The development of early childhood teachers' pedagogical knowledge (PK), content knowledge (CK) and pedagogical content knowledge (PCK) were the best among the seven knowledge sub domains in TPACK.(b)The number of years of teaching experience was significantly positively correlated with early childhood teachers' pedagogical knowledge (PK), content knowledge (CK) and pedagogical content knowledge (PCK). Besides, early childhood teachers with over ten years of teaching experience had better self-assessed pedagogical knowledge (PK), content knowledge (CK) and pedagogical content knowledge (PCK) than those teachers with less than ten years of teaching experience. (c) A significant positive

correlation was found between pedagogical knowledge (PK), and pedagogical content knowledge (PCK) and age; however, a significant negative correlation existed with technology knowledge (TK) and age. Older early childhood teachers' self-assessed pedagogical knowledge (PK) was better than younger teachers while the young early childhood teachers had a better self-assessed technology knowledge (TK) (d) Early childhood teachers with a frequency of using information technology above 20 hours a week had better self-assessed technology knowledge (TK) and technological content knowledge (TCK) than those with a frequency under 5 hours a week Recommendations were also provided based on the findings from this study."

Demir, S. (2011). Two inseparable facets of technology integration programs: Technology and theoretical framework. *Eurasia Journal of Mathematics, Science & Technology Education, 7*(2), 75-88. Retrieved from http://www.ejmste.com/v7n2/EURASIA_v7n2_Demir.pdf

Abstract:
"This paper considers the process of program development aiming at technology integration for teachers. For this consideration, the paper focused on an integration program which was recently developed as part of a larger project. The participants of this program were 45 in-service teachers. The program continued for four weeks and the conduct of the program was video-recorded. Along with the video-records, the content of the program and the tools employed to document participants' development were analyzed. The analyses were performed on the basis of four components of integration program: objectives, content, teaching-learning situations and assessment. During the analyses, theoretical framework on which the program was based and the technology employed during the program was also evaluated. Based on this evaluation, this paper argues that in the process of both design and conduct of integration programs the technology employed during the program implementation as well as the theoretical framework which informs the use of technology during the program implementation need to be considered carefully. The paper provides evidence that technology and theoretical framework are two inseparable facets of both design and conduct of integration programs and a true understanding of the benefits of these programs could only be achieved through the consideration of these two along with the four components of any integration program."

de Olviera, J. M. (2010). Pre-service teacher education enriched by technology-supported learning environments: A learning technology by design approach. *Journal of Literacy & Technology, 11*(1/2), 89-109.

Abstract:
"Many teacher educators are now concerned about how to scaffold student teachers in the development of the literacy demands of the digital age. The present paper presents a descriptive account of a learning technology by design approach to teacher education, which basically addresses this problem. It draws

on a technological pedagogical content knowledge framework to conceptualize what it means learning to teach in the digital age and presents an educational experience, the subject New Technologies Applied to Education, taught in a pre-service teacher education program. The results of this subject approach show that the students' semiotic production is an evidence that when learners are motivated, their capacity to learn is not limited by teachers' capacity to teach. It is suggested pre-service teacher education should prepare future teachers not only to consume, but also to produce and distribute semiotic resources, taking a more active and critical role in their learning process."

Ehrke, J. (2011). *The efficacy of mobile computing platforms: A case study* (Abilene Christian University Connected Mobile Learning Fellows 2011 Research Reports). Retrieved from http://www.acu.edu/technology/mobilelearning/Research/index.html

Abstract:
"Over the next decade, it is anticipated that mobile learning technologies will significantly impact the future of the graphing calculator platform. The impact of integrated devices (devices which blend productivity, social media, and computing) on educational design in mathematics remains largely unexplored. In this study, we analyze the results of a fall 2010 focused comparison of two sections of a first-year, general education mathematics course. Student performance data and student perceptions of usability are compared across two platforms: the SpaceTime™ mobile computing app and the Texas Instruments™ TI-8x series of graphing calculators. Pedagogical implications of the case study results are viewed and discussed as an integration of action-research within the TPACK framework."

George, M. A. (2011). Preparing teachers to teach adolescent literature in the 21st century. *Theory Into Practice, 50*(3), 182-189.

Abstract:
"Written primarily for other English teacher educators, this article explores one university professor's attempt to reflect on, review, and revise the content, pedagogy, and assessments utilized to teach a graduate course in adolescent literature to preservice and in-service teachers. The new and improved course is designed to simultaneously build content, pedagogical, curricular, and technological pedagogical content knowledge in English teachers."

Graham, C. R. (2011). Theoretical considerations for understanding technological pedagogical content knowledge (TPACK). *Computers & Education, 57*(3), 1953-1960.

Abstract:
"The technological pedagogical content knowledge (TPACK) framework is increasing in use by educational technology researchers around the world who

are interested in issues related to technology integration. Much that is good can be found in the TPACK framework; however considerable theoretical work needs to be done if TPACK research is to cohere and constructively strengthen the field of educational technology. This paper uses criteria for theory building as a lens for examining the TPACK framework. Specific weaknesses are identified, which in turn suggest areas needing theoretical development. This paper calls for researchers to increase emphasis on using research findings to constructively build common definitions and understandings of the TPACK constructs and the boundaries between them."

Haciomeroglu, E. S., Bu, L., Schoen, R. C., & Hohenwarter, M. (2011). Prospective teachers' experiences in developing lessons with dynamic mathematics software. International *Journal for Technology in Mathematics Education, 18*(2), 71-82.

Abstract:
"This study sought to examine the development of prospective secondary mathematics teachers' Technological Pedagogical Content Knowledge as they worked individually and in small groups to develop and present lessons with dynamic mathematics software. In a three-semester long study, data were collected from 68 prospective secondary mathematics teachers enrolled in methods courses through their written reflections, lesson plans, and classroom observations. Our results suggest that the prospective teachers' perspectives on teaching and learning mathematics with technology were enriched as a result of their participation in course activities. We discuss pedagogical implications for these results in a final section."

Hammond, T. C. & Manfra, M. M. (2009). Technology integration. *Social Studies Research & Practice, 4*(3), 139-150.

Abstract:
"Social studies educators have displayed an interest in student-created multimedia, including digital documentaries. The research community has responded with a small but growing body of studies, but the literature to date has not explored students' perspectives on these assignments. This study combined classroom observations, document analysis, and student interviews to examine students' views of technology, the curriculum, and their final products. The findings reveal that students come to technology-based, content-driven assignments with prior conceptions of both the technology and the content. These expectations shape student actions and transform the assignment, in some cases surpassing curricular expectations. Evidence from students' products, classroom observations, and interview data, however, also suggest that student agency was limited by the classroom reality of mimetic learning. The results of this study have various implications for teacher educators and educational researchers interested in leveraging technology to improve learning. They must acknowledge the dynamic nature of classroom interaction and the

impact student choices have on Technological Pedagogical Content Knowledge (TPACK). Technology integration occurs in the operational curriculum, often in unpredictable ways. Based on our study we know that student preconceptions and desires impact the learning goals. By better under-standing the role of student agency, teachers can plan for instruction that uses digital history to effectively teach content."

Hardy, M. D. (2010). Facilitating growth in preservice mathematics teachers' TPCK. *National Teacher Education Journal, 3*(2), 121-138.

Abstract:
"The X-Tech Project was intended to enhance preservice secondary mathematics teachers' technological pedagogical content knowledge as well as their perceptions of that knowledge. Findings indicated not only that the Project attained that goal but that practically-oriented methods that meet many of the participants' technology related needs are productive avenues for facilitating such learning. Use of a variety of resources to explore problems relevant to the level at which participants will teach, planning technology-infused lessons, and critiquing technological resources appear to be particularly beneficial."

Jaipal, K., & Figg, C. (2010). Unpacking the "Total PACKage": Emergent TPACK characteristics from a study of preservice teachers teaching with technology. *Journal of Technology & Teacher Education, 18*(3), 415-441.

Abstract:
"Four preservice teachers participated in a school-based collaborative initiative where they were supported by two university faculty members, a school board technology consultant and a master's student to integrate technology into teaching practice. Preservice teachers planned and taught technology-enhanced lessons during a seven-week practice-teaching block at two K-8 schools. This article proposes a framework that outlines particular characteristics for supporting preservice teachers' effective integration of technology into classroom practice. The characteristics emerged from a cross-case analysis of data sources from the four participants. Data sources included pre and post focus group interviews, individual interviews, planning and support sessions, lesson plans, and observations of preservice teachers' classroom practice. A framework is proposed that expands understandings of the current Technological, Pedagogical, and Content Knowledge (TPACK) model (Koehler & Mishra, 2008) for classroom practice."

Khan, S. (2011). New pedagogies on teaching science with computer simulations. Journal of Science Education and Technology, 20(3), 215-232. doi: 10.1007/s10956-010-9247-2

Abstract:

“Teaching science with computer simulations is a complex undertaking. This case study examines how an experienced science teacher taught chemistry using computer simulations and the impact of his teaching on his students. Classroom observations over 3 semesters, teacher interviews, and student surveys were collected. The data was analyzed for (1) patterns in teacher-student-computer interactions, and (2) the outcome of these interactions on student learning. Using Technological Pedagogical Content Knowledge (TPCK) as a theoretical framework, analysis of the data indicates that computer simulations were employed in a unique instructional cycle across 11 topics in the science curriculum and that several teacher-developed heuristics were important to guiding the pedagogical approach. The teacher followed a pattern of “generate-evaluate-modify” (GEM) to teach chemistry, and simulation technology (T) was integrated in every stage of GEM (or T-GEM). Analysis of the student survey suggested that engagement with T-GEM enhanced conceptual understanding of chemistry. The author postulates the affordances of computer simulations and suggests T-GEM and its heuristics as an effective and viable pedagogy for teaching science with technology.”

Koehler, M. J., Mishra, P., Bouck, E. C., DeSchryver, M., Kereluik, K., Shin, T. S., & Wolf, L. G. (2011). Deep-play: Developing TPACK for 21st century teachers. *International Journal of Learning Technology, 6*(2), 146-163. doi: 10.1504/IJLT.2011.042646 Retrieved from http://punya.educ.msu.edu/publications/koehler.et.al.ijlt2011.pdf

Abstract:

"A key complication facing teachers who seek to integrate technology in their teaching is the fact that most technologies are not designed for educational purposes. Making a tool an educational technology requires creative input from the teacher to re-design, or maybe even subvert the original intentions of the designer. The learning technology by design (LT/D) framework has been proposed as being an effective instructional technique to develop deeper understanding of technological pedagogical content knowledge. In this paper we expand our description of the LT/D technique to develop what we call a deep-play model for teacher professional development. The deep-play model integrates: a) pedagogy for key 21st century learning skills; b) content that cuts across disciplines with trans-disciplinary cognitive tools; c) technology by the creative repurposing of tools for pedagogical purposes."

Kukkonen, J., Kärkkäinen, S., Valtonen, T., & Keinonen, T. (2011). Blogging to support inquiry-based learning and reflection in teacher students' science education. *Problems of Education in the 21st Century, 31,* 73-84.

Abstract:

“This study aims to clarify primary school teacher students' experiences about the use of blogs in the context of a science course which includes collaborative

inquiry-based approaches and a field trip. Teacher students were asked to design and conduct a small inquiry and report the phases of the process in a blog and then write their ideas about inquiry-based teaching and learning in it. The inquiry process was loosely scaffolded by linking the blogs together. The students were also asked to fill in a questionnaire of technological pedagogical content knowledge (TPACK), in order to acquire insight into their views on the scaffolding needed for their own inquiry process, as well as the role of scaffolding in the inquiry method in primary school. The findings showed that after discussing them with each other, teacher students were able to formulate personally meaningful problems for their investigation. Teacher students investigated multidisciplinary elements and learned about different phases of the inquiry and the blogs enabled them to follow the process of others. Teacher students' information retrieval and processing skills developed throughout the inquiry and aided them in other teacher education courses, also giving them a firm foundation and confidence in accessing and applying information as life-long learners."

Li, H. (2010). Handbook of Technological Pedagogical Content Knowledge (TPCK) for Educators. *International Journal of Continuing Education & Lifelong Learning, 2*(2), 119-120.

Abstract:
"The article reviews the book "Handbook of Technological Pedagogical Content Knowledge (TPCK) for Educators," edited by the American Association of Colleges for Teacher Education (AACTE) Committee on Innovation and Technology."

McGrath, J., Karabas, G., & Willis. J. (2011). From TPACK concept to TPACK practice: An analysis of the suitability and usefulness of the concept as a guide in the real world of teacher development. *International Journal of Technology in Teaching and Learning, 7*(1), 1-23. Retrieved from http://www.sicet.org/journals/ijttl/issue1101/1_Willis.pdf

Abstract:
"This paper describes the TPACK model and how it was used to guide the design and development of a school district's teacher development program that was funded by a grant from the New York State Department of Education. The usefulness of the TPACK model as a framework for teacher development projects was evaluated using interviews of teachers who participated in a project. The results indicate that TPACK is a very powerful and appropriate model when used as a framework for such projects. Even critiques and recommendations made by teachers were often expressions of TPACK basic principles or assumptions that highlighted where the project could have better met TPACK ideals. However, TPACK does not appear to be a model that can be used as a single source of conceptual guidelines. The interview data highlighted important, even crucial, aspects of a project that are not directly addressed by the TPACK

model. Chief among these were logistical issues, the need to consider principles of adult learning and diffusion models when designing development projects, and the crucial importance of building and supporting social/professional networks."

Mouza, C. (2011). Promoting urban teachers' understanding of technology, content, and pedagogy in the context of case development. *Journal of Research on Technology in Education, 44*(1), 1–29.

Abstract:
"This study investigated the potential of a professional development program centered on case development to help urban teachers: (a) integrate technology with content and pedagogy and (b) cultivate habits of reflection required to learn from practice. Qualitative analysis revealed that case development helped teachers develop an understanding of the nuanced relationships among technology, content, and pedagogy and engage in the type of reflection that enables learning from practice. Nevertheless, variability existed in the ways that teachers applied new knowledge to practice. Factors that influenced teachers' learning and practice included beliefs about students, prescribed curricula, and lack of resources."

Niess, M. L. (2011). Investigating TPACK: Knowledge growth in teaching with technology. *Journal of Educational Computing Research, 44*(3), 299-317.

Abstract:
"Technological pedagogical and content knowledge (TPACK) presents a dynamic framework for describing teachers' knowledge required for designing, implementing, and evaluating curriculum and instruction with technology. TPACK strategic thinking includes knowing when, where, and how to use domain-specific knowledge and strategies for guiding students' learning with appropriate information and communication technologies. Multiple visual and verbal descriptions reflect evolving recognitions of teacher educators and educational researchers as they have struggled to respond to the challenges in describing and developing teachers' TPACK. This extensive reflection maps the historical acceptance of pedagogical content knowledge (PCK) with the emerging views of and challenges with TPACK. A review of empirical progress in the investigation of TPACK serves to illuminate potential insights, values, and challenges for directing future educational implementations designed to identify a teacher's learning trajectory in the development of a more robust and mature TPACK for supporting them in teaching with current and emerging technologies."

Oster-Levinz, A., & Klieger, A. (2010). Online tasks as a tool to promote teachers' expertise within the Technological Pedagogical Content Knowledge (TPACK). Procedia - Social and Behavioral Sciences, 2(2), 354-358. doi: 10.1016/j.sbspro.2010.03.024 Retrieved from http://www.sciencedirect.com/science/article/pii/S1877042810000649

Abstract:
"In the Information Communication Technology (ICT) era, teachers will have to wisely use the online environment in order to realize a new pedagogy. We developed a digital indicator for examining the extent to which technological knowledge is integrated with pedagogical content knowledge (TPACK). This indicator is used to examine online tasks developed by teachers in different subjects over time. It enables quantitative measurement of the integration of technological knowledge with content knowledge and pedagogical content knowledge and thus affords a measure for the extent of integration. The digital indicator can be used to plan online tasks as well as for the teachers to test their own professional development in integrating technology in teaching. Use of the digital indicator can be implemented when training student teachers as well as in in-service training for teachers. Fifty-three online tasks developed by 14 high school teachers in different subjects were evaluated between 2001 and 2007. Evaluation of the online tasks was performed quantitatively using the digital evaluation instrument after it was validated and its reliability was examined. We examined the change and progress which took place in the integration of technological knowledge with pedagogical content knowledge over time as well as the contribution of guidance to the teachers' professional development for integration of technology in teaching. The findings indicate that the effect of time, which is expressed by the acquisition of experience, contributes to the integration of the technological knowledge with the teachers' pedagogical content knowledge. The findings also indicate that guidance plays a significant role in the implementation of the integration of technological knowledge with the teachers' pedagogical content knowledge. We recommend that correct integration of TPACK should be emphasized when planning professional development for teachers in the field of online tasks. We also recommend the development of models for teachers' professional development for integration of technology in teaching, with reference to the teachers' professional knowledge, i.e. their pedagogical content knowledge. The best ways for integrating the technological knowledge must be examined, such that the focus will not be on learning technological tools, but rather on the integration of pedagogy in technology. It is necessary to start from the field of knowledge and the teaching methods appropriate for this particular field of knowledge, and there to integrate technology. Optimal integration will lead to a change in teaching, to relevance for the students and to meaningful learning."

Özgün-Koca, S. A., Meagher, M., Edwards, M. T. (2011). A teacher's journey with a new generation handheld: Decisions, struggles, and accomplishments. *School Science and Mathematics, 111*(5), 209-224. doi: 10.1111/j.1949-8594.2011.00080.x

Abstract:
"In this technology-oriented age, teachers face daily decisions regarding the use of advanced digital technologies—graphing calculators, dynamic geometry software, blogs, wikis, podcasts and the like—to enhance student mathematical

understanding in their classrooms. In this case study, the authors use the Technological, Pedagogical, and Content Knowledge (TPACK) model in conjunction with a five-stage developmental model, which can be used to describe growth in TPACK to describe the initial attempts of a teacher, Jane, to develop TPACK as she learns and attempts to integrate an advanced teaching technology into her classroom, namely the TI-Nspire graphing calculator. The study tracks her struggles to reconcile some traditional beliefs about how students learn with her desire to be responsive to what she perceives as affordances of advanced digital technologies. Main data collection methods were journal writing, observations, document analysis, and interviews. Using the five-stage developmental model, we saw that this experience helped Jane to move among different stages. This study showed that the TPACK model with the five-stage developmental model can be a beneficial tool for researchers to study teachers' professional growth and is also a valuable tool for teachers to reflect on their own growth."

Özmantar, M. F., Akkoç, H., Bingölbali, E., Demir, S., & Ergene, B. (2010). Pre-service mathematics teachers' use of multiple representations in technology-rich environments. *Eurasia Journal of Mathematics, Science & Technology Education, 6*(1), 19-36.

Abstract:
"In this paper, we examine the development of pre-service mathematics teachers' use of multiple representations during teaching in technology-rich environments. The pre-service teachers took part in a preparation program aimed at integration of technology into teaching mathematics. The program was designed on the basis of Technological Pedagogical Content Knowledge (TPCK) framework; and the mathematical content chosen for the program was the concept of derivative. The pre-service teachers' development was scrutinized in terms of their knowledge of representations, of connections established among the representations, and of the aspects of derivative emphasized by these connections. On the basis of our analyses we argue that any attempt to prepare pre-service teachers for effective use of technology in teaching mathematics needs to explicitly focus on the functions of multiple representations in tandem with the mathematical content under consideration. We discuss the educational implications of the study in designing and conducting of the preparation programs related to the successful integration of technology in teaching mathematics."

Pamuk, S. (2011), Understanding preservice teachers' technology use through TPACK framework. *Journal of Computer Assisted Learning.* Advance online publication. doi: 10.1111/j.1365-2729.2011.00447.x

Abstract:
"This study discusses preservice teachers' achievement barriers to technology integration, using principles of technological pedagogical content knowledge (TPACK) as an evaluative framework. Technology-capable participants each

freely chose a content area to comprise project. Data analysis based on interactions among core components of TPACK revealed that participants struggled with developing new knowledge. Lack of pedagogical experience limited development of appropriate technology integration approaches. Creating new knowledge bases based on different teaching components can be difficult for preservice teachers because it requires a deep understanding of core knowledge and interpretation of the teaching context and its dynamics. Developing pedagogical content knowledge (PCK) is an important factor in overall technology integration; teachers must make it a priority to acquire PCK before integrating technology. In preservice teacher education, PCK development must be supported with actual teaching experience. We believe that the results of the study may provide valuable insight with respect to proper focus on technology integration and recognizing limitations and challenges within TPACK principles to both those who teach technology integration and those who design TPACK-based activities."

Polly, D. (2011). Developing students' higher-order thinking skills (HOTS) through technology-rich tasks. *Educational Technology, 51*(4), 20-26.

Abstract:
"Technology has been shown to positively influence student learning when students explore technology-rich tasks that simultaneously require them to use higher- order thinking skills (HOTS), such as analyzing or evaluating information or creating new representations of knowledge. Educational technology researchers have posited that in order for teachers to effectively integrate technology, teachers need a set of knowledge components referred to as Technological, Pedagogical, and Content Knowledge (TPACK). This article examines the overlap between technology-rich tasks that develop HOTS and TPACK in the context of formal school settings. Implications for research and practice related to implementing technology-rich tasks and developing teachers' TPACK are also discussed."

Polly, D. (2011). Developing teachers' Technological, Pedagogical, and Content Knowledge (TPACK) through mathematics professional development. *International Journal for Technology in Mathematics Education, 18*(2), 83-96.

Abstract:
"In recent years, educational technologists have advanced the construct Technological and Pedagogical Content Knowledge (TPACK) to describe teachers' knowledge related to effectively integrating technology. In this paper, I use the TPACK framework to examine elementary school teachers' experience in a year-long professional development program, where participants used technology to explore mathematical tasks and were charged with integrating technology-rich tasks in their own classrooms. Participants were observed repeatedly during the school year when they reported their intent to use

pedagogies from the professional development. While both participants integrated technology in their classroom, and displayed evidence of TPACK, their enacted pedagogies did not completely align to the pedagogies emphasized during professional development. Implications and suggestions for supporting and researching teachers' development of TPACK are also shared."

Polly, D. (2011). Examining how the enactment of TPACK varies across grade levels in mathematics. *Journal of Computers in Mathematics & Science Teaching, 30*(1), 37-59.

Abstract:
"Technological pedagogical and content knowledge (TPACK) has been advanced as a construct to describe teachers' understandings related to effectively teaching with technology. This study examined the development of TPACK of two teachers during their mathematics teaching after participating in a learner-centered professional development (LCPD) project designed to support technology integration. Inductive analyses of classroom observations and interviews indicate that both teachers were able to enact aspects of TPACK in their classroom. However, teachers' use of technology only developed students' higher-order thinking skills and conceptual understanding in limited ways. Implications for future professional development projects and the TPACK model are also discussed."

Sahin, I. (2011). Development of survey of Technological Pedagogical and Content Knowledge (TPACK). *Turkish Online Journal of Educational Technology, 10*(1), 97-105.

Abstract:
"The purpose of this study is to develop a survey of technological pedagogical and content knowledge (TPACK). The survey consists of seven subscales forming the TPACK model: 1) technology knowledge (TK), 2) pedagogy knowledge (PK), 3) content knowledge (CK), 4) technological pedagogical knowledge (TPK), 5) technological content knowledge (TCK), 6) pedagogical content knowledge (PCK), and 7) TPACK. This study is conducted in five phases: 1) item pool, 2) validity and reliability, 3) discriminant validity, 4) test-retest reliability, and 5) translation of the TPACK survey. To examine language equivalence, both Turkish and English versions of the TPACK survey are administered to preservice teachers studying English language education. It is determined the questionnaire meets the language equivalence. Results demonstrate the TPACK survey is a valid and reliable measure."

Salinas, C., Bellows, M. E. & Liaw, H. L. (2011). Preservice social studies teachers' historical thinking and digitized primary sources: What they use and why. *Contemporary Issues in Technology and Teacher Education, 11*(2), 184-204. Retrieved from http://www.editlib.org/p/36223

Abstract:
“In this qualitative case study the authors explored secondary social studies preservice teachers’ abilities to discern the digitized primary resources available to them for historical thinking instruction. The emerging analysis highlights the development of these young teachers’ knowledge and understandings of digitized resources as they relate to historical thinking via a pragmatic meter and their pedagogical content knowledge. Using the teacher cognition scholarship of Shulman (2004), the study suggests that the preservice teachers’ enumerated knowledge sources are vital in tracing teachers' decisions.”

Schul, J. E. (2010). The mergence of CHAT with TPCK: A new framework for researching the integration of desktop documentary making in history teaching and learning. *THEN: Technology, Humanities, Education & Narrative, 7,* 9-25.

Abstract:
“The description of the integration of desktop documentary making into a history classroom requires a research model or heuristic capable of capturing students' interactions with various mediating agents, including their history teacher. This article claims that a mergence of Cultural Historical Activity Theory (CHAT) with Technological Pedagogical Content Knowledge (TPCK) provides a model sufficiently dynamic to describe how students making documentaries draw upon their teacher's instruction, the software's history making operations, and other resources while engaged in the compositional process.”

Schul, J. E. (2010). Necessity is the mother of invention: An experienced history teacher's integration of desktop documentary making. *International Journal of Technology in Teaching & Learning, 6*(1), 14-32.

Abstract:
“Desktop documentary making elicits a new and unique way of doing history, and an examination into its integration into classroom instruction is warranted. This qualitative study explored one experienced teacher's integration of desktop documentary making into a secondary history classroom. In addition to examining the teacher's instructional practices, the compositional practices of five of this teacher's students were investigated in order to illuminate the teacher's integration of desktop documentary making as it related to history teaching and learning. Data were collected and coded to summarize the emergent themes. The findings reveal that the teacher's integration of desktop documentary making complimented and enhanced inquiry-based practices already present in his classroom.”

Swan, K. & Hofer, M. (2011). In search of Technological Pedagogical Content Knowledge: Teachers' initial foray into podcasting in economics. *Journal of Research on Technology in Education, 44*(1), 75-98.

Abstract:
“In this paper, we report on work with eight practicing ninth grade social studies teachers to determine how they chose to integrate podcasting to help their students build on their economic literacy, which includes building both economic concepts and skills. The study is rooted in an interpretivist research paradigm, using the Council for Economic Education's National Voluntary Content Standards in Economics (1997) and Mishra and Koehler's (2006) theory of Technological Pedagogical Content Knowledge (TPACK) to frame data generation, analysis, and the reporting of results. We found that teachers demonstrated strong technological pedagogical knowledge (TPK) but a lack of technological content knowledge (TCK) in the design and implementation of the podcasting projects. We argue that the lack of teachers' content-based rationale for podcasting is a function of the universal nature of some digital tools, such as podcasting, in contrast to more specialized tools, such as computer simulations.”

Toth, E. E. (2009). Virtual inquiry in the science classroom: What is the role of Technological Pedagogial Content Knowledge? *International Journal of Information & Communication Technology Education, 5*(4), 78-87. doi: 10.4018/jicte.2009041008

Abstract:
“The article presents a study conducted to assist teachers in their development of pedagogical content knowledge (PCK) for classroom inquiry in the college introductory biology classrooms or high school biology, as relevant to the selection and use of technological tools. The study examines previous research including inquiry learning that is defined as the coordination of designing experiments and asking questions, the characteristics of educational software tools that support learning effectively and the pedagogical content knowledge. The results show that when it comes to supporting inquiry learning, all software tools are not created equal, thus previous research studies report contradictory findings of effectiveness.”

Valtonena, T., Pontinena, S., Kukkonena, J., Dillona, P., Väisänena, P., & & Hacklina, S. (2011). Confronting the technological pedagogical knowledge of Finnish net generation student teachers. *Technology, Pedagogy and Education, 20*(1), 3-18. doi: 10.1080/1475939X.2010.534867

Abstract:
“The research reported here is concerned with a critical examination of some of the assumptions concerning the 'Net Generation' capabilities of 74 first-year student teachers in a Finnish university. There are assumptions that: (i) Net Generation students are adept at learning through discovery and thinking in a hypertext-like manner (Oblinger & Oblinger, 2005; Prensky, 2001); and (ii) when they enter the teaching profession, members of this generation will be able to transfer these characteristics into their teaching practices (Prensky, 2001). The research is formulated around an extended framework for student teachers'

technological pedagogical knowledge. The students designed learning modules incorporating the use of information and communication technology (ICT). The learning modules were subjected to document and artefact analysis incorporating concept-driven coding. Supplementary data were collected through a questionnaire concerned with the students' adoption of new technologies. The findings suggest that assumptions about Net Generation student teachers' abilities to adopt and adapt ICT in their teaching are highly questionable and that greater attention should be given to the development of their technological pedagogical knowledge."

Vidoni, K.; Lady, S. Assay., L., & Ewing-Taylor, J. (2010). Nevada Pathway Project: Preparing 21st century principals. *Principal Leadership, 11*(3), 64-67.

Abstract:
"The article focuses on features and benefits of the Pathway to Nevada's Future Pathway project. The project has two goals namely to change classroom experiences through the use of technology and to create professional development resources for administrators and teachers. The project reportedly utilizes a framework technology integration based on the convergence of technological, pedagogical and content knowledge of teachers."

Voogt, J. M., Alayyar, G. M., & Fisser, P. (2011). ICT integration through design teams in science teacher preparation. *International Journal of Learning Technology, 6*(2), 125-145.

Abstract:
"In this study, the technological pedagogical content knowledge (TPACK) framework is used to prepare students in the science teacher preparation program at the Public Authority of Applied Education and Training in Kuwait. Students worked in small design teams and were coached by technology, pedagogy, and content experts, to find a technological solution for a pedagogical problem that a teacher normally faces. In design teams, students blended content, pedagogy, and information and communication technology (ICT) to design a learning environment enhanced with ICT. Data was collected on students' attitudes towards ICT and teamwork, their ICT skills, and their perception of their TPACK development. Pre-service teachers' need for support and the criteria for that support were assessed. The findings indicated that students gained higher results in TPACK and ICT skills, and had a positive attitude toward ICT and toward working in design teams."

Wilson, E., & Wright, V. (2010). Images over Time: The intersection of Social Studies through technology, content, and pedagogy. *Contemporary Issues in Technology & Teacher Education, 10*(2), 220-233.

Abstract:

“In this study, the authors examined the intersections between technology, pedagogy, and content through two social studies teachers' development from preservice to in-service teaching. Qualitative data were collected during their teacher education programs, student teaching experiences, and 5 years into their in-service teaching. Teacher narratives illustrate the connections between technology, pedagogy, and content in these teachers' social studies classrooms. The researchers note the complexity of technology integration and recommend that teacher educators support and promote opportunities for continuing education and professional development in teachers' growth of technological pedagogical content knowledge.”

Zhan, Y., & Ren, Y. (in press). An empirical study on improving mathematics preservice reachers’ TPACK. *Journal of China Educational Technology.* May be retrievable from http://www.oriprobe.com/journals/zgdhjy.html

Abstract: (translated)
"In 2006, Mishra and Koehler proposed the concept of TPACK which is a new framework of teacher knowledge for teaching by technology effectively. Basing on the researches aboard, this paper is about an empirical study of TPACK in China. The research addressed the question of “what kind of course is helpful in improving preservice teachers’ TPACK?” while choosing preservice teachers who were studying mathematics teaching in a university in Shanghai as the research sample. The course we designed applied a “Learning by Design” and self-questioning strategies. A TPACK scale for mathematics teachers was developed by referring to the scales of Schmidt and Archambault. The pre-post scales data shows participants’ TPACK improved after taking the course."

### *Chapters*

Bell, L., Juersivich, N., Hammond, T. C., & Bell, R. L. (2012). The TPACK of dynamic representations. In R. N. Ronau, C. R. Rakes, & M. L. Niess (Eds.), *Educational technology, teacher knowledge, and classroom impact: A research handbook on frameworks and approaches* (pp. 103-135). doi: 10.4018/978-1-60960-750-0.ch005

Abstract:
“Effective teachers across K-12 content areas often use visual representations to promote conceptual understanding, but these static representations remain insufficient for conveying adequate information to novice learners about motion and dynamic processes. The advent of dynamic representations has created new possibilities for more fully supporting visualization. This chapter discusses the findings from a broad range of studies over the past decade examining the use of dynamic representations in the classroom, focusing especially on the content areas of science, mathematics, and social studies, with the purpose of facilitating the development of teacher technological pedagogical content knowledge. The

chapter describes the research regarding the affordances for learning with dynamic representations, as well as the constraints—characteristics of both the technology and learners that can become barriers to learning—followed by a summary of literature-based recommendations for effective teaching with dynamic representations and implications for teaching and teacher education across subject areas."

Hammond, T. C., Alexander, R. C., & Bodzin, A. M. (2012). Assessment in authentic environments: Designing instruments and reporting results from classroom-based TPACK research. In R. N. Ronau, C. R. Rakes, & M. L. Niess (Eds.), *Educational technology, teacher knowledge, and classroom impact: A research handbook on frameworks and approaches* (pp. 32-57). doi: 10.4018/978-1-60960-750-0.ch003

Abstract:
"The TPACK framework provides researchers with a robust framework for conducting research on technology integration in authentic environments, i.e., intact classrooms engaged in standards-aligned instruction. Researchers who wish to identify the value added by a promising technology-supported instructional strategy will need to assess student learning outcomes in these environments; unfortunately, collecting valid and reliable data on student learning in classroom research is extremely difficult. To date, few studies using TPACK in K-12 classrooms have included student learning outcomes in their research questions, and researchers are therefore left without models to guide their development, implementation, and analysis of assessments. This chapter draws upon the literature and our own research and assessment experiences in technology-integrated, standards-aligned classroom instruction to give examples and advice to researchers as they develop, analyze, and write up their observations of student learning outcomes. In particular, we focus on standard items, specifically multiple choice items, as an accepted (if limited) method for assessing student understanding. We seek to fill an existing gap in the literature between assessment advice for educational psychologists (who typically work outside of classroom settings) and advice given to teachers (who have lower thresholds for issues such as validity and reliability). Classroom researchers will benefit from this advice to develop, validate, and apply their own objective assessments. We focus on the content areas of science and social studies, but this advice can be applied to others as well."

Hu, C. (2012). Creating an environment for pre-service teachers to develop Technical Pedagogical and Content Knowledge. In T. Le & Q. Le (Eds.), *Technologies for Enhancing Pedagogy, Engagement and Empowerment in Education: Creating Learning-Friendly Environments* (pp. 115-128). doi: 10.4018/978-1-61350-074-3.ch010

Abstract:

"This chapter reports a teacher education program in applying the framework of TPACK to the design of its ICT curriculum: the design principles employed, its implementation and a formative evaluation. A survey adapted from Schmidt et al. (2009) was administered at the beginning and completion of the course. The post-course survey showed an increase in pre-service teachers' self-reported ratings in all three types of knowledge, namely technological knowledge, technological pedagogical knowledge, and technology, pedagogy and content knowledge. Although a majority (53.1%) of the pre-service teachers favored the approach of learning technology through engaging in design projects, many suggested that more structured instruction would benefit their learning."

Johnston, C. J. & Moyer-Packenham, P. S. (2012). A model for examining the criteria used by pre-service elementary teachers in their evaluation of technology for mathematics teaching. In R. N. Ronau, C. R. Rakes, & M. L. Niess (Eds.), *Educational technology, teacher knowledge, and classroom impact: A research handbook on frameworks and approaches* (pp. 200-227). doi: 10.4018/978-1-60960-750-0.ch009

Abstract:
"Multiple existing frameworks address aspects of teachers' knowledge for teaching mathematics with technology. This study proposes the integration of several frameworks, including TPACK (Mishra & Koehler, 2006), MKT (Ball, Thames, & Phelps, 2008), and technology evaluation criteria (Battey, Kafai, & Franke, 2005) into a new comprehensive model for interpreting teachers' knowledge of the use of technology for teaching mathematics: the T-MATH (Teachers' Mathematics and Technology Holistic) Framework The study employed quantitative and qualitative methods to examine 144 pre-service elementary teachers' evaluations of technology for future mathematics teaching. The proposed model and its application to this group of pre-service teachers suggest that there are multiple dimensions to understanding teachers' knowledge of uses of technology for mathematics teaching, and that teachers' self-identified evaluation criteria reveal the dimension in which their knowledge resides. Understanding teachers' progressions through these dimensions may provide insights into the types of experiences that support teacher development of the knowledge necessary to teach mathematics using appropriate technologies."

Koehler, M. J., Shin, T. S., & Mishra, P. (2012). How do we measure TPACK? Let me count the ways. In R. N. Ronau, C. R. Rakes, & M. L. Niess (Eds.), *Educational technology, teacher knowledge, and classroom impact: A research handbook on frameworks and approaches* (pp. 16-31). doi: 10.4018/978-1-60960-750-0.ch002

Abstract:
"In this chapter we reviewed a wide range of approaches to measure Technological Pedagogical Content Knowledge (TPACK). We identified recent empirical studies that utilized TPACK assessments and determined whether they

should be included in our analysis using a set of criteria. We then conducted a study-level analysis focusing on empirical studies that met our initial search criteria. In addition, we conducted a measurement-level analysis focusing on individual measures. Based on our measurement-level analysis, we categorized a total of 141 instruments into five types (i.e., self-report measures, open-end questionnaires, performance assessments, interviews, and observations) and investigated how each measure addressed the issues of validity and reliability. We concluded our review by discussing limitations and implications of our study."

Lee, J. K., & Manfra, M. M. (2012). TPACK vernaculars in Social Studies research. In R. N. Ronau, C. R. Rakes, & M. L. Niess (Eds.), *Educational technology, teacher knowledge, and classroom impact: A research handbook on frameworks and approaches* (pp. 158-175). doi: 10.4018/978-1-60960-750-0.ch007

Abstract:
"To address the myriad effects that emerge from using technology in social studies, we introduce in this chapter the concept of vernaculars to represent local conditions and tendencies, which arise from using technology in social studies. The chapter includes three examples of TPACK vernaculars in social studies. The first explores a theoretical TPACK vernacular where Web 2.0 technologies support social studies and democratic life. The second example is focused on a three-part heuristic for seeking information about digital historical resources from the Library of Congress. Example three presents personalized vernacular TPACK developed by teachers planning to use an online gaming website called Whyville. Research and theorizing on vernacular forms of TPACK in social studies can aid teachers as they reflect on their own experiences teaching with technology."

Lyublinskaya, I. & Tournaki, N. (2012). The effects of teacher content authoring on TPACK and on atudent achievement in algebra: Research on instruction with the TI-Nspire™ handheld. In R. N. Ronau, C. R. Rakes, & M. L. Niess (Eds.), *Educational technology, teacher knowledge, and classroom impact: A research handbook on frameworks and approaches* (pp. 295-322). doi: 10.4018/978-1-60960-750-0.ch013

Abstract:
"A year-long PD program was provided to four NYC integrated algebra teachers. The PD comprised of teacher authoring of curriculum that incorporated TI-Nspire™1 technology. Teacher TPACK levels were measured through a TPACK Levels Rubric, created and validated by the authors. The rubric was used to assess the teachers' written artifacts (lesson plans and authored curriculum materials) and observed behaviors (PD presentations and classroom teaching through observations). Results indicated that, first teachers' TPACK scores for written artifacts paralleled those of PD presentations. Second, the classroom teaching was either at the same level or lower than written artifacts. Third,

teachers did not improve with every lesson they developed; instead, their scores vacillated within the two or three lower TPACK levels. Finally, the students taught by the teachers with higher TPACK level had higher average score on the NYS Regents exam and higher passing rates."

Miller, T. K. (2012). A theoretical framework for implementing technology for mathematics learning. In R. N. Ronau, C. R. Rakes, & M. L. Niess (Eds.), *Educational technology, teacher knowledge, and classroom impact: A research handbook on frameworks and approaches* (pp. 251-270). doi: 10.4018/978-1-60960-750-0.ch011

Abstract:
"This chapter details a theoretical framework for effective implementation and study of technology when used in mathematics education. Based on phenomenography and the variation theory of learning, the framework considers the influence of the learning context, students' perceptions of the learning opportunity, and their approaches to using it upon measured educational outcomes. Elements of the TPACK framework and the CTFK model of teacher knowledge are also addressed. The process of meeting learning objectives is viewed as leading students to awareness of possible variation on different aspects, or dimensions, of an object of mathematical learning."

Niess, M. L. (2012) Teacher knowledge for teaching with technology: A TPACK lens. In R. N. Ronau, C. R. Rakes, & M. L. Niess (Eds.), *Educational technology, teacher knowledge, and classroom impact: A research handbook on frameworks and approaches* (pp. 1-15). doi: 10.4018/978-1-60960-750-0.ch001

Abstract:
"Technology, pedagogy, and content knowledge (TPACK) is a dynamic lens that describes teacher knowledge required for designing, implementing, and evaluating curriculum and instruction with technology. TPACK strategic thinking incorporates knowing when, where, and how to use domain-specific knowledge and strategies for guiding students' learning with appropriate digital, information, and communication technologies. This chapter maps historical responses to the question of the knowledge that teachers need for teaching amid the emerging views of and challenges with TPACK. A review of empirical progress serves to illuminate potential insights, values, and challenges for directing future research designed to identify a teacher's learning trajectory in the development of a more robust and mature TPACK for teaching with current and emerging information and communication technologies."

Piro, J. M. & Marksbury, N. (2012). Technologizing teaching: Using the WebQuest to enhance pre-service education. In R. N. Ronau, C. R. Rakes, & M. L. Niess (Eds.), *Educational technology, teacher knowledge,*

*and classroom impact: A research handbook on frameworks and approaches* (pp. 228-250). doi: 10.4018/978-1-60960-750-0.ch010

Abstract:
"With the continuing shift of instructional media to digital sources occurring in classrooms around the world, the role of technology instruction in the pre-service curriculum of K-12 teachers is acquiring increasing salience. However, barriers to its inclusion continue to exist. In this chapter we focus on a model of hybridity designed to embed technology instruction into pre-service education. This model is known as the WebQuest and involves the development of a technology-driven learning activity that scaffolds the building of skills in content, pedagogy, and technology integration in pre-service teachers. We discuss data from an exploratory project conducted within a class of graduate pre-service teachers experiencing instruction in creating a WebQuest, and offer some preliminary findings. We place these results within a larger perspective of the CFTK and TPACK frameworks and their application to issues germane to pre-service teacher education."

## 3. Recent TPACK Presentations

Di Blas, N., Paolini, P. & Torrebruno, A. (2010). Digital storytelling at school: Does the TPCK model explain what's going on? In J. Sanchez & K. Zhang (Eds.), *Proceedings of World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education 2010* (pp. 2239-2248). Chesapeake, VA: AACE. Retrieved from http://www.editlib.org/p/35880.

Abstract:
"From year 2006, thousands of students (aged between 5 and 18 years) and hundreds of teachers have taken part in PoliCultura, an initiative by HOC-LAB of Politecnico di Milano calling Italian schools to create multimedia "narratives". A number of user studies show that relevant and substantial educational benefits are achieved thanks to this program. On the ground of the collected evidences, as well as of data from previous experiences with educational 3D-multiuser environments, this paper aims at raising a theoretical question: what is the role of the "Technical Knowledge" of the teachers in a successful technology-based learning experience? Does the TPCK model provide an adequate explanation? From our experience, Technical Knowledge, in fact, seems to play a different role with respect to Content or Pedagogy Knowledge."

Galstaun, V., Kennedy-Clark, S. & Hu, C. (2011). The impact of TPACK on pre-service teacher confidence in embedding ICT into the curriculum areas. In T. Bastiaens & M. Ebner (Eds.), *Proceedings of World Conference on Educational Multimedia, Hypermedia and Telecommunications 2011* (pp. 3439-3448). Chesapeake, VA: AACE. Retrieved from http://www.editlib.org/p/38352

Abstract:
“This paper presents the preliminary findings of two case studies in which a TPACK framework was used to embed information and communication technologies (ICT) into curriculum areas. TPACK is a strategy that emphasises the interconnectivity between content, pedagogy and technology. The first case study involved a cohort of 216 postgraduate pre-service teachers in an ICT in education unit of study, and the second case study involved 18 undergraduate and postgraduate pre-service teachers majoring in science education. Data presented in this paper was collected from pre- and post-tests. The results of the pre- and post-test analysis indicate that there was a significant change in pre-service teachers’ self-reported ability and confidence in selecting, evaluating and using ICT within a subject area. Overall, the preliminary analysis of data in these case studies supports the use of a TPACK framework to embed ICT within curriculum areas.”

Goldstein, O., Waldman, N., Tesler, B., Shonfeld, M., Forkush-Baruch, A., Mor, N., Zelkovich, Z., Heilweil, I., Kozminsky, L. & Zidan, W. (2011). Information and Communication Technologies (ICT) integration by teacher educators in Israeli colleges of education: The current state of affairs, 2008-2009. In T. Bastiaens & M. Ebner (Eds.), *Proceedings of World Conference on Educational Multimedia, Hypermedia and Telecommunications 2011* (pp. 152-159). Chesapeake, VA: AACE. Retrieved from http://www.editlib.org/p/37859

Abstract:
“This study examines the current state of ICT integration by faculty members in Israeli Colleges of Education using combined quantitative and qualitative research methods. Findings reflect significant progress in ICT implementation in teaching by faculty in comparison to the previous decade: what was perceived then as innovative—using Office tools, online resources and e-mail—is now routine practice. Most faculty members implement these basic ICT uses. However, only few use technology to bring about change in their teaching methods. Most important goals in the current situation are: (a) further expanding faculty involvement in ICT integration in teaching and (b) developing innovative pedagogical approaches best suited to respond to the demands of the Information Era.”

Hollingsworth, M. & Gunn, T. (2011). Learning in the 21st century: High school completion for FNMI students. In T. Bastiaens & M. Ebner (Eds.), *Proceedings of World Conference on Educational Multimedia, Hypermedia and Telecommunications 2011* (pp. 1683-1688). Chesapeake, VA: AACE. Retrieved from http://www.editlib.org/p/38088

Abstract:

“High school completion for Aboriginal Canadians is well below that of non-Aboriginal Canadians. Non-completion has deep consequences for individuals, families, and communities. Students who do not feel a sense of community and are not engaged in their school experience tend not to complete. Contemporary research suggests changes are necessary to address the needs of living in the 21st Century and to increase high school completion rates. These goals may be addressed through common strategies. Intended as a means of increasing student engagement and building a deeper sense of community in learning settings, the current research explores implementing TPACK planning, Web 2.0 technologies, and 21st Century Learning with Aboriginal student populations. Quantitative and qualitative data are collected in this two-year study. Initial anecdotal evidence suggests promising preliminary outcomes. As the study progresses, the data will help provide an understanding of the role of these strategies in leading to high school completion.”

Juniu, S. (2011). Educational Technology: Pedagogical tools in Physical Education. In T. Bastiaens & M. Ebner (Eds.), *Proceedings of World Conference on Educational Multimedia, Hypermedia and Telecommunications 2011* (pp. 2200-2208). Chesapeake, VA: AACE. Retrieved from http://www.editlib.org/p/38166

Abstract:
“Building on Shulman's (1987) idea of pedagogical content knowledge (PCK), teachers’ subject and pedagogical knowledge requires an understanding of the relationship of these elements, rather than thinking of them in isolation. In order to teach in a given discipline, the teacher must have the knowledge on the subject, the understanding of the teaching strategies to represent this content, the knowledge of the learners’ characteristics, and the knowledge of the educational context (i.e. gymnasium). In taking up this discussion, this presentation examines the TPACK framework as a way to prepare physical educators to integrate technology in the teaching and learning process and to understand how to represent subject matters with technology in pedagogically ways. The approach is to reflect on the pedagogical actions and on the subject matter when designing successful, technology integrated projects in physical education.”

Kafyulilo, A., Fisser, P., & Voogt, J. (2011, May). ICT use in science and mathematics teacher preparation: Developing pre-service teachers' TPACK. Paper presented at the E-Learning Africa conference, Dar es Salaam, Tanzania. Presentation slides retrieved from http://www.slideshare.net/Vangidunda/tpack-elearning-africa-2011

Abstract: None

Lai, T.l. & Lin, H.F. (2011). A case study of the differences between experienced and in-experienced math teachers' TPACK. In T. Bastiaens & M. Ebner

(Eds.), *Proceedings of World Conference on Educational Multimedia, Hypermedia and Telecommunications 2011* (PP. 3051-3055). Chesapeake, VA: AACE. Retrieved from http://www.editlib.org/p/38294

Abstract:
"While using technology in the classroom has been advocated in the field for decades, teachers using technology in classrooms is not pervasive. Studies have found that for in-service teachers, merely providing short-term, one-shot technology training workshops may not be sufficient. Teachers need to learn how to use specific content-based technologies in the classroom. Based on Mishra and Koehler's Technological Pedagogical Content Knowledge (TPACK) framework, this study explored the difference between an experienced teacher and an inexperienced middle school math teacher's TPACK, and factors that influence high school math teachers' TPACK in general. Four experienced and inexperienced high school math teachers were interviewed for their knowledge and experiences of using technology teaching geometrics. Qualitative data analysis techniques were applied to analyze the differences between experienced and inexperienced math teachers' TPACK."

Lane, J. (2011). Preparing teachers of the future: A national initiative to integrate ICT in teacher education in Australia. In T. Bastiaens & M. Ebner (Eds.), *Proceedings of World Conference on Educational Multimedia, Hypermedia and Telecommunications 2011* (pp. 451-456). Chesapeake, VA: AACE. Retrieved from http://www.editlib.org/p/37904

Abstract:
"This paper shares a journey of innovation and change to integrate ICT in Teacher Education Courses in a School of Teacher Education in Australia. It is linked to two initiatives, The Teaching Teachers for the Future Project (TTF), led by the Australian Learning and Teaching Council (ALTC) and Curriculum 2012, a university- based curriculum reform project. Thirty-seven Australian Universities are currently involved in the larger TTF project. It is anticipated this project will impact on 55,000 student teachers in Australia. The TTF project team includes the Australian Council of Deans of Education, the Australian Institute for Teachers and School Leaders, Education Services Australia and the Australian Council for Computers in Education. The new initiatives to integrate ICT and the main barriers to curriculum change are described. The paper has relevance for those wanting to improve Teacher Education, and renew teaching in Tertiary Institutions to include 21st Century Technologies."

Liu, S.H. (2011). Differences between enrolled in an integrated course and did not in TPACK and technology integration for preservice teachers. In *Proceedings of Global TIME 2011* (pp. 171-176). Chesapeake, VA: AACE. Retrieved from http://www.editlib.org/p/37074

Abstract:

"Technology integration is increasingly important for preservice teachers. However, preservice teachers still lack sufficient understanding due to isolated courses in teacher education programs. This study aims to explore the differences between preservice teachers who enrolled in an integrated course and those who did not in technological, pedagogical and content knowledge (TPACK) and technology integration implementation during participating in school-based field practice. The integrated course, consisting of various teaching tasks about TPACK, was arranged as an elective course. One year afterward, 401 preservice teachers, including 159 preservice teachers who enrolled in the integrated course, were invited to fill out a validated questionnaire. The analytical results, by applying ANOVA and t-test statistical methods, indicate that the integrated course is effective for promoting preservice teachers' knowledge and implementation about technology integration, while teaching fields which they majored in as students do not differ."

Liu, S. H. (2011). Modeling pre-service teachers' knowledge of, attitudes toward, and intentions for technology integration. In T. Bastiaens & M. Ebner (Eds.), *Proceedings of World Conference on Educational Multimedia, Hypermedia and Telecommunications 2011* (pp. 3350-3355). Chesapeake, VA: AACE. Retrieved from http://www.editlib.org/p/38335

Abstract:
"The study, which combines TAM and TPACK, examines the direct and indirect effects of knowledge of technology integration on pre-service teachers' attitudes toward technology use (ATU) and intention to integrate technology (IIT) while teaching. Structural equation modeling was applied to model the relationships in a set of latent variables. In total, 470 pre-service teachers preparing for a school-based field practice were invited to fill out a validated questionnaire. Analytic results reveal that TPACK affects pre-service teachers' ATU, and IIT while teaching. Study findings also indicate that pre-service teachers can combine diverse knowledge obtained from teacher education courses to use technology positively and intentionally to optimize student learning. I recommend that an adequate fit between TPACK and technology integration can serve as a base model for future studies of the ability pre-service teachers to integrate technology and teaching for pre-service teachers."

Maor, D. & Roberts, P. (2011). Does the TPACK framework help to design a more engaging learning environment? In T. Bastiaens & M. Ebner (Eds.), *Proceedings of World Conference on Educational Multimedia, Hypermedia and Telecommunications 2011* (pp. 3498-3504). Chesapeake, VA: AACE. Retrieved from http://www.editlib.org/p/38360

Abstract:
"This paper describes an attempt to design an e-learning course within a framework that combines theoretical underpinnings with pedagogy and content knowledge. It focuses on how a university lecturer can facilitate learning that

integrates pedagogical and technological knowledge. The Technology Pedagogy and Content Knowledge (TPACK) framework enables new ways of thinking about technology integration and emphasizes the intersection of these three domains: technology, pedagogy and content knowledge. Students' involvement in a blended learning course and their reflections were examined to provide a picture of the synergy or lack thereof in relation to this framework. This paper offers a look at the intersections of the TPACK domains to consider how the use of Web 2 technologies in teaching complement the other domains. It also describes how students assessed the combination of the technological, pedagogical and content knowledge domains in their learning experiences."

McCann, K. (2011). Increasing interactivity across the islands: A case study analysis of interactive whiteboards in the classroom. In S. Barton et al. (Eds.), *Proceedings of Global Learn Asia Pacific 2011* (pp. 681-684). Chesapeake, VA: AACE. Retrieved from http://www.editlib.org/p/37246

Abstract:
"This study aspires to describe the technological pedagogical and content knowledge (TPACK) and practices of current educators as they integrate interactive whiteboards (IWBs) across various educational settings. Participants in this study are educators who have taken part in a formal, IWB-centered professional development course. Through the lenses of the concerns-based adoption model (CBAM) and change theory, this research seeks to identify insights and implications for changes in instruction and learning, as well as strategies for longer-term professional development, instructional design and support for practitioners in the field. This paper hopes to serve as a prospectus, and thus, a springboard for a doctoral dissertation and research in an effort to further investigate these case-specific issues and characteristics."

Mumcu, F. K. ve Usluel, Y. K. (2010, April). *Teknolojik pedagojik içerik bilgisi modeline göre BİT'in öğrenme-öğretme sürecine entegrasyonuyla ilgili ölçek geliştirme çalışması [A scale development study of integration of ICT into learning and teaching process according to TPACK].* Paper presented at the Tenth International Educational Technology Conference (IETC), İstanbul, Turkey. Retrieved from http://www.academia.edu/Papers/in/Scale_Development

Abstract:
"This study aims to develop a scale about integration of information and communication technologies (ICT) into learning and teaching process under technological pedagogical content knowledge (TPACK) model. For this aim, a scale was developed by researchers and applied to 327 teachers from 21 primary schools in Ankara, capital of Turkey. In order to find out validity and reliability of the scale, confirmatory factor analysis and Cronbach Alpha coefficient were used. Confirmatory factor analysis revealed that the TPACK scale consists of 15 items and four sections, and the scale is at an acceptable

degree of goodness of fit. As a result of analysis according to TPACK model, 4 items were identified as technological knowledge; 4 items were identified as technological content knowledge; 4 items were identified as technological pedagogical knowledge; and 3 items were identified as technological pedagogical content knowledge. Cronbach's coefficient of reliability in the analysis was examined and found to be .96. On the basis of factor scores, Cronbach's coefficients are .86 for technological knowledge, .85 for technological content knowledge, .93 for technological pedagogical knowledge and .91 for technological pedagogical content knowledge."

Oster-Levinz, A. & Klieger, A. (2011). Does developing online tasks draw teachers nearer to interrelated knowledge (TPACK)?. In S. Barton et al. (Eds.), *Proceedings of Global Learn Asia Pacific 2011* (pp. 696-701). AACE. Retrieved from http://www.editlib.org/p/37249

Abstract:
"Teachers have to wisely use the online environment in order to realize a new pedagogy. In this paper we will discuss the knowledge required of teachers when integrating technology in teaching – TPACK, and a digital indicator we developed for the evaluation of the teachers' different types of knowledge: pedagogical knowledge, technological knowledge and technological pedagogical content knowledge (TPACK). We examined 53 online tasks developed by teachers over seven years, where some of the teachers received guidance and accompaniment in the development of the tasks. The findings refer to the professional development of the teachers which took place in these fields. We found that online tasks that teachers develop can comprise a measure for examining the extent of integration of technological knowledge with content knowledge and with pedagogical knowledge."

Valanides, N. & Angeli, C. (2011, July). *Thinking critically about technology from an educational perspective: Implications for developing Technological Pedagogical Content Knowledge.* Workshop presented at the 13th International Conference of the International Society for the Study of European Ideas (ISSEI), Nicosia, Cyprus. Abstract retrieved from http://issei2012.haifa.ac.il/Valanides.htm

Abstract:
"Many thinkers have, from antiquity to the present, expressed serious reservations about the role of technology in education and its possibly destructive effects on the cognitive capabilities of the individual. Others have responded to ongoing technological advances either with unreserved enthusiasm or with qualified endorsement. This workshop aims to explore possibilities of thinking about technology as a Janus-faced operation, i.e., as a human-made reality that can work in both enabling and disabling directions and whose role depends on the ability of human beings to harness technology to enabling rather than disabling learning purposes. The educational cultivation of critical thinking and

teachers' competence to teach with technology, namely their technological pedagogical content knowledge will be discussed as such possibilities for thinking about the seamless integration of technology in teaching and learning. Within this framework, the workshop organizers welcome papers from a variety of educational perspectives. For instance, philosophical-educational contributions may cover the ground from ancient conceptions of criticality (e.g. Socratic examined life) to contemporary philosophical treatments of technology (e.g. Heidegger's critique of technological thought and intervention). Pedagogical discussions of critical thinking and technological pedagogical content knowledge may supply the workshop with a more applied and classroom-oriented perspective on understanding technology. Science education contributions may map new developments in educational employment of scientific and technological outlooks on life and the world."

Ward, C. L. (2011, June). *The development of Technological Pedagogical Content Knowledge (TPACK) in instructors using Quality Matters training & rubric.* Paper presented at a Regional Conference of the Quality Matters Program, Columbus, Ohio. Abstract retrieved from http://www.qmprogram.org/files/Regional%20Conference%20downloadable%201.pdf

Abstract:
The need for online offerings at colleges and universities requires a new skill set for the instructors asked to develop quality content in new learning environments. This study explores the impact that the QM training, rubric and peer collaboration model have in helping instructors construct new knowledge in the areas of TPACK (Technological, Pedagogical, Content Knowledge), a conceptual framework that describes the dynamic relationship needed between technology, pedagogy and content.

## 4. Recent TPACK-Related Dissertations

Baert, H. (2011). *The integration of technology within physical education teacher education: Perceptions of the faculty* (Doctoral dissertation). Retrieved from ProQuest Dissertations and Theses (AAT 3459854).

Abstract:
"In 2008, the national Physical Education Teacher Education (PETE) standards included a more integrated approach to teaching pre-service teachers about technology and stated that teacher candidates should be able to plan and implement technology infused learning experiences that meet lesson objectives. With the inclusion of the 2008 standards, PETE faculty have the task to create instruction that effectively integrates technology. This study investigated the preparedness for technology integration of 198 teacher educators within nationally recognized PETE programs. The study utilized survey research design

to identify current technologies used, analyze current level of technology proficiency in relationship to the level of integration, identify factors that aid or hinder the technology infusion process and examine approaches PETE programs use to integrate technology within PETE programs. Roger`s Diffusion Theory (2003) and the Technological Pedagogical Content Knowledge Framework (Mishra & Koehler, 2006) were used as theoretical guides. Results indicated low proficiency and integration levels. On average, proficiency levels were that of basic use of technology and integration levels indicated that PETE professors were aware of the use of technology but often did not integrate it or teach it to the students. In addition, the level of proficiency predicted integration levels significantly. Computer technologies, pedometers and heart rate monitor were tools most often integrated within PETE programs. PETE teacher educators expressed concerns related to the abundance of technologies as well as the limited availability and accessibility of technologies both at the PETE level and within K-12 schools. The results and literature suggest PETE faculty can enhance technology integration by developing a clear vision of technology integration, creating a technology plan, constructing teaching technology labs, and encouraging faculty-practitioner collaboration. In light of the 2008 national PETE standards, the results suggest that both the national and regional associations as well as PETE administrators should explore various professional development models in the area of both using technology (improving proficiency levels) as well as teaching effective teaching strategies related to technology (enhancing integration levels). Crucially, strategies where technology can assist in the enhancement of the overall quality of PE, in both PETE and K-12 PE, should be the main focus."

Forssell, K. (2011). *Technological Pedagogical Content Knowledge: Relationships to learning ecologies and social learning networks* (Doctoral dissertation, Stanford University). Retrieved from http://www.stanford.edu/~forssell/dissertation/

Abstract:
"Improving learning experiences for all students is the ultimate goal of research in technology use in education. With more availability and better usability of technology in schools, the potential for teachers to use digital tools in schools is greater than ever. However a key factor determining whether new technologies are adopted is the extent to which teachers know how to use them to support students' learning. The special knowledge of how technologies can support students' learning of subject area content is known as technological pedagogical content knowledge (TPACK).

This study explored the relationship of accomplished teachers' TPACK confidence to their use of technology with students and to their teaching and learning contexts. In an online survey, 307 National Board Certified teachers provided information about the frequency and breadth of their computer use with students; their use of computers in their personal lives; the school, classroom,

and personal resources available to them for learning; and the people in their learning networks supporting their learning to use new technologies for teaching. Although the representativeness of the sample was limited and the measures self-reported, they provided rich opportunities to discover relationships and suggest avenues for supporting teacher learning of new technologies.

Analyses showed that these accomplished teachers' confidence in their knowledge of how to use new technologies for teaching was different from their confidence in using technologies more generally. Further, TPACK confidence related to student use of computers in the classroom. No associations were found between TPACK confidence and age, gender, grade levels, subject areas, or student populations. However, confidence in teaching with technology did relate to measures of the teachers' learning resources. More varied learning resources and more productive social learning networks were associated with higher TPACK confidence. Three key types of support provided by learning partners -- learning together, posing challenges, and connecting the teacher to others to learn from -- were significantly more common among high-TPACK teachers.

Findings in this study point to ways we might further understand, and subsequently increase, teacher confidence in using new technologies to support student learning. Several questions are raised for future research: Do learning resources lead to confidence in knowledge, or does confidence lead to awareness of existing resources? To what extent can TPACK be measured without first assessing the teacher's PCK? And how might we develop survey measures that reliably capture the complexity of technological pedagogical content knowledge? Understanding TPACK and the conditions under which it develops is an important field of research, as we strive to help teachers learn to use new technologies effectively to support powerful student learning."

Hervey, L. G. (2011). *Between the notion and the act: Veteran teachers' TPACK and practice in 1:1 settings* (Doctoral dissertation). Retrieved from ProQuest Dissertations and Theses (AAT 3463705). Available: http://repository.lib.ncsu.edu/ir/bitstream/1840.16/6799/1/etd.pdf

Abstract:
"The technological pedagogical content knowledge (TPACK) framework is a nuanced lens to study teachers' 21st century professional knowledge and practice (Mishra & Koehler, 2006). Veteran teachers in 1:1 settings have not been the focus in TPACK research. In this mixed-methods study, veteran teachers were surveyed to determine their self-reported technological pedagogical content knowledge (TPACK). Qualitative data included teachers' videotaped lessons, interview transcripts and field notes. Discussion highlights the need for a valid and reliable instrument to measure secondary teachers' TPACK, the value of a priori coding to illuminate TPACK, and generational challenges veteran teachers face while practicing in 1:1 settings."

Ivy, J. T. (2011). *Secondary mathematics teachers' perceptions of their integration of instructional technologies* (Doctoral dissertation). Retrieved from ProQuest Dissertations and Theses (AAT 3461290).

Abstract:
"This qualitative research study explored the beliefs and practices regarding integrations of instructional technologies by seven secondary mathematics teachers. The researcher conducted an initial interview, a classroom observation, and a follow-up interview with each participant. Participants also submitted sample lessons and completed a TPACK Development Model Self-Report Survey. The interviews and observations were analyzed using deductive analysis, using the Technological Pedagogical Content Knowledge (TPACK) Development Model to assess technology-related practices.

Through responses to the TPACK Development Model Self-Report Survey, the participants revealed their perceptions of their practices and beliefs regarding technology integration. These perceptions were compared to the researcher's analysis of interviews, observations, and lesson samples. The researcher found that the participants perceived themselves to have much higher TPACK levels than indicated by other data collected. There was also a noted lack of pedagogical content knowledge (PCK) among participants with low TPACK, which indicated that their teaching practices limited technology integration. Pressures from standardized testing and interactions with colleagues were common factors noted to support technology integration. Pressures from standardized testing, however, tended to result in graphing calculator integration for computations and other rote uses.

The researcher also noted that participants were largely unable to differentiate between instructional technologies and non-instructional technologies. Participants erroneously reported presentation tools, such as LCD projectors, as instructional technology. Most participants lacked a vision for integrating technology as a tool for learning mathematics. Instead, many participants felt that technology posed a threat to the learning process. One participant, however, was a notable exception to these statements. Individual cases and the emergent themes are discussed."

Landry, G. A. (2010). *Creating and validating an instrument to measure middle school mathematics teachers' Technological Pedagogical Content Knowledge (TPACK)* (Doctoral dissertation, University of Tennessee - Knoxville). Retrieved from http://trace.tennessee.edu/utk_graddiss/720

Abstract:
"Due to the pervasiveness of technology, the role and preparation of teachers as they strategically use technology for teaching mathematics needs to be examined. Technological pedagogical content knowledge (TPACK) is a

framework for knowledge as teachers develop meaningful learning experiences for their students while integrating strategic use of technology (Mishra & Koehler, 2006). The purpose of this study was to develop a survey for measuring mathematics teachers' Mathematical Technological Pedagogical Content Knowledge (M-TPACK). The survey measures the domains of mathematics content, pedagogy and technology. This mixed methods study first examined middle school mathematics teachers' TPACK through the use of an existing survey (Schmidt et al., 2009). Interviews were conducted to determine the availability and use of technology in middle school mathematics classrooms, and teachers' strategic use of available technology for mathematics instruction. Finally, a survey measuring M-TPACK was developed to specifically measure teachers' mathematical TPACK.

Grandgenett (2008) asks for more concentration on helping teachers to imagine "possibilities" for using various approaches and strategies for integrating technology in mathematics instruction. This study presents important findings and supports the need for mathematics teachers' professional development to reconceptualize the role of technology in mathematics instruction. By using the developed M-TPACK Survey, teacher educators and administers can use information about teachers' knowledge and beliefs concerning technology to enhance teacher education programs and plan professional development. The survey developed from this study can be used for stakeholders as they determine the needs of mathematics teachers, move the concept of TPACK beyond theory and toward practice, and move toward offering appropriate technology experiences to enhance strategic mathematics instruction."

Riales, J. W. (2011). *An examination of secondary mathematics teachers' TPACK development through participation in a technology-based lesson study* (Doctoral dissertation). Retrieved from ProQuest Dissertations and Theses (AAT 3461312).

Abstract:
"This qualitative research study used a layered case study (Patton, 2002) to examine the technological, pedagogical, and content knowledge (TPACK) of a group of inservice secondary mathematics teachers as they participated in a technology-based lesson study. Using the TPACK Development Model (Niess, 2009) as a lens, this dissertation examines interactions of the group members during lesson study meetings as well as individual case studies of four of the six participants.

Data were gathered from initial surveys, initial and post-interviews, initial and post-classroom observations, writing prompts, and transcriptions of lesson study group meetings. Data were analyzed to determine the TPACK development levels for different themes of the model at different stages during the lesson study process. Thick descriptions are provided of actions and quotes from the participants that exemplified various TPACK development levels.

Findings indicated that the design and purpose of technology-based lesson study provided participants opportunities to practice actions from the higher levels of the TPACK Development Model during the lesson study. Based on classroom observations, half of the participants demonstrated practices that indicated increases in TPACK development levels following the lesson study. Those participants with less experience with technology in their educational backgrounds demonstrated greater positive changes. Participant responses to interview questions and writing prompts indicated that experiencing learning with technology and observing students. thinking served to prompt changes in their own practices."

(The following dissertation came to our attention recently, even though it was defended five years ago. It is one of only two TPACK-related dissertations defended in 2006 that we have found; the two earliest TPACK-based dissertations, we believe.)

Rodriguez, J. C. (2006). *Weaving technology in the design of learning experiences in world language teacher education: The development of a cognitive tool, an instructional device and an exploration* (Doctoral dissertation). Retrieved from ProQuest Dissertations and Theses (AAT 3243835).

Abstract:
"This dissertation constitutes a first step toward improving our understanding of how better and more sophisticated uses of technology in the context of world language teacher education (WLTE) can be achieved. This work includes (a) the design and development of a prototype of a cognitive tool intended to support the design of language learning experiences; (b) an article that advocates project-based learning (PBL) as a powerful instructional device to support sophisticated learning experiences in WLTE; and (c) the exploration of conceptual and interactual aspects of said cognitive tool. Chapter 2, "Project-based learning: A promising pathway to technology integration in world language teacher education" proposes a taxonomy of complex WLTE tasks. This article discusses how some of the possibilities that PBL offers can be operationalized in WLTE and argues that providing preservice language teachers experiences with and exposure to sophisticated pedagogical interventions, such as the ones supported by PBL, can improve the integration of technology into the design of language learning activities. As this article shows, PBL is suitable to take full advantage of the complexity of WLTE to immerse preservice teachers in rich design experiences that integrate technology. However, implementing PBL in WLTE poses many challenges. Technology tools that facilitate the conceptualization, creation and management of projects may help in the implementation of PBL in WLTE. Chapter 3, "Postcards from the Mind: Designing language learning experiences with technology," is a design-based research study that explores a prototype of such tool. This research gives us some insights into the cognitive

processes involved in the design of language learning experiences. The cognitive processes identified included (a) the activation of composite forms of knowledge, such as pedagogical-content knowledge (PCK) and technological pedagogical content knowledge (TPCK), which have been hypothesized to be a prerequisite for the effective integration of technology into learning experiences; (b) the iterative consideration of general pedagogical guidelines; and (c) the application of a mental model to the design of language learning experiences. Interactual and conceptual aspects of the tool that did or did not support the users' cognitive processes are discussed. Findings from this study have implications for WLTE and interface design."

**5. Recent TPACK-Related Professional Development**

Mark Fijor, a professional development provider in the Arlington Heights, Illinois school district, has created a rich and thoughtful set of blog posts that explain how his district is using TPACK-based ideas and practices district-wide in professional development efforts this year. In his first post, he explains:

"…our district has done a phenomenal job of providing teachers and students with access to technology. In addition, our teachers are exposed to a wide variety of tools through in-services and conferences outside of the district. However, with this access and knowledge comes the idea of overexposure. Teachers are finding there are many different tools available for a task, and because of this, many are unsure of which is the best tool. Teachers are free to explore on their own and use a variety of tools, but this is limited to those who are truly interested about learning on their own and experimenting. When these tools are shared with staff, many of the teachers are left to wonder the tools apply to what they are doing in the classroom, or are overwhelmed by the amount of resources available.

It is from these dilemmas that I have developed a framework and a series of guidelines that address the idea of systemic technology integration. In meeting with teachers and administrators from various districts and experience levels, I believe that the following series of post will address many of the concerns and problems with technology integration in schools."

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ITEN, the Inter-American Teacher Education Network, sponsored a Webinar about TPACK on August 19, 2011. Dina Rosen, from Kean University, spoke about: "TPACK and Developmentally Appropriate Technology Use." The purpose of the Webinar was:

"To introduce, illustrate and discuss two key frameworks for effective technology integration, Technological Pedagogical Content Knowledge (TPACK) and Developmentally Appropriate Technology Use (DATU). TPACK is a framework that describes the nature of knowledge required by teachers for Technology

integration in their teaching. DATU is a framework for using technology with young learners, preschool through third grade."

A recording of the Webinar is available online at:
http://oasconnect.adobeconnect.com/p72jn5nul96/?launcher=false&fcsContent=true&pbMode=normal

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Candace Marcotte, a middle school English teacher, created a practical and detailed YouTube video called "Grammar 2.0" to share (with other teachers) how she makes the learning of grammar interactive for her students.

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Lara Ervin, a research assistant at Stanford University, used these slides to help her to teach a professional development workshop at San Jose State University in June 2011:
Technology, Pedagogy, and Content Knowledge: Rethinking the Role of Technology in K-12 Classrooms.

**6. Other TPACK Updates**

*Tech & Learning* magazine named our own Punya Mishra (Michigan State University) and Ann Thompson (Iowa State University) as two of the "10 Most Influential People in Ed Tech for 2011" as selected by the publication's "readers and advisors" in June. Read the article here. Congratulations to Ann and Punya!

(Illustrations by Jay Bevenour:
http://www.techlearning.com/article/the-big-10/48010)

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The 4th edition of Meaningful Learning with Technology by Jane L. Howland, David Jonassen, Rose M. Marra (Allyn & Bacon, 2011) has added a discussion of TPACK to this popular preservice text, saying:

"Chapter 1 features a review and discussion of three alternative conceptions and standards for meaningful learning. The inclusion of the ISTE NETS, 21st Century Skills, and Technological Pedagogical Content Knowledge or TPACK (with an additional Learning Knowledge dimension proposed for the TPACK model) helps students gain understanding of major educational technology and learning standards."

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**7. TPACK Work in Progress**

Michael Sisley at the University of Camberra in Australia created this short video to encourage preservice teachers to respond to a TPACK survey being given to all teacher candidates studying at 39 universities in Australia this year. The video tells a bit about the new national TPACK-based technology integration effort, of which this research is a part. A more complete description of this ambitious national effort is reproduced from issue #10 of the newsletter below for your reference.

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**Teaching Teachers for the Future**
http://www.altc.edu.au/ttf/
(See TPACK link near the top of the page.)

"This substantial and innovative $7.8m national Teaching Teachers for the Future (TTF) project, financed by DEEWR through the ICT Innovation Fund (ICTIF) under the Digital Strategy for Teachers and School Leaders strategy, specifically targets systematic change in the Information and Communication Technology in Education (ICTE) proficiency of graduate teachers across Australia.
The project team is led by the Australian Learning and Teaching Council (ALTC), and includes the Australian Council of Deans of Education (ACDE), the Australian Institute for Teaching and School Leadership (AITSL), Education Services Australia (ESA), the Australian Council for Computers in Education (ACCE), and the 39 Australian higher education institutions with pre-service teacher education programs as partners.

The project focuses on enabling pre-service teachers to achieve and demonstrate (upon graduation) competence in the effective and innovative use of ICT in education to improve student learning. It aims to achieve this through the systematic embedding of an ICTE dimension in:

- pre-service teacher education curriculum, pedagogies, assessment, professional experience,
- university classroom and self-study resources,

- the national program accreditation framework and the Graduate Teacher Standards, and
- national professional learning networks of ICT and curriculum methods experts within and across the Institutions."

**8. 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. (Ed.). (2011, October 10). TPACK newsletter issue #11: October 2011 [Electronic mailing list message]. Retrieved from http://punya.educ.msu.edu/research/tpck/newsletter-archive/

**8. 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 and contribute to the TPACK wiki at: http://tpack.org/
- Join the TPACK SIG at: http://site.aace.org/sigs/tpack-sig.htm
- Subscribe to the tpack.research, tpack.teaching, tpack.grants and/or tpack.future discussion lists at: http://site.aace.org/sigs/tpack-sig.htm
- Access the TPACK Learning Activity Types taxonomies at: http://activitytypes.wmwikis.net/
- Access two tested TPACK assessment instruments at: http://activitytypes.wmwikis.net/Assessments

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.news.editors@wm.edu

**Standard End-Matter**

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

- Judi

…for the SITE TPACK SIG leadership:

Candace Figg, Co-Chair, Brock University
Mark Hofer, Co-Chair, College of William & Mary
Judi Harris, Wing Chair, College of William & Mary
Mario Kelly, Futon, Hunter College
Matt Koehler, Chaise Lounge, Michigan State University
Punya Mishra, Recliner, Michigan State University