

# Teaching The Pedagogical Content Knowledge Of Astronomy

The 2nd edition of the Handbook of Technological Pedagogical Content Knowledge (TPACK) for Educators addresses the concept and implementation of technological pedagogical content knowledge—the knowledge and skills that teachers need in order to integrate technology meaningfully into instruction in specific content areas. Driven by the growing influence of TPACK on research and practice in both K-12 and higher education, the 2nd edition updates current thinking about theory, research, and practice. Offering a series of chapters by scholars in different content areas who apply the technological pedagogical content knowledge framework to their individual content areas, the volume is structured around three themes: Current thoughts on TPACK Theory Research on Technological Pedagogical Content Knowledge in Specific Subject Areas Integrating Technological Pedagogical Content Knowledge into Teacher Education and Professional Development The Handbook of Technological Pedagogical Content Knowledge (TPACK) for Educators is simultaneously a mandate and a manifesto on the engagement of technology in classrooms.

There has been a growing interest in the notion of a scholarship of teaching. Such scholarship is displayed through a teacher's grasp of, and response to, the

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relationships between knowledge of content, teaching and learning in ways that attest to practice as being complex and interwoven. Yet attempting to capture teachers' professional knowledge is difficult because the critical links between practice and knowledge, for many teachers, is tacit. Pedagogical Content Knowledge (PCK) offers one way of capturing, articulating and portraying an aspect of the scholarship of teaching and, in this case, the scholarship of science teaching. The research underpinning the approach developed by Loughran, Berry and Mulhall offers access to the development of the professional knowledge of science teaching in a form that offers new ways of sharing and disseminating this knowledge. Through this Resource Folio approach (comprising CoRe and PaP-eRs) a recognition of the value of the specialist knowledge and skills of science teaching is not only highlighted, but also enhanced. The CoRe and PaP-eRs methodology offers an exciting new way of capturing and portraying science teachers' pedagogical content knowledge so that it might be better understood and valued within the profession. This book is a concrete example of the nature of scholarship in science teaching that is meaningful, useful and immediately applicable in the work of all science teachers (preservice, in-service and science teacher educators). It is an excellent resource for science teachers as well as a guiding text for teacher education. Understanding teachers' professional knowledge is critical to our efforts to promote quality classroom practice. While PCK offers such a lens, the construct is abstract. In this book, the authors have found an interesting and engaging

way of making science teachers' PCK concrete, useable, and meaningful for researchers and teachers alike. It offers a new and exciting way of understanding the importance of PCK in shaping and improving science teaching and learning. Professor Julie Gess-Newsome Dean of the Graduate School of Education Williamette University This book contributes to establishing CoRes and PaP-eRs as immensely valuable tools to illuminate and describe PCK. The text provides concrete examples of CoRes and PaP-eRs completed in "real-life" teaching situations that make stimulating reading. The authors show practitioners and researchers alike how this approach can develop high quality science teaching. Dr Vanessa Kind Director Science Learning Centre North East School of Education Durham University

Syftet med avhandlingen är att undersöka hur och under vilka villkor som svensklärares kunskap om skrivundervisning växer fram i och efter lärarutbildningen. I en delstudie analyseras hur skrivande, skrivutveckling och skrivundervisning framställs och förmedlas som kunskapsområden i kursplaner som beskriver ämnesteoretiska och ämnesdidaktiska kurser i ämneslärarutbildningen i svenska. Resultatet visar att det i detta hänseende finns ett påtagligt tomrum som dels kan relateras till den låga andelen mål som uttryckligen handlar om skrivande, skrivutveckling och skrivundervisning i skolan, dels kan relateras till ord och uttryck som har svag referens till skrivundervisning som ett skrivutvecklande arbete. Den andra delstudien handlar om vad blivande och verksamma gymnasielärare i svenska lägger tyngdpunkt på när de i

kvalitativa intervjuer talar om text, skrivande och skrivundervisning. Resultatet visar ett mönster som går från fokus på konkreta textdetaljer på lokal textnivå till ett mer övergripande förhållningssätt där samtliga textnivåer tycks samspela i en mer balanserad helhet. I samma material analyseras hur kunskap som kan relateras till skrivundervisning manifesteras när intervjupersonerna talade om skrivundervisning. I de blivande lärarnas utsagor manifesteras främst ämneskunskap, medan de verksamma lärarna främst manifesterar skrivdidaktisk kunskap. Lärarnas ämneskunskap är också mer komplex än studenternas. Den tredje delstudien handlar om hur nyblivna svensklärares skrivdidaktiska kunskap förändras under det första året i yrket och vilka faktorer som ligger bakom en sådan förändring. Genom kvalitativa intervjuer vid tre tillfällen (september, februari och juni) undersöks hur lärarna tycks transformera sina ämneskunskaper till undervisningsstrategier i skrivundervisningen. Resultatet visar att lärarnas strategier för att undervisa i skrivande förändras under läsåret. Förändringen tycks gå från en teoretisk och överförande undervisning till en mer praktisk och upptäckande undervisning. Detta pekar på en förändrad skrivdidaktisk kunskap. Det verkar främst vara arbetet tillsammans med eleverna som leder till denna förändring. En annan viktig faktor tycks vara återkommande moment (cykler) som gör det möjligt för lärarna att omvandla sin förståelse av skrivutvecklande arbete tillsammans med eleverna. Sammantaget pekar avhandlingens resultat på att svensklärares skrivdidaktiska kunskap främst utvecklas i yrket. The teaching of writing

is a complex activity. The aim of this thesis is to investigate when and how the knowledge needed for the teaching of writing is developed in teacher education and during the first years of teaching. One sub-study focuses writing, writing development and the teaching of writing in teacher education syllabi. The result shows that the objectives with focus on writing and writing development in school are relatively few and that the main emphasis is on the teachers' work when the students have already finished writing. Furthermore, the expressions used in the syllabi vary in specificity, which might lead to difficulties detecting the teaching of writing as a field of knowledge in the teacher education programme. In the second sub-study, one analysis focuses on the way in which prospective and novice teachers of Swedish talked about text, writing, and the teaching of writing. The result shows a development that starts with a focus on details at a local text level and expands into a more comprehensive view with a focus on global text levels. The second analysis concerns subject matter knowledge and pedagogical content knowledge (PCK) for teaching writing. The result shows that the knowledge manifested by the prospective teachers mainly consists of subject matter knowledge, whereas the knowledge manifested by the teachers mainly consists of PCK for teaching writing. In the third sub-study, nine novice Swedish teachers were interviewed in September, February and June during their first year in the profession. This study focuses on the transformation of the teachers' subject matter knowledge into teaching strategies. The result shows that the teachers' use of teaching strategies

changed throughout the year. There is a shift from theory and transmission to practice and discovery. What mainly causes this shift seems to be the teachers' work together with their students and the possibility to teach the same content or field of knowledge repeatedly. The overall analysis thus shows that the PCK for teaching writing is mainly developed in the teaching profession; in other words, after the exam from the teacher education programme.

In the past decades wide-ranging research on effective integration of technology in instruction have been conducted by various educators and researchers with the hope that the affordances of technology might be leveraged to improve the teaching and learning process. However, in order to put the technology in optimum use, knowledge about how and in what way technology can enhance the instruction is also essential. A number of theories and models have been proposed in harnessing the technology in everyday lessons. Among these attempts Technological and Pedagogical Content Knowledge (TPACK) framework introduced by Mishra and Koehler has emerged as a representation of the complex relationships between technology, pedagogy and content knowledge. The TPACK framework extends the concept of Shulman's pedagogical content knowledge (PCK) which defines the need for knowledge about the content and pedagogical skills in teaching activities. Since then the framework has been embraced by the educational technology practitioners, instructional designers, and educators. TPACK research received increasing attention from education and training community

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covering diverse range of subjects and academic disciplines and significant progress has been made in recent years. This book attempts to bring the practitioners and researchers to present current directions, trends and approaches, convey experience and findings, and share reflection and vision to improve science teaching and learning with the use of TPACK framework. A wide array of topics will be covered in this book including applications in teacher training, designing courses, professional development and impact on learning, intervention strategies and other complex educational issues. Information contained in this book will provide knowledge growth and insights into effective educational strategies in integration of technology with the use of TPACK as a theoretical and developmental tool. The book will be of special interest to international readers including educators, teacher trainers, school administrators, curriculum designers, policy makers, and researchers and complement the existing literature and published works.

Science is a subject matter that requires learners to explore the world and develop their own abilities on the basis of that exploration. As technology broadens and deepens, science teachers need to expand their Technological Pedagogical Content Knowledge (TPACK), which determines how well they use technology to help students learn science. The book details our efforts to prepare science teachers to teach with the help of technology, examining various aspects of teacher education, professional development and teaching material preparation. It consists of three parts, which focus

on: how TPACK is conceptually constructed within the field of science education, how teacher evaluation and teaching materials are developed and utilized based on the transformative model and how science teachers are prepared and supported with electronic resources based on the integrative model. The book offers a valuable resource for all those working in science education, as well as those readers who are interested in teacher education. Science teachers will come to know how simulations and animations can pedagogically support student learning. Practices for teachers' TPACK development such as learning-by-design, evaluation and measurement and teacher communities are also addressed, applied and discussed in the case of science teachers. The individual chapters will provide teacher educators and researchers from all disciplines with new insights into preparing teachers for the Digital Era. Published by Taylor & Francis Group for the American Association of Colleges for Teacher Education This Handbook addresses the concept and implementation of technological pedagogical content knowledge -- the knowledge and skills that teachers need in order to integrate technology meaningfully into instruction in specific content areas. Recognizing, for example, that effective uses of technology in mathematics are quite different from effective uses of technology in social studies, teachers need specific preparation in using technology in each content area they will be teaching. Offering a series of chapters by scholars in different content areas who apply the technological pedagogical content knowledge framework to their individual content areas, the volume

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is structured around three themes: What is Technological Pedagogical Content Knowledge? Integrating Technological Pedagogical Content Knowledge into Specific Subject Areas Integrating Technological Pedagogical Content Knowledge into Teacher Education and Professional Development The Handbook of Technological Pedagogical Content Knowledge for Educators is simultaneously a mandate and a manifesto on the engagement of technology in classrooms based on consensus standards and rubrics for effectiveness. As the title of the concluding chapter declares, "It's about time!" The American Association of Colleges for Teacher Education (AACTE) is a national, voluntary association of higher education institutions and related organizations. Our mission is to promote the learning of all PK-12 students through high-quality, evidence-based preparation and continuing education for all school personnel. For more information on our publications, visit our website at: [www.aacte.org](http://www.aacte.org).

Pedagogical Content Knowledge (PCK) has been adapted, adopted, and taken up in a diversity of ways in science education since the concept was introduced in the mid-1980s. Now that it is so well embedded within the language of teaching and learning, research and knowledge about the construct needs to be more useable and applicable to the work of science teachers, especially so in these times when standards and other measures are being used to define their knowledge, skills, and abilities. Re-examining Pedagogical Content Knowledge in Science Education is organized around three themes: Re-examining PCK: Issues, ideas and development; Research

developments and trajectories; Emerging themes in PCK research. Featuring the most up-to-date work from leading PCK scholars in science education across the globe, this volume maps where PCK has been, where it is going, and how it now informs and enhances knowledge of science teachers' professional knowledge. It illustrates how the PCK research agenda has developed and can make a difference to teachers' practice and students' learning of science.

Abstract: "In an era of educational reform, investigating teachers' pedagogical content knowledge has implications for many involved in education, from policy makers and curriculum designers to those in teacher education. This thesis proposed a model, designed by the researcher, used to examine Shulman's (1986) theory of pedagogical content knowledge. In particular, it addressed primary teachers' pedagogical content knowledge required for teaching measurement. By examining teachers' mathematics pedagogical content knowledge a greater understanding of teachers' professional knowledge was gained enabling improvement of teacher quality, by being able to identify more clearly individual teacher's needs for professional development. This study addressed four specific research questions. How evident is the teacher's depth of mathematical knowledge of measurement within their teaching? How do teachers show that they understand and address the needs of students when teaching? How to teachers demonstrate their general pedagogical knowledge when teaching? How is a teacher's knowledge and practice impacted by other factors when teaching and what

are these major factors? A qualitative research model was used in which four teachers of Years Three and Four participated, providing four individual case studies. Each teacher was interviewed at the commencement of the study, was observed and recorded throughout their teaching of a sequence of measurement lessons, interviewed prior to and following each lesson, and finally responded to a reflective questionnaire two weeks after the sequence of lessons had concluded. Due to the extensive nature of the data, a series of vignettes was written, based upon MATHEMATICAL PEDAGOGICAL CONTENT KNOWLEDGE viii identified teaching episodes, significant to addressing the research questions. These vignettes contributed to the cross case analysis (Yin, 2010), along with the other data. The study found that the teachers' knowledge varied considerably in each of the areas of knowledge of teaching, knowledge of students and knowledge of mathematics. Consequently, the teachers were rated differently in relation to their pedagogical content knowledge, ranging from very weak to strong. These differences were examined in terms of the model, providing evidence that the model effectively explained variations in teachers' pedagogical content knowledge. Factors such as self-efficacy, teacher beliefs and the culture of the school were also shown to influence each teacher's pedagogical content knowledge. The model was shown to be dynamic and it clearly identified how and why pedagogical content knowledge varied from one teacher to another. This study has shown that the model used to represent pedagogical content knowledge demonstrated theoretical,

methodological and diagnostic value. This study concludes with a discussion of implications for policy and practice at system level and for teacher education courses for preservice teachers. The findings of this study provide further understanding of teacher pedagogical content knowledge, which is an essential step towards improving teacher quality and teaching practice. The evidence suggests that this model could be used for further research into pedagogical content knowledge beyond the teaching of measurement."

This dissertation, "Preservice Teachers' Development of Pedagogical Content Knowledge for Teaching Nature of Science Through a Progressive Video-based Reflection Task" by Man-sum, Lo, ???, was obtained from The University of Hong Kong (Pokfulam, Hong Kong) and is being sold pursuant to Creative Commons: Attribution 3.0 Hong Kong License. The content of this dissertation has not been altered in any way. We have altered the formatting in order to facilitate the ease of printing and reading of the dissertation. All rights not granted by the above license are retained by the author. Abstract: Teaching and learning Nature of Science (NOS) is becoming an increasingly important part of science education. Effective NOS instruction depends on teachers' Pedagogical Content Knowledge for teaching NOS (PCKnos). However, little is known about the characteristics of PCKnos, how it is developed, or the factors influencing that development. This study explores these aspects through a naturalistic study of the learning experiences of eight secondary school biology preservice teachers

(PSTs) enrolled in a one-year Postgraduate Diploma in Education (PDGE) teacher training course in Hong Kong. The PSTs' PCKnos development was traced by analysing the assignments they submitted to the course and the transcripts of two semi-structured interviews. The Video Reflection Assignment (VRA) was particularly informative. It required the PSTs to comment on the same set of videos at three different times: at the beginning, halfway through, and at the end of the PGDE course. The videos featured NOS instruction in one way or another. By analysing how the PSTs' comments on specific video episodes evolved over time, supplemented by the interview data, their PCKnos development was documented. Factors influencing PCKnos development were identified mainly through the analysis of interview data. A new method, similar to the recently introduced PCK-map methodology, was created to visualize the findings. Among the five constituent components of the PSTs' PCKnos, their knowledge of instructional strategies was found to be the most developed, and their knowledge of assessment to be the weakest. The PSTs developed their PCKnos through progressive reflection on the same videos by drawing upon various experiences. Five factors influenced this process: (1) PSTs' NOS understanding, (2) their prior learning and/or research experience, (3) their experience of attending the PGDE course, (4) their classroom teaching experience, and (5) the VRA. The VRA appears to be a potent tool for developing PSTs' PCKnos in two respects. First, the PSTs could utilize what they saw in the videos either as a source of experience on

which to reflect, or to stimulate their reflections on newly acquired experiences. Second, the progressive nature of the VRA could deepen the PSTs' reflection, particularly with the aid of a theoretical framework in later reflection tasks. The VRA was found to be helpful in overcoming three challenges to the development of PSTs' PCKnos: their weak understanding of NOS and of what constitutes effective NOS pedagogy, and the lack of school environments conducive to learning to teach NOS. PSTs may have few opportunities to observe others' effective NOS instruction or to experiment with NOS instruction themselves during their practicum; the videos in the VRA can play an important role in supplementing this lack of classroom experiences. It was further found that videos showing explicit-reflective NOS instruction were more effective in developing PSTs' PCKnos than those showing implicit NOS instruction. To conclude, this study establishes that video-based progressive reflection tasks could be potent tools for developing PSTs' PCKnos, and makes recommendations on how to implement and refine these tasks. Implications for education policy and future research are also discussed.

Subjects: Science - Study and Research Paper (undergraduate) from the year 2010 in the subject Pedagogy - The Teacher, Educational Leadership, University of Twente , course: Education science, language: English, abstract: This article is focused on unveiling the concept of TPACK in relation to teaching and learning in science and mathematics as well as the meaning of TPACK for pre-service science and mathematics teachers training. In describing this,

different literatures were consulted on the meaning of TPACK, its origin and the way it can be integrated in pre-service science and mathematics teacher preparation. It was noted from literature that TPACK is the core of good teaching with technology, and that it's important for teachers to have an understanding of TPACK. Studies further show that the way pre-service teachers are taught to integrate technology, pedagogy and content is the same way they can implement the approach in their own teaching. In addition, studies argue for pre-service teachers to learn on how technology can help to enhance students learning in science and mathematics rather than learning how to teach technology. Different frameworks have been proposed on how to shift from teaching technology to using technology to enhance learning. For example some studies provide the curricular plans for developing pre-service teachers' competencies of integrating technology pedagogy and content. To enhance pre-service teachers' competency in technology integrations, some studies have reported the need for pre-service science and mathematics teachers to engage in the hands-on activities that reflect the real teaching with technology. Example of hands activities proposed in most studies includes planning of a lesson, presenting it to peers, getting critics from peers and re-planning it again. The cyclic development of the lesson is reported to enhance pre-service teachers' competency in working with technology in a real classroom situation. It is therefore concluded that implementation of TPACK in pre-service teachers training should start with orientation of the pre-service teachers to the use of

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technology in teaching by providing them with sufficient opportunity to engage in hands-on activities.

This book reviews the Teacher Education and Development Study: Learning to Teach Mathematics, which tested 23,000 primary and secondary level math teachers from 16 countries on content knowledge and asked their opinions on beliefs and opportunities to learn.

There has been a growing interest in the notion of a scholarship of teaching. Such scholarship is displayed through a teacher's grasp of, and response to, the relationships between knowledge of content, teaching and learning in ways that attest to practice as being complex and interwoven. Yet attempting to capture teachers' professional knowledge is difficult because the critical links between practice and knowledge, for many teachers, is tacit. Pedagogical Content Knowledge (PCK) offers one way of capturing, articulating and portraying an aspect of the scholarship of teaching and, in this case, the scholarship of science teaching. The research underpinning the approach developed by the authors offers access to the development of the professional knowledge of science teaching in a form that offers new ways of sharing and disseminating this knowledge. Through this Resource Folio approach (comprising CoRe and PaP-eRs) a recognition of the value of the specialist knowledge and skills of science teaching is not only highlighted, but also enhanced. The CoRe and PaP-eRs methodology offers a new way of capturing and portraying science teachers'

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mission is to promote the learning of all PK-12 students through high-quality, evidence-based preparation and continuing education for all school personnel. For more information on our publications, visit our website at: [www.aacte.org](http://www.aacte.org).

Educational technologies are vastly becoming a common-place entity in classrooms as they provide more options and support for teachers and students. However, many teachers are finding these technologies difficult to use as they were never fully trained on how to utilize it or have received little instruction on how to effectively apply it in the classroom. Technological Pedagogical Content Knowledge (TPACK) Framework for K-12 Teacher Preparation: Emerging Research and Opportunities features contemporary insights into a multi-year research effort that concluded with the design and development of an online TPACK learning trajectory. Highlighting how this development impacts the design of professional development coursework for educators, this publication is a critical work for in-service teachers, researchers, and online course developers.

This thesis investigates the teaching of English as a foreign language (EFL) at the Indonesian junior secondary school level. Drawing on the notion of Shulman's (1987) concept of pedagogical content knowledge (PCK), it examines teacher knowledge of curriculum, content, students and pedagogy in teaching EFL writing. Employing a mixed-methods case study approach, this study utilised in-depth semi-structured interviews, classroom observations and stimulated recalls to analyse this knowledge through both self-report and instances of practice. It involved 15 teachers, seven of them were those who have been professionally certified

under the Indonesian laws regarding teacher quality, and eight of them were not. The findings of the study suggest that, regardless of their capable demonstrations of specific teaching areas in the observed writing lessons, the certified and non-certified teacher participants' PCK articulation and enactment were, generally, considered to be at a low level. the present study considered that factors that may have contributed to the unexpectedly, relatively low PCK level were associated with an imbalance between knowledge of English language and knowledge of the content specifically related to writing instruction that is apparent from the analysis of EFL pre-service teacher education and in-service teacher professional development programmes. One unexpected finding was that the non-certified teachers showed superior strengths in their knowledge of their students, compared to their certified colleagues. Students' typical profiles in their schools seemed to contribute significantly to how the non-certified teachers responded to their learning needs. The present study makes recommendations to improve the professional quality of English teachers. EFL pre-service teacher education should offer a balance between language-knowledge and pedagogically-related content and ensure adequate emphasis on practical dimensions of instruction. Sustaining and improving certified teachers could be enhanced by engaging them in an on-going and advanced professional development programme and instituting a continuing evaluation programme.

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The COVID-19 pandemic drastically transformed the classroom by keeping students and

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teachers apart for the sake of safety. As schools emptied, remote learning rapidly expanded through online services and video chatrooms. Unfortunately, this disrupted many students and teachers who were not accustomed to remote classrooms. This challenge has forced K-12 teachers to think differently about teaching. Unexpectedly and with little time to prepare, they have been confronted with redesigning their curriculum and instruction from face-to-face to online virtual classrooms to protect students from the COVID-19 virus while ensuring that these new online initiatives remain sustainable and useful in the post-pandemic world. As teachers learn to take advantage of the affordances and strengths of the multiple technologies available for virtual classroom instruction, their instruction both in online and face-to-face will impact what and how students learn in the 21st century. The Handbook of Research on Transforming Teachers' Online Pedagogical Reasoning for Engaging K-12 Students in Virtual Learning examines the best practices and pedagogical reasoning for designing online strategies that work for K-12 virtual learning. The initial section provides foundational pedagogical ideas for constructing engaging virtual learning environments that leverage the unique strengths and opportunities while avoiding the weaknesses and threats of the online world. The following chapters present instructional strategies for multiple grade levels and content areas: best practices that work, clearly describing why they work, and the teachers' pedagogical reasoning that supports online implementations. The chapters provide ways to think about teaching in virtual environments that can be used to guide instructional strategy choices and recognizes the fundamental differences between face-to-face and virtual environments as an essential design component. Covering such topics as K-12 classrooms, pedagogical reasoning, and virtual learning, this text is perfect for professors, teachers, students,

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educational designers and developers, instructional technology faculty, distance learning faculty, and researchers interested in the subject.

Research on teachers' professional knowledge hints at teachers' pedagogical content knowledge being an important criterion for instructional quality and student achievement. This research project investigates the relation between teachers' pedagogical content knowledge, teachers' actions, and students' content knowledge in physics comparing Finland, Germany, and Switzerland.

Effective teachers have good pedagogical content knowledge (PCK). Pedagogical content knowledge is the intersection of discipline specific content knowledge and pedagogical knowledge. How effectively are pre-service teachers helped to develop good PCK? In this project we asked our pre-service teachers how they would respond to a particular student misconception before and after teaching three topics, to determine if there had been any growth in their PCK. Although the pre-service teachers had deepened their knowledge on teaching specific mathematics content, few changed their answer to the question or showed a deeper understanding of what the student had understood. This then has implications for our teaching--we need to make our thinking explicit so that pre-service teachers can see the complexity of these issues.

Undoubtedly, teachers of this century should empower themselves both pedagogically and technologically to be able to teach more efficiently and enable efficient learning. Although there is extensive research on the way language should be taught, research on the use of technological pedagogical and content knowledge (TPACK) by teachers of English as a foreign language is still in need of more scientific support. English as a Foreign Language Teachers'

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TPACK: Emerging Research and Opportunities is an essential reference source that discusses the concept of TPACK and its related concepts to the knowledge base of teaching English as a foreign language (TEFL). Featuring research on topics such as computer-assisted language learning, the role of teachers, and teacher knowledge base, this book is ideally designed for educators, TEFL teachers, professionals, academicians, researchers, and students seeking coverage on more practical and research-based instructional designs for language classrooms. This book enhances readers' understanding of science teachers' professional knowledge, and illustrates how the Pedagogical Content Knowledge research agenda can make a difference in teachers' practices and how students learn science. Importantly, it offers an updated international perspective on the evolving nature of Pedagogical Content Knowledge and how it is shaping research and teacher education agendas for science teaching. The first few chapters background and introduce a new model known as the Refined Consensus Model (RCM) of Pedagogical Content Knowledge (PCK) in science education, and clarify and demonstrate its use in research and teacher education and practice. Subsequent chapters show how this new consensus model of PCK in science education is strongly connected with empirical data of varying nature, contains a tailored language to describe the nature of PCK in science education, and can be used as a framework for illuminating past studies and informing the design of future PCK studies in science education. By presenting and discussing the RCM of PCK within a variety of science education contexts, the book makes the model significantly more applicable to teachers' work.

This book focuses on developing and updating prospective and practicing

chemistry teachers' pedagogical content knowledge. The 11 chapters of the book discuss the most essential theories from general and science education, and in the second part of each of the chapters apply the theory to examples from the chemistry classroom. Key sentences, tasks for self-assessment, and suggestions for further reading are also included. The book is focused on many different issues a teacher of chemistry is concerned with. The chapters provide contemporary discussions of the chemistry curriculum, objectives and assessment, motivation, learning difficulties, linguistic issues, practical work, student active pedagogies, ICT, informal learning, continuous professional development, and teaching chemistry in developing environments. This book, with contributions from many of the world's top experts in chemistry education, is a major publication offering something that has not previously been available. Within this single volume, chemistry teachers, teacher educators, and prospective teachers will find information and advice relating to key issues in teaching (such as the curriculum, assessment and so forth), but contextualised in terms of the specifics of teaching and learning of chemistry, and drawing upon the extensive research in the field. Moreover, the book is written in a scholarly style with extensive citations to the literature, thus providing an excellent starting point for teachers and research students undertaking scholarly studies in

chemistry education; whilst, at the same time, offering insight and practical advice to support the planning of effective chemistry teaching. This book should be considered essential reading for those preparing for chemistry teaching, and will be an important addition to the libraries of all concerned with chemical education. Dr Keith S. Taber (University of Cambridge; Editor: Chemistry Education Research and Practice) The highly regarded collection of authors in this book fills a critical void by providing an essential resource for teachers of chemistry to enhance pedagogical content knowledge for teaching modern chemistry. Through clever orchestration of examples and theory, and with carefully framed guiding questions, the book equips teachers to act on the relevance of essential chemistry knowledge to navigate such challenges as context, motivation to learn, thinking, activity, language, assessment, and maintaining professional expertise. If you are a secondary or post-secondary teacher of chemistry, this book will quickly become a favorite well-thumbed resource! Professor Hannah Sevian (University of Massachusetts Boston) In this study I examined the role of collaboration, curriculum, and the classroom context in the development of pedagogical content knowledge of a mathematics teaching intern. Additionally, I investigated the nature of the collaborative process between the teaching intern and his mentor teacher as they collaborated on

action (during structured planning time) and in action (while students were present). The teaching internship resided in a seventh-grade mathematics classroom during the teaching of a probability unit from a standards-based curriculum, Connected Mathematics Project. Using existing research, a conceptual framework was developed and multiple data sources (audio taped collaborations, observations of the intern's teaching practices, semi-structured interviews, and a mathematics pedagogy assessment) were analyzed in order to understand the teaching intern's development of knowledge of instructional strategies, knowledge of student understandings, curricular knowledge, and conceptions of purpose for teaching probability. Results identified numerous dilemmas related to planning and implementing instruction. Although the teaching intern developed pedagogical content knowledge, he often experienced difficulty accessing it while teaching. Through collaboration, curriculum, and the classroom context, the teaching intern learned to incorporate his pedagogical content knowledge in instruction. Analysis revealed that as he gained new knowledge he was able to shift his focus from content to the use of instructional strategies for teaching and learning. The curriculum was the primary focus of collaboration and initiated the intern's examination of the learning-to-teach process. Collaboration on action and collaboration in action proved to be essential elements in the

development of pedagogical content knowledge.

This ambitious text is the first of its kind to summarize the theory, research, and practice related to pedagogical content knowledge. The audience is provided with a functional understanding of the basic tenets of the construct as well as its applications to research on science teacher education and the development of science teacher education programs.

The Pedagogical Content Knowledge in an Educational Context (PCK-EC) model is proposed as a framework to support teachers, coaches and researchers in the examination of teacher knowledge within a specific context and with a particular focus. This framework combines the theoretical and practical aspects represented by five dimensions of teachers' attitudes and teachers' knowledge (technology, learners' cognition, subject matter, pedagogy) within an educational context that includes curricular, technological, social, cultural, and teaching - learning contexts. Two case studies were used to examine the utility of the proposed PCK-EC model. Data collected included: semi-structured initial and final interviews; teacher's journals of reflection (completed after teaching each lesson); direct observations during lessons; observations from video recordings of lessons; transcripts from initial and final interviews; and other collected documents in regards to the educational context. The interpretive repertoires

method allowed us to identify and characterize groups of themes in each dimension of teachers' attitudes and knowledge, and supported inter-relationships between themes. The PCK-EC was useful to support a deep description of a collection of themes by using different sources of data. Analysis of each one of these collections of themes allowed us to understand teachers' PCK-EC and provided insights about how different technological tools might affect teachers' attitudes and their knowledge. The dimensions of teachers' attitudes and knowledge are not isolated, but rather they are inter-related during teaching practice. It is possible to recognize inter-relationships (outgoing and incoming) between themes (within and across dimensions). It is suggested that the frequency of the outgoing and incoming inter-relationships found between themes might give us an average weight for each of the dimensions of the PCK-EC and this could represent teachers' attitudes and knowledge used during teaching practice. The collection of themes identified might be useful as a tool to support teachers as they explore their attitudes and their knowledge needed for teaching a specific topic with the use of technological tools, and may provide coaches with an effective mechanism to support the identification of an individuals' PCK and development needs.

Schwartz Powerful Ideas in Elementary Mathematics: Pedagogical Content

Knowledge for Teachers, 1/e ISBN: 0205493750 "This book would be a great tool for helping [today's future elementary teachers] acquire a 'gut level' understanding of mathematics concepts." - Hester Lewellen, Baldwin-Wallace College, OH "The writing in this text is very clear and would easily be understood by the intended audience. The real-world examples put the various math concepts into a context that is easily understood. The vignettes at the beginning of each chapter are interesting and they get the reader to begin thinking about the math concepts that will follow. Each of the chapters seem to build on one another and the author often refers back to activities and concepts from previous chapters which is meaningful to the reader because it lets the reader know that the information they are learning builds their conceptual understanding of other mathematical concepts. " - Melany L. Rish, University of South Carolina, Aiken Organized around five key concepts or "powerful ideas" in mathematics, this text presents elementary mathematics content in a concise and nonthreatening manner for teachers. Designed to sharpen teachers' mathematics pedagogical content knowledge, the friendly writing style and vignettes relate math concepts to "real life" situations so that they may better present the content to their students. The five "powerful ideas" (composition, decomposition, relationships, representation, and context) provide an organizing framework and highlight the

interconnections between mathematics topics. In addition, the text thoroughly integrates discussion of the five NCTM process strands. Features: Icons highlighting the NCTM process standards appear throughout the book to indicate where the text relates to each of these. Practice exercises and activities and their explanations reinforce math concepts presented in the text and provide an opportunity for reflection and practice. Concise, conversational chapters and opening vignettes present math contents simply enough for even the most math-anxious pre-service teachers.

Unlike pre-service teachers, the great majority of in-service teachers provided complete or near complete explanations for all types of errors in all operations. The great majority of in-service teachers suggested complete or near complete instructional strategies for dealing with addition and subtraction errors; but re-teaching or incomplete instructional strategies for dealing with multiplication and division errors. The majority of pre-service teachers gave no specific strategy or re-teaching for error types in all fraction operations. There was correlation between teachers' ability to identify errors and their causal attributions and between causal attributions and suggested instructional strategies for all operations.

This volume represents both recent research in pedagogical content knowledge

(PCK) in science, technology, engineering and math (STEM), as well as emerging innovations in how PCK is applied in practice. The notion of “research to practice” is critical to validating how effectively PCK works within the clinic and how it can be used to improve STEM learning. ?As the need for more effective educational approaches in STEM grows, the importance of developing, identifying, and validating effective practices and practitioner competencies are needed. This book covers a wide range of topics in PCK in different school levels (middle school, college teacher training, teacher professional development), and different environments (museums, rural). The contributors believe that vital to successful STEM education practice is recognition that STEM domains require both specialized domain knowledge as well as specialized pedagogical approaches. The authors of this work were chosen because of their extensive fieldwork in PCK research and practice, making this volume valuable to furthering how PCK is used to enlighten the understanding of learning, as well as providing practical instruction. This text helps STEM practitioners, researchers, and decision-makers further their interest in more effective STEM education practice, and raises new questions about STEM learning.

This dissertation, "The Development of Pedagogical Content Knowledge in Novice Secondary School Teachers of English in the People's Republic of China" by ???,

Xiaoyan, Judy, Zhu, was obtained from The University of Hong Kong (Pokfulam, Hong Kong) and is being sold pursuant to Creative Commons: Attribution 3.0 Hong Kong License. The content of this dissertation has not been altered in any way. We have altered the formatting in order to facilitate the ease of printing and reading of the dissertation. All rights not granted by the above license are retained by the author.

Abstract: Abstract of thesis entitled The Development of Pedagogical Content Knowledge in Novice Secondary School Teachers of English in the People's Republic of China submitted by ZHU, Xiaoyan Judy ( ??? ) for the Degree of Doctor of Philosophy at the University of Hong Kong in July 2003 This study investigates pedagogical content knowledge (PCK) development in four novice EFL teachers during their second or third years of teaching in Guangzhou, PRC. Although research on PCK began in the late 1980s, most studies have centred on either expert or student teachers/first-year teachers, and have captured snapshots of PCK at a certain point in their subjects' teaching careers. Few have researched PCK growth longitudinally. The present study explores how teachers' PCK evolves during their early years of teaching, and identifies a trigger for PCK development. The research is content-specific (teaching of EFL), context-specific (Guangzhou), and subject-specific (novices beyond their first year of teaching). It uses an analytical framework adapted from Shulman (1986, 1987); Grossman (1990, 1995) and Turner-Bisset (1999, 2001), which focuses on six components of PCK: conceptions of teaching purposes, knowledge of curriculum,

subject matter knowledge, knowledge of students, knowledge of pedagogy, and knowledge of self. This qualitative research employs multiple case studies for in-depth study. The four informants were deliberately selected. They had completed their pre-service and induction teacher education programmes and were members of the first generation of Chinese secondary teachers of English required to implement the newly-promoted communicative language teaching (CLT) under the new English curriculum launched in 1992. The data collected from the four teachers between July 1999 and June 2002 included 14 lesson plans, 17 videotaped lessons, 22 written reflections and 27 semi-structured interviews. The results indicate that the four novices experienced a gradual transition from a firmly teacher-oriented to a slightly more learner-oriented perspective. This transition was marked in the teachers concerned by a steady shift from a technique-based to a student-based understanding of teaching; from unquestioning implementation to initial reflection, and from a rigid to a slightly more flexible pedagogy. Their change was characterized by an ongoing, uneven and unstable progression in their learning-to-teach experiences. The significance of the study is that different forms of PCK emerge over time. At the outset, the six elements are in a rather rudimentary and separate state of development. Context-free knowledge of pedagogy, superficial knowledge of students and limited curricular knowledge are most in evidence, but relate to each other at a fairly superficial level. This relationship deepens over time. Analysis of the data suggests that knowledge of students plays an

important role in triggering PCK development and integration. This study argues that the teachers' PCK develops out of the contextualised conceptualizations of their understanding of students and teaching, professional learning and reflective practice, and that there is a dialectical relationship between their developing PCK and the context within which they work. In the PRC context, The Expert Teacher presents an engaging, research-informed view on which teaching strategies work best to provoke long-term learning in students. 'But what does this look like in a classroom?' This question generally occurs to interested practitioners when they enquire into evidence-based approaches to teaching and learning. And it is often the case that they get to the end of a teaching manual only to find that the answers still escape them. In The Expert Teacher, however, Darren Mead provides many of the answers. A highly respected teacher, Darren has devoted his professional life to attaining pedagogical excellence - and in this book he shares effective tools and techniques that have been tried and tested over many years in the classroom, much to the long-term benefit of his pupils' learning. A warning though: this book is not for teachers seeking quick fixes or superficial tricks. The Expert Teacher is for educators who are eager to experience the excitement of knowing and teaching their subject masterfully.

[Truncated abstract] Physical educators are required to provide children with the necessary skills to equip them for successful participation in lifelong physical activity

(Trost, 2005; Curriculum Council, 1998). Hastie (1994) identifies the need to increase knowledge concerning teacher effectiveness by identifying teacher characteristics that lead to higher levels of student achievement. Knowledge of how to teach specific content in specific contexts has been defined by Melaldo, Blanco & Ruiz (1998) as pedagogical content knowledge (PCK). This study served to determine the extent to which the teachers were displaying PCK in their teaching. Furthermore, the study aimed to explore the relationship between PCK and student outcomes along with the relationship between PCK and the school. Within this study, female PE teachers (n=5) and students (n=125, 9-13 years of age) from five co-educational non-government schools, within the Perth metropolitan region participated in the project in term two of 2008. These teachers were PE specialists, responsible for the planning, teaching and assessing of PE in primary schools. This study used Grossman (1990) to evidence PCK in teaching and evaluate the impact of PCK. Grossman (1990) has defined four elements of PCK; knowledge and beliefs about the purpose of teaching, knowledge of student's understanding of subject matter, knowledge of instructional strategies and knowledge of curriculum content. To assess the impact of these four theoretical elements, this study made them operational through the use of a rigorous, practical data collection process. Firstly, the teacher s theoretical belief system was determined using Ennis and Chen s (1995) VOI-2. This VOI-2 profile was then observed for in the teaching, along with elements of the PE lesson such as; activity, activity focus, teaching

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styles, opportunities provided for student to learn, as well as instructions and feedback. Data from the students was gathered throughout the observed lessons to determine the behaviour of the students and the activity output of a sub-set of representative students. Following the observations, the students completed a questionnaire to quantify their feelings of enjoyment towards the PE programme and PE teacher. At the completion of the observations, each teacher was interviewed. The interview enabled teachers to describe their perceptions of support provided to them by the school. All data gathered were used to determine the extent to which the teachers were displaying (PCK) in their teaching and relates directly to Grossman s (1990) four elements of PCK...

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.

Technological pedagogical content knowledge (TPCK) reflects a new direction in understanding the complex interactions among content, pedagogy, learners and technology that can result in successful integration of multiple technologies in teaching and learning. The purpose of this edited volume is to introduce TPCK as a conceptual framework for grounding research in the area of teachers' cognitive understanding of the interactions of technology with content, pedagogy and learner conceptions.

Accordingly, the contributions will constitute systematic research efforts that use TPCK to develop lines of educational technology research exemplifying current theoretical conceptions of TPCK and methodological and pedagogical approaches of how to develop and assess TPCK.

Since its emergence over two decades ago, the construct of pedagogical content knowledge (PCK) has significantly impacted preservice and inservice teacher education, educational policy, and educational research. PCK has served to re-focus educators' attention on the important role of subject matter in educational practice and away from the more generic approach to teacher education that dominated the field

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prior to 1975. This ambitious text is the first of its kind to summarize the theory, research, and practice related to pedagogical content knowledge. The audience is provided with a functional understanding of the basic tenets of the construct as well as its applications to research on science teacher education and the development of science teacher education programs. The authors are prominent educators representing a variety of subject matter areas and K-12 grade levels. Although the focus of the text is science education, it should provide valuable reading for any individuals with interests in professional teacher education.

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