Technological Pedagogical Content Knowledge for Teacher Education

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Abstract; *Today's world is on the way of technology and education is also focusing on technological way of learning. Today is also called the age of technology and education also follows these technologies to enhance virtual and conceptual learning beyond the boundary. According to the age, it demands to integrate and infuse ICT with pedagogy. Teacher education institution is facing most challenging tasks to infuse technology with teaching. ICT should infuse into content and pedagogy in such a way that crates and enable conceptual understanding to the learner as well as teacher. In 1986, Shulman was provided the concept of Pedagogical Content Knowledge and Mishra &Koehler extended the concept in the year of 2006, as TPACK (Technological Pedagogical and Content Knowledge) but now it is called as TPCK (Technological Pedagogical Content Knowledge). For this, teacher education institution needs to be propagating the concept of TPCK among teacher educators and teacher. TPCK is the concept in which, technology and pedagogy need to be adopt or organise or create according to the nature of content. The present paper is focused on the fundamental concept of TPCK framework and its importance to modern decade of teaching learning process.*

Keywords; *Teacher Knowledge, TPCK Framework, TK, PK, CK, TPK, TCK, PCK*

Introduction

In the earlier decade only talked about the pedagogical content knowledge but now it is the level of infusing ICT with pedagogy. Due to infusion of technology with pedagogy, the concept has evolved 'TPCK'. It has three core components as; Technology, Pedagogy and Content. To the interaction of among three components give seven concepts as; TK, PK, CK, TPK, TCK, PCK, and TPCK. So it is called TPCK Framework.

Good teaching requires an understanding of how technology relates to the pedagogy and content? The relationships between content, pedagogy, and technology, in practical terms, this means that apart from looking at each of these components in isolation but teacher educators and teacher also need to look at them in fusion form: pedagogical content knowledge (PCK), technological content knowledge (TCK), technological pedagogical knowledge (TPK), and all three amalgamated together as technological pedagogical content knowledge (TPCK).

We are living in the age of technology; most of the people utilize tech-hand held devices. Our children are also attracting towards new edge of technology. So we the teacher as well as teacher educators have to adapt and utilize technology in the

classroom for conceptual teaching learning process. According NCF 2005 and constructivist approach, children is the central part of learning and teacher has to create and enable such an environment through which children can learn as the way of virtual experiences.

It attempts to confine some of the crucial qualities of teacher knowledge required for technology amalgamation in teaching. The pedagogical uses of technology entail the expansion of a complex, which is situated form of knowledge that Mishra & Kohler (2006) call Technological Pedagogical Content Knowledge (TPCK). They hypothesized the composite roles of, and interaction among, three main components of learning environments: content, pedagogy, and technology. This model has much to offer to discussions of technology integration at multiple levels; theoretical, pedagogical, and methodological.

The introduction of digital technology in educational practices has changed scenario in the process of teaching and learning. Simply introducing technology to the educational process is not an adequate amount. The question is that, what teachers need to know in order to appropriately incorporate technology into their teaching.

Theoretical perspective is not only constrains in our existing educational uses of computers, but also critically limits our vision of what might be accomplished with computer technology in a broader social, cultural, or educational context. Developing theory for educational technology is difficult because it requires a detailed understanding of complex relationships that are contextually bound. Moreover, it is difficult to study cause and effect when teachers, classrooms, politics, and curriculum goals vary from case to case. One approach, called design experiments, honours this complexity and has recently gained prominence in educational research (Brown, 1992; Cobb, Confrey, diSessa, Lehrer, &Schauble, 2003).

TPCK Framework for Teacher Knowledge

Teaching is a highly complex activity that draws on many kinds of knowledge. It is a complex cognitive skill taking place in an ill-structured, dynamic environment (Greeno & Leinhardt, 1986; Spiro, Coulson, Feltovich, & Anderson, 1988; Spiro, Feltovich, Jacobson, & Coulson, 1991). Proficiency in teaching is depending on flexible access to highly organized systems of knowledge (Glaser, 1984; Putnam & Shulman, 1986, 1987). There are plainly various knowledge systems that are essential to teaching, including knowledge of student's thinking and learning, and knowledge of subject matter. In recent times, teacher education has shifted primarily to pedagogy, emphasizing general pedagogical classroom practices independent of subject matter and often at the expense of content knowledge (Ball & Mc Diarmid, 1990). For different approaches toward teacher education have emphasized one or the other domain of knowledge, focusing on knowledge of content or knowledge of pedagogy. Shulman (1986) transformed thinking about teacher knowledge by introducing the idea of pedagogical content knowledge (PCK). He argued that the subject matter knowledge and pedagogy were being treated as mutually elite domains in research concerned with these domains (Shulman, 1987). To address this dichotomy, he proposed considering the necessary relationship between the two by

introducing the notion of PCK. PCK exists at the amalgamation of content and pedagogy.

Thus, it goes beyond a simple consideration of content and pedagogy in isolation from one another. PCK represents the blending of content and pedagogy into an understanding of how particular aspects of subject matter are organized, adapted, and represented for instruction. Shulman (1986) argued that having knowledge of subject matter and general pedagogical strategies was not adequate for capturing the knowledge of good teachers. To exemplify the complex ways in which teachers think about how particular content should be taught and including ''the ways of representing and formulating the subject that make it comprehensible to others.'' The concept of PCK was extended by scholars after Shulman (van Driel, Verloop, & De Vos, 1998). In fact, Shulman's (1986) initially described the teacher knowledge such as subject-matter knowledge and knowledge of educational framework.

The paper stress on PCK is based on Shulman's acknowledgement; that pedagogical content knowledge is of unique interest because it identifies the distinctive bodies of knowledge for teaching and learning. It represents the amalgamation of content and pedagogy into an understanding of how particular topics, problems, or issues are organized, represented, and adapted to the diverse interests and abilities of learners, and presented for instruction.

Though, Shulman did not talk about technology and its relationship to pedagogy and content. Traditional classrooms use a range of technologies, from curriculum to OHP, from typewriters in literature classrooms. However, until in recent times, most digital technologies are used in the classrooms (Bruce & Hogan, 1998). In contrast, the more common usage of technology refers to digital computers and computer software, and mechanisms that are novel but used as in additional form. Thus, Shulman's approach has changed since the 1990s is that technologies have come to the front position of educational. Primarily, the digital technologies requirement was for learning but how to apply them to teaching it was big challenges. These new technologies integrate hardware and software such as computers, educational games, and the Internet and the countless applications supported by it.

These new technologies have changed the scenario of the classroom. Ranging from illustrations on a blackboard or interactive multimedia simulations or Web-based hyper-texts is to the drive computer metaphor of the brain. Technologies have met the expense of representations, analogies, examples, explanations, and demonstrations that can help make curriculum more accessible to the learner.

Moreover, the rapid rate of advancement of these new digital technologies provide opportunity to use of technology for pedagogy of specific content could. Thus, teachers could focus on the variables related to content and pedagogy and be assured that technological contexts would not affect their career as a teacher. Thus, knowledge of technology becomes a significant part of overall teacher knowledge. For instance, former Shulman's influential work on PCK, knowledge of content and knowledge of pedagogy were considered separate and independent from each other. Likewise, today, knowledge of technology is often considered to be separate from knowledge of

pedagogy and content. But, these are not separated as we understand. All three concepts are interdependent with each other.

Though, the relationships between content (subject matter), pedagogy (the methods of teaching and learning), and technology (digital computer technology) are complex. So it may be inappropriate to see knowledge of technology as being isolated from knowledge of pedagogy and content. The Mishra and Koehler's' framework emphasizes the associations, interactions, affordances, and constraints between and among content, pedagogy, and technology. In this model, knowledge about content (C), pedagogy (P), and technology (T) is essential for developing good teaching. However, rather than treating these as separate bodies of knowledge, this model additionally emphasizes the complex relationship of these three bodies of knowledge.

Various Components of TPCK Framework

According to Lee Shulman (1986), considered the relationship between content and pedagogy and proposed the concept as Pedagogical Content Knowledge. Similarly, Punya Mishra and Matthew J. Koehler extended the concept PCK to dissolution of Technological knowledge in PCK, and then he proposed the concept as Technological Pedagogical Content Knowledge (TPCK framework). Due to amalgamation between three develop seven components as; TK, CK, PK, TCK, PCK, TPK, and TPCK. Thus, the following elements are essential in the framework.
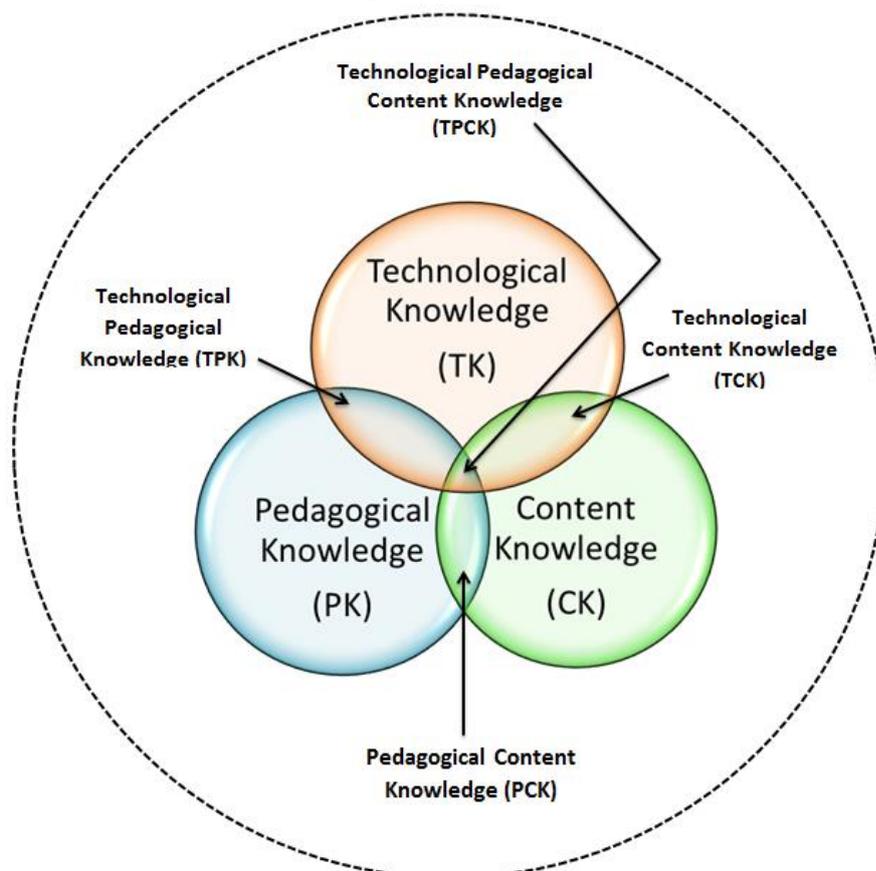
Figure; Shows Detailed Concept of TPACK Framework
Model takenfromwww.tpack.org

Content Knowledge

Content knowledge (CK) is knowledge of subject matter that is to be learned or taught in the school and college. Teacher must know and understand the subjects that he/she teach in the classroom. The content knowledge includes knowledge of facts, concepts, theories, and procedures (Shulman, 1986) within a given field; knowledge of explanatory frameworks that organize and connect ideas; and knowledge of the rules of evidence and proof. Teacher must also understand the nature of knowledge and inquiry in different fields. Teachers who do not have these understandings can misrepresent those subjects to their students (Ball& Mc Diarmid, 1990).

Pedagogical Knowledge

Pedagogical knowledge (PK) is methods of teaching and learning. This is the basic form of knowledge that is concerned with development of lesson plan, classroom management, student learning and implementation, and evaluation. It is the knowledge of techniques or methods to be used in the classroom; the nature of the target audience; and strategies for evaluating student understanding. It requires an understanding of cognitive, social, and developmental theories of learning and how they apply to students in their classroom. A teacher having good pedagogical knowledge understands how students construct knowledge, acquire skills, and develop habits of mind and positive attitude toward learning.
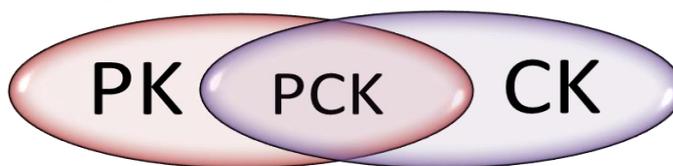
Technological Knowledge

Technological knowledge (TK) is knowledge of technologies which is used in education. It may be called as ICT in education. Technological knowledge involves the skills required to operate particular technologies. The ICT or digital technologies comprise knowledge of computer hardware and software, and the ability to use standard sets of software tools such as word processors, spreadsheets, browsers, and e-mail. TK includes knowledge of how to install and remove peripheral devices, install and remove software programs, and create and archive documents. The majority standard technology workshops and tutorials tend to focus on the acquisition of such skills. Technology is continually changing; the nature of TK needs to shift with time as well. The capability to learn and adapt to new technologies are important for the need of modern age.
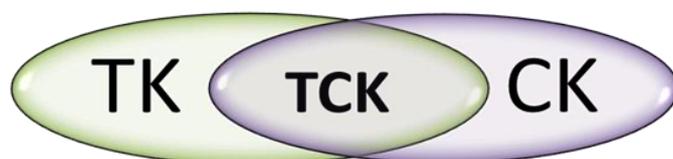
Pedagogical Content Knowledge

The concept has proposed by lee Shulman. According this concept, the knowledge of pedagogy is pertinent to the teaching of specific content. This includes knowledge of teaching approaches fit to the content, and likewise, knowledge of elements of the content can be arranged for better teaching and learning. PCK is concerned with the representation and formulation of concepts, pedagogical techniques, and knowledge of what makes concepts difficult or easy to learn, knowledge of students' prior knowledge, and theories of epistemology. It also involves knowledge of teaching strategies that incorporate appropriate conceptual representations in enjoin to address learner difficulties and misconceptions and foster

meaningful understanding. It is the combination of contents with specific strategies in such a way in which teaching learning takes place in an effective manner.
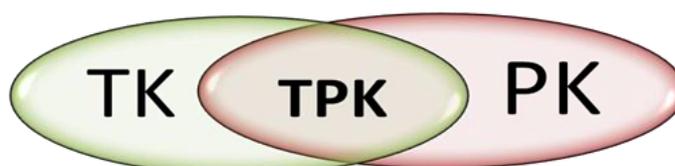

Figure; Shows Detailed Concept of Pedagogical Content Knowledge

Technological Content Knowledge

Technological content knowledge (TCK) is knowledge of using technologies with specific content. Teachers need to know not just the subject matter they teach but also the manner in which the subject matter can be changed by the application of technology. Though, ICT does more than that, by allowing students to ''play'' with virtual nature of learning. It plays a significant role in the modern age of teaching and learning process.

Figure; Shows Detailed Concept of Technological Content Knowledge

Technological Pedagogical Knowledge

Technological pedagogical knowledge (TPK) is knowledge of teaching and learning settings, and on the other hand knowing how teaching might change as the result of using particular technologies. This might comprise an understanding of a range of tools exists for a particular task, the ability to choose a tool based on its fitness, strategies for using the tool's affordances, and knowledge of pedagogical strategies and the ability to apply those strategies for use of technologies. It consists of knowledge of tools for maintaining class records, attendance, and grading, and knowledge of generic technology-based ideas such as Web Quests, discussion boards, and chat rooms. It is also called as strategies of teaching with ICT devices.

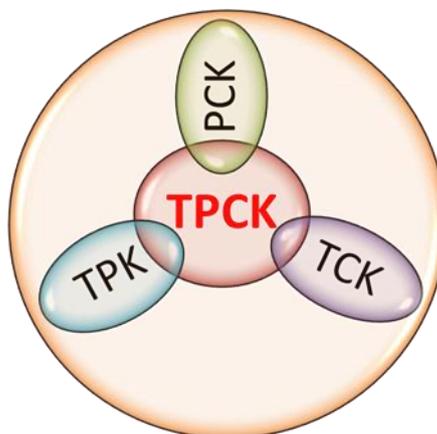Figure; Shows Detailed Concept of Technological Pedagogical Knowledge

Technological Pedagogical Content Knowledge

Technological pedagogical content knowledge (TPCK) is an evolving structure of knowledge that goes beyond all three components (Content, Pedagogy, and Technology). TPCK is the base of excellent teaching with technology. It requires an understanding of the demonstration of concepts using technologies; pedagogical techniques that use digital technologies in constructive ways to teach content; knowledge of how technology can help to students concept formation; knowledge of

previous knowledge of students; and knowledge of how technologies can be used to build on existing knowledge and to develop new concept of teaching learning process.

Describing PCK, Marks (1990) said that it ''represents a class of knowledge that is central to teachers' work and that would not typically be held by non-teaching subject matter experts or by teachers who know little of that subject''. It means that, ''TPCK represents a class of knowledge that is central to teachers' work with technology. This knowledge would not typically be held by technologically proficient subject matter experts, or by technologists who know little of the subject or of pedagogy, or by teachers who know little of that subject or about technology.''

Thus, the model of technology integration in teaching and learning argues that developing good content requires a thoughtful interweaving of all three key sources of knowledge: technology, pedagogy, and content. The core view is that there is no single technological solution that applies for every teacher, every course, or every view of teaching.

Figure; Shows Concept of Technological Pedagogical Content Knowledge

Quality teaching requires developing a fine distinction understanding of the complex relationships between technology, content, and pedagogy, and using this understanding to expand appropriate, context-specific strategies and representations. Fruitful technology integration in teaching needs to consider all three knowledge not in isolation, but quite within the complex relationships. Clearly, separating the three components (content, pedagogy, and technology) in the model / framework is an analytic act and one that is difficult to tease out in practice. In genuineness, these components exist in a state of dynamic equilibrium.

The traditional views of the relationship between the three elements argue that content drives most decisions; the pedagogical goals and technologies to be used follow from a choice of what to teach. Some time it happens in reverse way when introducing new technology. For example; the introduction of the Internet can be seen as an example of a technology whose arrival forced educators to think about core pedagogical issues (Mishra &Peruski, Wallace, 2004). So, in this context, it is the technology that drives the kinds of decisions that we make about content and pedagogy. Viewing any of these components in isolation from the others represents harm to good and conceptual teaching. Teaching and learning with technology exist in

a dynamic transactional relationship (Bruce, 1997) between the three components in this framework; if we change any one of the component, then it cannot be reimburse by other two. For example, teaching biology (content) would drive the kinds of representations to be used (symbolic representations such as taxonomy, or visual representations such as molecular diagrams— that is, the pedagogy) and the technologies used to display and manipulate them. In this example, suitable technologies include special plug-ins that allow students to dynamically view and manipulate molecular representations. On the other hand; if the technology presently accessible would not support the writing of content or representations, it would force an online instructor to develop other ways to represent content and thus bang pedagogy. Likewise, if the content is regarding learning simple facts about the properties of each of the periodic bio-molecular elements, then some pedagogical representations (e.g., essays) are not as eye-catching. Similarly, a course about video might require certain technological tools, like digital video. These interactions go both ways; deciding on a particular technological tool will offer constraints on the representations that can be developed and the course content that can be covered and delivered, which in turn affects the pedagogical process as well.

The integration of a new technology or new medium for teaching suddenly forces us to confront basic educational issues because this new technology or medium reconstructs the dynamic equilibrium among all three elements. For instance, consider faculty members developing online courses for the first time. The relative newness of the online technologies forces these faculty members to deal with all three factors, and the relationships between them, often leading them to ask questions of their pedagogy, something that they may not have done in a long time (Mishra, 2004).

The integration of a new technology is not the similar as introducing another unit to a course. It frequently raises basic questions about content and pedagogy that can overwhelm even instructor is experienced. Thus, TPCK is a form of knowledge that teacher educator as well as teachers fetch to play anytime they teach. Sometimes this may not be understandable, particularly in cases in which standard technologies are being used. But new technologies frequently disrupt the importance, requiring teachers to re-structure not just their comprehending of technology but of all three components.

Necessitate and Significance TPCK for Teacher Education

Paradigm shifts in the field of education in recent decades create a new way of learning which demands technology integration with pedagogy. Implementing the technological pedagogy integration in teaching and learning advancement that managing the changes are highly complex and possibly one of the most challenging tasks for any teacher education institution. ICT has to be infused into pedagogy in such a way that creates a constructive learning environment / virtual learning environment.

- Creating environment of constructive pedagogy
- Creating virtual learning environment
- Creating conceptual learning environment

- Creating interactive learning environment
- Develop the basic understanding of critical pedagogy
- Apprehend the ICT tool in professional development
- Assist teacher educators as well as teacher how to use digital technology in teaching learning process
- Avoid the haphazardly use of limited technology with various contents
- Novelizing the vision of teacher institution to use technology with a range of curriculum
- Act as a model of blended learning as an instructional tool
- Comprehend the role of teacher educator in pedagogy technology integration
- Develop an understanding of various approaches of integrating technology in pedagogy
- Acquaint themselves with various sorts of emerging technologies in classroom interaction and classroom instruction
- Provide conceptual clarity on different modes of learning style which are emerging with increasing emphasis on constructivist approaches in school education and are required for comprehensive assessment within the confines of the school learning.

These are some key explanation of the need and importance of TPCK in the field of teacher education. It is the need of modern age, without technology we cannot think for quality education (NCF-2005). It gives practical procedure and experiences, "how and what technologies to be infuse with specific contents" to teachers as well as teacher educators.

Conclusion

The rapid rate of advancement of these new digital technologies provide opportunity to use of technology for pedagogy of specific content. In the age of technology; most of the people utilize tech-hand held devices. Our children are also attracting towards new edge of technology. In the earlier decade only talked about the pedagogical content knowledge but now it is the level of infusing ICT with pedagogy. Due to infusion of technology with pedagogy, the concept has evolved 'TPCK'. It has three core components as; Technology, Pedagogy and Content. To the interaction of among three components give seven concepts as; TK, PK, CK, TPK, TCK, PCK, and TPCK. So it is called TPCK Framework.

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References

Ball, D. (1996). Teacher learning and mathematics reforms: What we think we know and what we need to learn. Phi Delta Kappan, 77(7), 500–508.

Ball, D. L., & Mc Diarmid, G. W. (1990). The subject matter preparation of teachers. W. R. Houston (Ed.), Handbook of research on teacher education (pp. 437–449). New York: Macmillan.

Brown, A. L. (1992). Design experiments: Theoretical and methodological challenges in creating complex interventions in classroom settings. Journal of the Learning Sciences, 2(2), 141–178.

Bruce, B. C. (1997). Literacy technologies: What stance should we take? Journal of Literacy Research, 29(2), 289–309.

Bruce, B. C., & Hogan, M. C. (1998). The disappearance of technology: Toward an ecological model of literacy. Handbook of literacy and technology: Transformations in a post-typographic world (pp. 269–281).

Cobb, P., Confrey, J., diSessa, A., Lehrer, R., &Schauble, L. (2003). Design experiments in education research. Educational Researcher, 32(1), 9–13.

Gibson, J. J. (1986). The ecological approach to visual perception.

Glaser, R. (1984). Education and thinking: The role of knowledge. American Psychology, 39(2),

Harel, I., & Papert, S. (1990). Software design as a learning environment. Interactive Learning Environments, 1(1), 1–32.

Koehler, M. J., & Mishra, P. (2005).Teachers learning technology by design.Journal of Computing in Teacher Education, 21(3), 94–102.

Koehler, M. J., Mishra, P., & Yahya, K. (2004). Content, pedagogy, and technology: Testing a model of technology integration. Paper presented at the annual meeting of the American Educational Research Association, April 2004, San Diego, CA.

Koehler, M. J., Mishra, P., & Yahya, K. (in press). Tracing the development of teacher knowledge in a design. Seminar; Integrating content, pedagogy, and technology. Computers and Education.

Koehler, M. J., Mishra, P., Hershey, K., & Peruski, L. (2004).With a little help from your students: A new model for faculty development and online course design. Journal of Technology and Teacher Education, 12(1), 25–55.

Koehler, M. J., Mishra, P., Yahya, K., & Yadav, A. (2004). Successful teaching with technology: The complex interplay of content, pedagogy, and technologyCharlottesville, VA: Association for the Advancement of Computing in Education.

Marks, R. (1990). Pedagogical content knowledge: From a mathematical case to a modified conception. Journal of Teacher Education, 41(3), 3–11.

Mishra, P. (1998). Learning complex concepts in chemistry with multiple representations: Theory based design and evaluation of a hypertext for the periodic system of elements. Unpublished doctoral dissertation, University of Illinois at Urbana-Champaign.

Mishra, P. (2005). On becoming a Web site. First Monday, 10 (4), http://firstmonday.org/issues/issue104/mishra/index.html

Mishra, P., & Koehler, M. J. (2003). Not ''what'' but ''how''; Becoming design-wise about educational technology. In Y. Zhao (Ed.), What teachers should know about technology; Perspectives and practices (pp. 99–122). Greenwich, CT; Information Age Publishing.

Mishra, P., & Koehler, M. J. (2006). Designing learning from day one: A first day activity to Technology in the college classroom. Stillwater, OK: New Forums Press.

Mishra, P., Hershey, K., & Cavanaugh, S., (2006).Teachers, learning theories and technology.

Mishra, P., Zhao, Y., & Tan, S. (1999). Unpacking the black box of design: From concept to software. Journal of Computing in Educational Research, 32 (3), 220–238.

Murray, F. B. (Ed.). (1996). The teacher educator's handbook: Building a knowledge base for the preparation of teachers. San Francisco; Jossey Bass.

Neiss, M. L. (2005). Preparing teachers to teach science and mathematics with technology: Developing a technology pedagogical content knowledge. Teaching and Teacher Education, 21(5), 509–523.

Putnam, R. T., & Borko, H., (2000). What do new views of knowledge and thinking have to say about research on teacher learning? Educational Researcher, 29(1), 4–15.

Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. Educational Researcher, 15(2), 4–14.

Shulman, L. S. (1987). Knowledge and teaching: Foundations of the new reform. Harvard Educational Review, 57(1), 1–22.

Spiro, R. J., Coulson, R. L., Feltovich, P. J., & Anderson, D. K., (1988). Cognitive flexibility theory: Advanced knowledge acquisition in ill-structured domains.

Spiro, R. J., Feltovich, P. J., Jacobson, M. J., & Coulson, R. L. (1991). Cognitive flexibility, constructivism, and hypertext: Random access instruction for advanced knowledge acquisition in ill-structured domains. Educational Technology, 31(1), 24–33.

Van Driel, J. H., Verloop, N., & DeVos, W. (1998).Developing science teachers' pedagogical content knowledge. Journal of Research in Science Teaching, 35(6), 673–695.

Veal, W. R., & MaKinster, J. G. (1999). Pedagogical content knowledge taxonomies; Electronic Journal of Science Education, 3(4).Retrieved June 28, 2004 from http://unr.edu/homepage/crowther/ejse/ejsev3n4.html

Vyas, S., & Mishra, P. (2002). The re-design of an after school reading club. In R. Garner, M. Gillingham, & Y. Zhao (Eds.), Hanging out: After-school community based programs for children (pp. 75–93).

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