Guiding teachers in the process of ICT integration: Analysis of three conceptual models

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"Based on internal research, we understand that experiential learning is the most effective method of adult education," Chris Henry, Director of Player Development at the National Football League, said in an interview. "NFL players have grown up using technology, so it makes sense for us to teach using interactive learning tools rather than through a traditional lecture."

The impact on their players' thought processes is what really caught the NFL's attention. Their goal of assisting players to behave in accordance with the integrity of the League resulted in the development of a series of serious games grounded in ethical decision-making. By presenting real-life situations and engaging material, the NFL found the players to be more involved in the learning process and enthusiastic about discussing how they go about making complex decisions. As an organization that wants to stay at the forefront of training and educating players, the NFL finds serious games to be an extremely effective way of preparing their players for ethical decision-making as they transition through their careers.

**Conclusions**

Several unpublished pilot studies, by Boston University, the Army Research Laboratory, and the Walter Reed Army Institute of Research, as well as a growing body of anecdotal evidence, indicate that interactive, immersive decision-making training is effective in positively influencing attitudes and behavior.

An appreciation for the characteristics of today's "digital natives" and an understanding of how the video-game generation interacts with the world has given us new opportunities to increase efficiency and face problems of an ethical or moral nature. As educators, we have the responsibility to use these 21st century tools to empower and encourage responsible and productive workplace behavior. Cutting-edge instructional technology reaches users on their own turf and, we believe, exponentially increases their ability to handle moral dilemmas and face challenges with confidence and conviction.

**References**


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**Guiding Teachers in the Process of ICT Integration**

**Analysis of Three Conceptual Models**

Qiyun Wang

The rapid development of emerging technologies has resulted in the availability of a number of information and communication technologies (ICT) tools. Teachers must have the competency to choose and integrate proper tools into teaching and learning. Over the years, a number of conceptual models have been developed to guide the process of ICT integration. Some of the models look similar on the surface but are different in many aspects. Better discernment of the differences will enable teachers to follow the models more appropriately. This article compares the differences among the TPACK, PST, and CoI models on the key components of content, pedagogy, social interaction, and technology.

**Introduction**

In the new information age, an increasing number of ICT (Information and Communication Technologies) tools are available. They have great potential for teaching and learning, although the majority of the tools were not initially designed for educational purposes. Teachers must have the competency to find and select proper ICT tools for their teaching and learning needs and thereafter effectively apply them in the instructional process.

Over the years, a number of conceptual models have been developed to guide teachers through the process of ICT integration. Some of the models look similar on the surface, such as the TPACK model (Mishra & Koehler, 2006), the generic PST (pedagogy, social interaction, and technology) model (Wang, 2008a), and the Community of Inquiry (CoI) model (Garrison, Anderson, & Archer, 2000). They are all

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associated, either explicitly or implicitly, with the fundamental elements of content, pedagogy, social interaction, and technology, although different terms are used to represent these elements. However, further analysis of these models shows that they are different in purposes and in how they approach these components. Better understanding of differences will enable teachers to follow the models more appropriately and to integrate ICT into the curriculum more effectively.

This article compares the differences among the TPACK, PST, and CoI models on the elements of content, pedagogy, social interaction, and technology.

**Description of the Models**

**The TPACK Model**

The TPACK (or TPCK) model, as shown in Figure 1, illustrates the teacher knowledge required for effective ICT integration. It describes how teachers' understanding of technology, pedagogy, and content knowledge interact to produce effective discipline-based teaching with the support of technologies (Mishra & Koehler, 2006).

![Figure 1. The TPACK model.](image)

Content knowledge is the knowledge about the subject matter that is to be learned or taught. Pedagogical knowledge is knowledge that can be applied to guide student learning, classroom management, and student evaluation. It is deep knowledge about the processes and practices or methods of teaching (Harris, Mishra, & Koehler, 2007). Technological knowledge refers to the teachers’ competencies in ICT tools.

The TPACK model is built on Shulman's idea of PCK (pedagogical content knowledge). However, with the rapid development of ICT, technology becomes a powerful tool for teaching and learning. Possessing technological knowledge therefore becomes an essential competency of teachers (see http://tpack.org).

**The PST Model**

The PST model, as shown in Figure 2, analyzes the affordances of an ICT tool or a technology enhanced learning environment from three perspectives: pedagogical, social, and technological (Wang, 2008a).

The pedagogical affordances refer to those characteristics of the tool that determine if and how a particular learning activity could possibly be implemented within a given educational context. The social affordances refer to the perceived and actual properties of an ICT tool that can promote users' social interaction. The technological affordances refer to the usability of an ICT tool (Norman, 1988). They are concerned with whether the tool allows for the accomplishment of a set of tasks in an efficient and effective way that satisfies users.

Pedagogical and social affordances are the primary factors that influence the effectiveness of learning. However, the technological affordances determine to what extent the pedagogical and social affordances can be realized (Mandell, Sorge, & Russell, 2002). Without sufficient support of technology, many pedagogical and social design activities, such as asynchronous online discussions, are hard to implement. More information about the PST model and its applications can be found in Wang (2008a, 2008b, 2009) and Wang and Woo (2008).

**The Community of Inquiry (CoI) Model**

The CoI model, as shown in Figure 3, states that learning occurs in a community through the interaction of cognitive, social, and teaching presences (Garrison, Anderson, & Archer, 2000). Cognitive presence refers to the extent to which the students in a community of inquiry are able to construct meaning through sustained communication. Social presence is the ability of students to project themselves as 'real' or 'live' people in a community of inquiry. Teaching presence includes subject matter expertise, and design, facilitation, and direction of the learning process for the purpose of achieving learning outcomes.
In a community of inquiry the learning process is composed of and is heavily supported by the interaction of the cognitive, social, and teaching presences. Among these presences, cognitive and teaching presences are critical, as they directly affect the learning content and outcomes. Social presence supports both cognitive and teaching presences through its ability to sustain and support interaction among students and their peers and between students and the teacher. All the presences are maintained by the support of technology in a learning environment (see http://communitiesofinquiry.com/).

**Fundamental Elements of the Models**

The TPACK, PST, and Col models are associated with the fundamental elements of content (what to deliver), pedagogy (how to deliver it), social interaction (how to interact with others), and technology (how to support learning through ICT), although they use different terms. In this section, the differences among the models on these elements are elaborated.

**Content**

The content refers to subject topics, concepts, theories, ideas, or organizational frameworks (Shulman, 1986). It is usually presented in the form of printed learning resources or digital files, such as documents or PDFs.

Content mastery is a necessary condition for good teaching. Teachers must know the subject content in order to teach it well (Corrigan & Haberman, 1990; Shulman, 1986). In the TPACK model, having sufficient content knowledge is one of the necessary prerequisite conditions for teachers.

In the PST model, the content is an important ingredient of a learning environment, even though it is not listed explicitly. In the PST model, the same learning environment or ICT tool can be used to support the learning of different subjects. In addition, the content in a learning environment can be provided by various parties. It may be initially suggested by subject teachers and further added to by students. In this case, both the teacher and students are content contributors in the learning environment.

Content is a core element of a learning community in the Col model. It is related to cognitive and teaching presence. Garrison et al. (2000) state that the cognitive presence occurs between students and content. It is established when students actively interact with the content and reflect on it. Also, the teaching presence is important in a learning community, as it designs the educational experience, scaffolds the learning process, and offers direct instruction on the content.

**Pedagogy**

Pedagogy is the art of teaching. It includes teaching strategies, techniques, or approaches that a teacher uses to deliver instruction, facilitate learning, and assess students’ understanding. It is deep knowledge about the processes and practices or methods of teaching (Harris, Mishra, & Koehler, 2007). Pedagogy is crucial for teaching, as it deals with how to teach subject content in different contexts. Teachers as instructional designers must know a variety of teaching strategies, from which they choose appropriate one(s) for a specific group of students. Pedagogical knowledge hence plays a critical role in the TPACK model.

In the PST model, pedagogy refers to the pedagogical affordances that a learning environment or an ICT tool can offer for achieving specific learning objectives. For instance, if a learning objective is to promote a student’s critical thinking and writing online reflections and is identified as a useful strategy, the learning environment designed or ICT tool chosen must have the pedagogical affordances of enabling the student to write online reflections. In addition, a learning environment should be flexible enough to support various teaching strategies, as teachers may apply different pedagogical strategies in varied contexts (Hativa, Barak, & Simhi, 2001).

In the Col model, pedagogy is relevant to the teaching presence. The primary functions of teaching presence (design of educational experiences, facilitation, and direct instruction) are related to pedagogy. The design of educational experiences requires teachers to have content and pedagogical knowledge. Facilitation and direct instruction are pedagogical strategies that teachers often use to support teaching and learning.

**Social Interaction**

Social activities are common in daily life. People naturally live and work in various communities, in which they turn to others for help when they encounter
problems (Wilson & Lowry, 2000). However, the lack of visual cues and social interaction in an online learning environment is a major hindrance to effective learning, as the students and teachers are at a distance and do not often or ever meet face-to-face. Supporting social interaction between student and peers and between students and the teacher becomes critical for an online learning environment to be effective.

The knowledge of social interaction is not presented explicitly in the TPACK model. However, it is linked to pedagogical and technological knowledge. Pedagogical knowledge requires an understanding of not only cognitive and developmental theories but also social constructivist theories and their applications in learning contexts (Harris, Mishra, & Koehler, 2007). Also social networking media like Facebook provide an avenue for students to share information, discuss ideas, negotiate meanings, and interact with others. Having technological knowledge on social networking media will help teacher designers to better engage students in social learning.

In the PST model, social affordance is considered as one of the key features of a technology-enhanced learning environment or an ICT tool. A learning environment must provide a comfortable space in which the students are willing and able to communicate with one another. Also the learning environment must supply different forms of communication tools, such as asynchronous discussion forums and synchronous chat rooms.

In the Col model, social presence is an outcome of the social affordances. It is the degree to which students and the teacher present themselves socially and emotionally by utilizing the social affordances of the ICT tool. For instance, they may use a video conferencing tool that has rich visual cues to interact intuitively with others, or use emoticons or symbolic displays.

A number of strategies are helpful for establishing social presence in an online learning environment. For instance, Aragon (2003) suggests that course designers create social presence through developing welcome messages, incorporating audio, or structuring collaborative learning activities; instructors and students can maintain social presence by contributing to online discussion, answering e-mail promptly, sharing personal stories and experiences, and using humor and emoticons.

**Technology**

The technological component has become more prominent, for prevailing learning resources are in digital formats, and many learning activities are conducted through the support of a computer. In the TPACK model, technology is a prerequisite knowledge of teacher designers. They need to know various technologies available, their affordances and limitations, and effective ways of using them for specific target learners so that they can effectively integrate technologies into teaching and learning.

In the PST model, technology is a design and support tool. Teachers use ICT tools to design a learning environment. The affordances of the learning environment depend heavily on the affordances of the tools used. The technological affordances support the pedagogical and social affordances in a technology-mediated learning environment. Without proper technologies, some pedagogical and social activities would not be feasible.

In the Col model, technology is more of a mediating tool for learning. Technology supports the learning process so that the cognitive, social, and teaching presences can be established and maintained. However, different media have different potentials to support presences.

**Table 1** summarizes differences among the models on the elements of content, pedagogy, social interaction, and technology.

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**Conclusion**

TPACK, PST, and Col are effective models for guiding teachers through ICT curriculum integration. The TPACK model lists teachers' competencies for integrating ICT into teaching and learning. The competencies include content knowledge, technological knowledge, and pedagogical knowledge. The PST model analyzes the affordances of a designed learning environment from the pedagogical, social, and technological perspectives. The Col model describes the cognitive, social, and teaching presence when students are constructing knowledge while using a learning environment.

These models are related to the fundamental elements of content, pedagogy, social interaction, and technology. However, they have differences with regard to each component. For instance, technology is a necessary skill for teacher designers in the TPACK model, but it is a supporting tool for designing a learning environment in the PST model, and a mediating tool for learning in the Col model. In addition, the roles of teachers and students are different in the models. Teachers are instructional designers in the TPACK model but are instructors or facilitators in the Col and PST models.

Teachers may apply different models in the process of ICT integration. They can follow the TPACK model to identify what knowledge is required before designing a learning environment; use the PST model to investigate if the designed learning environment has the affordances for effective learning (Bower, 2008); or follow the Col model to examine to what extent the expected presence occurs in the learning environment. Understanding the differences among the models can help teachers adopt the models more appropriately and make ICT integration more effective.
Table 1. Differences among models on content, pedagogy, social interaction, and technology.

<table>
<thead>
<tr>
<th></th>
<th>Content</th>
<th>Pedagogy</th>
<th>Social Interaction</th>
<th>Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>TPACK</td>
<td>The content refers to the topics, concept, or theories of a subject. Teacher designers must possess sufficient subject content.</td>
<td>Teacher designers must grasp various pedagogical approaches.</td>
<td>Teacher designers must know social learning theory and apply it to the pedagogy.</td>
<td>Teacher designers must know the technologies available and have usage skills.</td>
</tr>
<tr>
<td>PST</td>
<td>The same learning environment can support content learning of different subjects. The content in a learning environment can be provided by teachers and students.</td>
<td>A learning environment must have sufficient pedagogical affordances.</td>
<td>A learning environment needs to provide a comfortable space.</td>
<td>They know the affordances and limitations of the technologies and the ways of using them for teaching and learning.</td>
</tr>
<tr>
<td>Col</td>
<td>Social presence occurs when students interact with content. Teachers may offer direct instruction on the content.</td>
<td>The community of inquiry must be able to establish and maintain cognitive and teaching presences.</td>
<td>The community of inquiry must support social presence.</td>
<td>Technology is a supporting tool. The ICT tool for the learning environment must be easy to use by students.</td>
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References


