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A cultural look at information and communication technologies in Eastern education

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Abstract The Eastern cultural tradition, together with other social factors, has shaped a group-based, teacher-dominated, and centrally organized pedagogical culture. Drawing upon this cultural perspective, this article reviews the development of information and communication technologies (ICT) in Eastern schools, including ICT planning and management, hardware infrastructures, software resources and services, professional development, and ICT-supported educational practices. It highlights the impact of the pedagogical culture on technology use, as well as the role of technology in pedagogical change. The review suggests a number of critical challenges Eastern educators need to address.

Keywords Asia · Educational change · Educational technology · Information and communication technology · Pedagogical culture

Application of information and communication technologies (ICT) in education is of primary concerns for educators all over the world. However, culture has a strong influence on the design, use, as well as management of information, communication, and learning systems (Wild, 1999). Educators from the Western and Eastern worlds are incorporating and utilizing technologies in different pedagogical cultures for varied purposes. Although the cultural differences are often subtle, seeing the variations can help us understand the contextual constraints and alternative possibilities, and develop a culturally adaptive approach to learning technology innovation. Drawing upon a cultural perspective, this article reflects on the development of ICT in schools in China as well as other Eastern societies, and highlights major challenges that need to be addressed.

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Characterizing the Eastern pedagogical culture

Rooted in Confucian philosophy, the Eastern culture embraces a dialectical and holistic world view, perceiving human beings and nature as one unified entity, considering the interdependent relationship between living things and their environment, the natural and human elements, and their mutual shaping in the construction of meaning (Chen, Mashhadi, Ang, & Harkrider, 1999; Nisbett, 2003). The Eastern tradition seeks harmony, order and well-being in a society by underlining social obligations of individuals and classes, who should behave in line with the social expectations of their social roles, spanning from seniors to young children, from governors to common citizens, for both male and female (Huang, 2002). Hence Easterners are more in favor of collectivism, urging individuals to surrender their own genuine interests for the sake of the well-being of the collectivity, being that a family or a state (Huang, 2002). This cultural tradition, together with other social factors such as economical structures, political systems and population pressures, has shaped a group-based, teacher-dominated, and centrally organized pedagogical culture. These features are elaborated in Fig. 1.

A typical image of an Eastern classroom involves a teacher conducting expositive teaching in front of a large class of well-disciplined students, seated in rows. However, this does not necessarily mean that teachers merely ''feed'' knowledge to learners passively. Qualified teachers tend to model responsible learning behaviors; stimulate learners' thinking and reflection by asking thought-provoking questions; design and use informative assignments to promote understanding and integration of knowledge; use a variety of strategies to adapt to the different needs and backgrounds of learners; and forge personal relationships with students and their families. In parallel, self-engagement and reflection

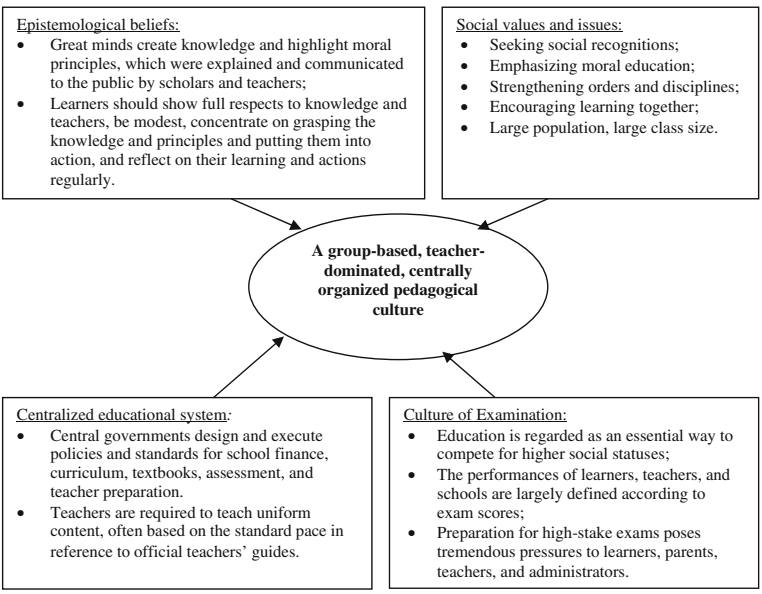

Fig. 1 Basic features of the Eastern pedagogical culture

are conceived as core qualities of a good student (see also, Jin & Cortazzi, 1998; Lee, Liu, & Lee, 2003; Stevenson & Stigler, 1992).

The development of ICT in Eastern schools

Drawing upon the cultural perspective elaborated above, the following makes a comprehensive review of ICT in schools in China and other Eastern societies. In light of a framework for integrating ICT in schools (Zhang, 2002, 2003), the development of ICT in five spheres is reviewed: (a) ICT planning and management; (b) hardware and infrastructures; (c) software and services; (d) human-ware; and (e) educational practices.

Systematic planning and management

In almost every Eastern country, there are special governmental agencies responsible for the planning and management of ICT in schools. In China, it is the system of educational technology centers that governs the planning and development of ICT in K-12 education. This hierarchical system, which aligns with the overall centralized educational administration system, consists of the national center, provincial centers, metropolitan centers, and county centers. In Japan, the Center for Educational Computing was set up to promote the use of computers in schools. It is jointly controlled by the Ministry of Education, Culture, Sports, Science and Technology and the Ministry of Economy, Trade and Industry.

To promote the development of ICT in schools, almost every Eastern country has been implementing their own national plans. The Ministry of Education, China launched the School Connection (or translated as ''Connecting Every School'') Project and the Modern Distance Education Project, as are detailed below. In Singapore, the Masterplan for Information Technology in Education is a blueprint that includes four key dimensions: curriculum and assessment, content and learning resources, physical and technological infrastructure, and human resource development (MOE of Singapore, 1997). In July 2002, the second Masterplan was unveiled, continuing to provide overall direction on how schools should harness ICT based on a holistic strategy (MOE of Singapore, 2002). In Japan, in addition to the establishment of the Fundamental Information Technology Law in 2000, the government established the e-Japan Strategy in 2001 and the e-Japan Strategy II in 2003. Cultivation of ICT personnel and promotion of ICT learning were positioned as important pillars in these strategies (IT Strategic Headquarters, 2001a, 2001b). South Korea implemented its first Master Plan for ICT in Education during 1997–2000, focusing on installations of basic infrastructures (e.g., hardware and software) and professional development of teachers. Its second Master Plan (2001–2005) extended to include ICT capacities of general citizens, focusing on enhancing teachers' capabilities for ICT application and development of ICT-based educational content. The third Master Plan, focusing on adapting education to the information age, in currently enacted (Ministry of Education and Human Resources Development of Korea, 2003). Thailand is implementing its National ICT for Education Master Plan, focusing on the development of ICT infrastructure, professional development and improvement of learning and administration (MOE of Thailand, 2004).

For most of the Eastern societies, there is an urgent need to mobilize and coordinate the forces of the market to provide abundant, high quality, and cost-effective ICT facilities, learning resources, and training services to schools. Another related challenge is to

guarantee adequate educational investments, and meanwhile develop a plausible budget that can support sustainable development and effective application of ICT in schools. A sustainable financial model is particularly needed to accelerate ICT infusion in rural areas that are far behind the digital age.

Hardware infrastructures

Taking advantage of the centralized administration systems, most of the nations launched national projects to promote ICT access in all schools. In 2000, China launched the School Connection Project, dedicated to connect at least 90% of its elementary and secondary schools through computer networks and satellite technologies, and provide all teachers and students with access to high quality online educational resources within five to ten years. To promote ICT in rural schools, the Ministry of Education started The Modern Distance Education Project for Primary and Secondary Schools in the Countryside in 2003 (MOE of China, 2003). It laid out a five-year plan to equip 37,000 junior high schools in rural areas with computer classrooms, 384,000 rural primary schools with digital satellite receiving stations, and 110,000 small-size rural primary schools with DVD players, TV sets, and instructional videodisks. This project aims to help 120,000,000 primary and secondary students benefit from high quality electronic learning resources, and eventually promote deep changes in learning and teaching approaches.

According to the Singaporean Masterplan (MOE of Singapore, 1997, 2002), pupils are provided with access to ICT in all learning areas of the school including computer laboratories, classrooms, libraries and special rooms; and every teachers is given a laptop computer. Japan was surprisingly slow in implementing educational technologies in the K-12 system in the 1990s, but it has been aggressively changing the situation in this century. As per the goals specified in the e-Japan Priority Plan, by 2005, all public schools would have constant high-speed Internet connections; all classrooms were to be connected to the Internet through LAN equipments; and all teachers in public schools were expected to apply ICT in classroom teaching (IT Strategic Headquarters, 2001a, 2001b).

The above initiatives have caused a rapid growth in hardware infrastructures in Eastern countries. For example, the construction of hardware facilities in China has sped up since 2000 (see Table 1). The student/computer ratio improved from 121:1 in 1999 to 27:1 in 2004. The number of schools that were connected to computer networks has also increased rapidly.

However, the construction of hardware and infrastructure is relatively a long-term task for China because of the weak foundation of school infrastructures and limited educational investment, particularly in rural areas and provinces in the western part. There are striking gaps between developed and underdeveloped/rural regions. In the last couple of years,

Table 1 The development of information infrastructures in schools in China Mainland

Year	1999	2000	2001	2002	2004
Number of computers	1,601,000	2,049,000	3,670,000	5,840,000	–
Student/computer ratio	121:1	99:1	55:1	35:1	27:1
Number of networked schools	–	4,600	10,687	26,000	35,000

Note. The above statistics were synthesized from several documents and project reports of the Ministry of Education of China

many big cities (e.g. Shanghai and Beijing) in east China have established metropolitan educational networks, which connect the educational information centers in the central cities, local centers at the county/district level, and LANs in schools. In 2001, the student/computer ratio in Beijing and Shanghai was 15:1 and 17:1 respectively; whereas in underdeveloped provinces like Yunnan, Guizhou and Gansu, this ratio was 186:1, 118:1, and 93:1 respectively.

One of the successful experiences in infrastructure development in Eastern societies is to integrate computer multimedia and networks with other technologies including satellite communications, educational television, VCD/DVD and more traditional technologies. In China, these sorts of integrated solutions are regarded as necessary ways to accommodate the huge differences in regional infrastructures and investments. In Japan, an interesting case is the NHK Educational Television which cooperated with university professors and schoolteachers to initiate a TV and Internet combination model in teaching an environmental education program and a program on comparative food culture. Through television, NHK could transmit the same visual image from a central TV station to all places in the country. Through computers in classrooms connected to the Internet, students could send feedback comments to the TV station, and could collaborate with schools or laboratories in other places (Mizukoshi, Kim, & Lee, 2000).

Educational software and services

Living in a teacher-dominated and knowledge-focused learning culture, Eastern educators, many of whom suffer from a shortage of learning and teaching resources, expect ICT to play a key role as new information sources to enlarge the scope of accessible information, present information in vivid, attractive ways, and deliver drill and practice with immediate feedback. This expectation leads to strong tendency towards content-bound, curriculum-compliant software that can aid their expositive teaching (Zhang, 2002). During the 1980's and 1990's, the dominant types of learning software featured tutorials, drill-and-practice, and computer-assisted tests; while more recently, they have evolved to CD-ROM-based and Web-based multimedia resources or gateways that are in compliance with the framework of the national curriculum. A typical example is the China Basic Education Resources Network (http://www.cbern.gov.cn/index.html), which hosts and sorts learning resources according to grade levels, subject areas, and types (e.g., assessment tools, reading materials, tutorials). The need for these resources is reinforced by the culture of examination that brings about high pressures to students, teachers, and parents. In contrast, in the Western learning culture that is more learner-centered, activity-focused, and individualized, technology is to a larger extent expected to function as content-open productivity tools (e.g. word processing, simulations, explorative environments, graphics, spreadsheet, database, presentation) (Becker, Ravitz, & Wong, 1999).

In future development, Eastern nations face a number challenges, including: (a) Transforming pedagogical models underpinning learning software and resources: More software resources need to be designed to engage learners' higher-order thinking, creative problem solving, and knowledge building discourse; and (b) The stimulation of the e-Learning market: Due to the shortage of educational software, teachers have to spend much energy designing courseware for their own classes, which is usually neither professional nor transferable. According to a recent survey of software use among schoolteachers in Beijing, about 68 percent of the software was made by teachers, often with assistance from technicians; 27 percent was commercial software; with 10 percent

downloaded from free websites (Beijing Basic Education Teaching Research Center, 2003). It is an urgent mission for the governments to attract commercial and public service (e.g. libraries, museums) institutions to take on the role in creating educational resources, and establish related quality control procedures and standards to improve pedagogical design and usability.

Human-ware: professional development and support

Professional development and support is a critical issue for using ICT in education. The lack of knowledge among teachers was perceived to be a major obstacle by school principals in many countries (Pelgrum & Anderson, 1999). This is particularly challenging for many Eastern societies. According to a survey among teachers (excluding ICT teachers) in Beijing, only 57 percent of the teachers could use a word processor; 21 percent could browse the Internet to find usable resources (Beijing Basic Education Teaching Research Center, 2003). The situation is even worse when it comes to the educational use of ICT (Chen, Li, & Zhang, 1996). The government has recognized this challenge, and launched a national project to promote continuing education of elementary and secondary teachers, elevating all teachers' competencies with ICT. In 2003, the Ministry of Education established the National Networked Teacher Education Union, aimed at integrating resources from several prestigious teacher education institutions to provide life-long learning and development opportunities to schoolteachers.

Pertaining to teacher development and support, China has a system of subject-based teaching groups in schools. Teachers teaching the same content subject in a school would work as a teaching group. They communicate their understanding of curriculum standards and textbooks, design instructional activities, share materials, observe and reflect on each other's teaching through a process similar to Japanese lesson study (Lewis, Perry, & Hurd, 2004), and compose tests to evaluate the effectiveness of their classes. When a novice teacher enters a school, he or she is provided with a mentor to guide his/her teaching and professional development. Newcomers in a school have rich opportunities to learn from the old timers' experiences. At higher levels, every school district, city, and province has a Teaching Research Center, the members of which, titled ''teaching researchers,'' work with particular subjects and are responsible for connecting and coordinating teachers to understand new educational policies and important research findings, design high-quality lessons, and share best practices through observations of ''model lessons.'' These systems help formalize strong professional communities of teaching practice within schools and beyond, which have major influences on teachers' teaching activities and professional development. Current professional development programs regarding ICT are based on these systems to help weave ICT into school life. However a downside of this approach is that the professional communities are often dominated by senior teachers, who generally show more resistances to the incorporation of new technologies and changes in mainstream teaching models.

Recently, a growing number of enthusiastic young teachers who are interested in learning innovations seek to create their own communities in the virtual world. The website of Being Education (http://www.being.org.cn) is an example. It was started by a group of enthusiastic educators, providing an online space where teachers share lesson designs, classroom experimentations, reflections, and resources, and participate in professional conversations.

Practical use of ICT in education

The specific roles played by ICT in educational practice can be skeletally summarized as the following:

ICT as a subject

To provide courses about computer/informatics was the earliest attempt when computers were first introduced into schools in China as well as in many other Eastern societies. In recent years, learning and teaching of ICT has been profoundly strengthened due to the recognition of the information age. In October 2001, the Ministry of Education of China developed a policy aimed at popularizing ICT education as one of the compulsory topics in the curriculum in all elementary and secondary schools before 2010. By the end of 2001, 92% of senior high schools had ICT courses. The content of this curriculum covers many main areas in new ICT including system architectures, operation systems, applications, multimedia, and computer networks. It is also dedicated to developing students' information literacy, including capabilities for finding, approaching, evaluating, using, generating, and communicating information, as well as related social and ethical issues in a broader sense (Zhang, 2002). Task- and project-based, application-orientated strategies are increasingly used in ICT learning and teaching. For example, students learn the basics of word processing by engaging in a poster design task. In Japan, among junior high schools, there had been a selective course called ''Elementary Information,'' which was redesigned as a compulsory course under the name of ''Information and Computers'' in 2002. In senior high schools, Information Technology was introduced into the curriculum in 2003. Although the subject itself is compulsory, each school may choose among three courses: course option #1 emphasizing the ability to make use of information, #2 highlighting scientific understanding of information theory and network systems, and #3 focusing on participation in the information society (Mizukoshi et al., 2000).

Use ICT to strengthen expositive teaching

As noted earlier, Eastern societies have a group-based, teacher-dominated, centrally organized pedagogical culture. Expository teaching is the most frequently used method, particularly in curriculum components where the primary objective is the students' mastery of standardized facts, concepts, rules and procedures, or when the objects of learning and/or resources available are thought to be too complex to be understood by the learners (Law et al., 2000). Within this cultural background, computers have been used to support expository teaching in large classes, including after-school assignments. In the hands of good teachers, technology tools are used to deliver vivid demonstrations and presentations, support extended learning experiences, and as a form of drill and practice with immediate feedback. A combination of teacher expertise and technology helps engage students in an increased level of reflection. For example, a primary mathematics teacher in Beijing uses quite common tutorial and drill-and-practice courseware to aid teaching of word problem solving. She intentionally prompts her students to think ahead of the tutorial program by asking them to ''predict'' what the computer will explain next; and promotes students' reflection on the underlying mathematical principles and relationships by clustering a series of word problems in drill-and-practice courseware as interrelated variations.

Increase learning opportunities through distance learning

Almost all the Eastern societies face a pressure of greatly increased population numbers. Many of them are highly motivated to use ICT to increase the participation ratio of education, especially higher education, through distance learning programs. China launched the Modern Distance Education Project in 1999 aimed at promoting lifelong learning. So far, more than sixty prestigious universities have been involved in this project to establish Web-Based Education Schools, offering distance-learning programs spanning vocational training and undergraduate and graduate education. The Vietnamese government has also been encouraging more flexible modes of delivery in higher education. In the early 1990's, enrolments in informal and flexibly delivered courses (including distance education and part-time studies) in Vietnamese higher education institutions rose much faster than enrolments in full-time, on-campus programs. There were around 50,000 students enrolled in distance education at the university level in Vietnam in the late 1990s (Le & Tran, 1999) and this number has been growing rapidly. Distance learning is also chosen as a way to improve learning opportunities in Japan, which had 250,000 to 300,000 distance learners in 2000 (Albrechtsen, Mariger, & Parker, 2001). After the development in the past years, distance learning in Eastern societies is undergoing an evolution from a focus on providing educational opportunities to those who were unable to attend a traditional university to providing life-long learning opportunities to those who have already earned a diploma or degree (Jung, 2000).

Along with the rapid development of online distance learning, great concerns have been raised about its quality and effectiveness. In a study, my colleagues and I conducted a survey on learners' utilizations and experiences of various formats of distance learning resources composing the sub-system of course materials and the sub-system of learning support and services. One of the main findings was the unbalanced development between the two sub-systems: the educational institution, a prestigious university that had played a leading role in online distance learning in China, focused heavily on the development of course packages, while it mostly neglected the importance of providing interactive, in-time learning support and services. It was inconvenient for the learners to consult their instructors for help and guidance; The local teaching assistants had not functioned as expected in promoting learners' learning activities; more than half of the learners reported that their instructors could not grade and return their assignments in time, and seldom gave them meaningful learning advice (Zhang, Sun, Wang, & Wu, 2003). As one the anonymous reviewers commented, the disparity between online material design and learning support services seems to be a pervasive phenomenon. It is an urgent task for distance learning institutions to establish more powerful, flexible, and effective learning support and services in order to ensure the quality and credibility of distance learning.

Strive for innovative practice by harnessing the potentials of ICT

On the spectrum of instructivism vs. constructivism, the Eastern learning culture locates nearer to the extreme of instructivist philosophy than the Western learning culture. Holding a belief that education should pass on what great minds have already discovered, Eastern schools have historically emphasized knowledge acquisition. This has generally resulted in better student learning of content, greater focus on academics, greater school accountability. However, it also leads to learners' weakness in self-directed learning abilities, creativity, and critical thinking skills. Facing the challenges of the knowledge society,

almost all the Eastern nations are dedicated to promoting the use of educational technology in a way that can develop students' problem solving capabilities, lifelong learning skills, and creativity and inventiveness—personal qualities that are essential to future national economic development (see also Ziguras, 2001). Bringing the Eastern pedagogical tradition into the Knowledge Age, and evolving a more democratic, creative learning culture based on it represent a major challenge.

In the late 1990's, China adopted a new national policy of Quality Education to shift schools' focus from competitive examinations to the substantial development of all students. An important action taken under this policy was the development of the New National Curriculum for Basic Education, committed to updating and restructuring curriculum content, and promoting deep change in learning and teaching approaches to engage students more deeply in active and creative learning, authentic problem solving, and collaboration. ICT is central to the focus of this reform both as an independent subject and a learning and teaching tool integrated across the curricula.

Technology-supported innovative learning is of focal interests to other Eastern nations as well. The Singaporean Masterplan sets out strategies for the use of educational technology to encourage active and self-directed learning. In Malaysia, ICT is expected to promote exploratory, discovery learning, constantly engaging students in finding, organizing, analyzing, and applying information in creative ways (Ziguras, 2001).

Driven by these educational reforms, new pedagogical practices are emerging in schools. For example, a large-scale survey indicated that the new curriculum reform in China had caused noticeable changes in classrooms: Students have more chances to participate in discussions, hands-on and problem solving activities, information search and communication, and self-evaluation; teachers were perceived to be more encouraging, open, and communicative (Ma & Tang, 2003). Nevertheless, oftentimes, students are only actively involved in completion of concrete, hands-on tasks and activities, but not in transformative discourse, deepening understanding, and higher-order thinking that lie at the heart of authentic inquiry (Zhang & Sun, 2005). For the reforms to go deeper, it is important to enculture students into knowledge building communities where they productively work with knowledge and ideas, with continual idea advancement instead of hands-on tasks at the center (Scardamalia & Bereiter, 1994).

The above summarizes the different purposes ICT serve in schools. It needs to be recognized that the overall rate of ICT use in teaching and learning is still far too low, even in regions that have good ICT facilities. According to a recent survey among schoolteachers (excluding ICT teachers) in Beijing, where the student/computer ratio was 15:1, primary and secondary teachers spent only 24 minutes and 38 minutes per week respectively in using computers in schools. Most of the time was spent in writing teaching notes and lesson plans, instead of on actual classroom processes. Eighty-seven percent of these teachers never used computers in their classroom (Beijing Basic Education Teaching Research Center, 2003). In an examination-oriented educational culture, the average achievement of a class on public exams and the rate of students who are able to enter a higher level of education are often regarded as the most-weighted factor in teacher evaluation. This is disadvantageous to those visionary teachers because the examinations are often at odds with innovative pedagogical approaches. New social ecologies that encourage ICT use (Zhao & Frank, 2003) and educational change need to be evolved in schools, and this will take a long time.

Cultural interactions underpinning ICT application

For Eastern societies, ICT integrated with new learning approaches (e.g., learner-centered, problem-based, self-directed learning) represent a new pedagogical culture, which is often ''imported'' from Western countries together with the epistemological beliefs and social values it is rooted in. The incorporation of new technologies as cultural artifacts often triggers deep cultural interactions, which involve both ''assimilation'' and ''accommodation,'' in much the same ways as how one's existing cognitive structure interacts with new stimuli from the environment, leading to his/her cognitive development (Piaget, 1972).

On one hand, educational practitioners in a culture tend to assimilate new technologies by, although unconsciously sometimes, selecting technologies that fit the existing pedagogical culture, designing them in familiar patterns, and adapting them in line with the features of the local educational system. Such assimilation processes can be seen through the specific strategies for ICT development and use adopted by Eastern societies reviewed above (e.g., centralized management and planning, community-based professional development, selection and use of learning software). I want to further elaborate this process using two examples.

The first example is the development of distance learning in China. Unlike the individualized, self-paced learning models and materials adopted by distance learning institutions in UK and other Western nations, distance learning in China has been to a great extent localized as group-based distance lecturing (see also, Tu & Twu, 2002; Zhu, Gu, & Wang, 2003), which organizes learners into classes at local learning centers to attend lectures. These are delivered through television, VCD/DVD, satellite-based digital video broadcasting, videoconferencing systems, or Internet-based video/audio streams synchronized with PowerPoint slides. Interestingly this approach seems to be in accordance with the expectation of Eastern learners. According to a survey among distance learners in undergraduate and graduate programs, 85 percent of the learners agreed that it is important to study in a classroom together with their classmates, and a majority of them stressed the importance of face-to-face interactions with teachers (Zhang, Wu, & Li, 2003). This result is consistent with observations of students in Korea (Jung, 2000) and South East Asia (e.g., Malaysia) (Ziguras, 2001).

In the second example, an earlier international comparison study showed that more than 50% of the middle schools in Hong Kong had digital projectors or LCD display boards, much higher than the average ratio in other regions. This reflects the needs of the schools to assimilate ICT tools in service of teacher-directed demonstrations and lectures in classroom (Law, Yuen, Ki, Li, & Lee, 1999).

On the other hand, importing a ''foreign'' artifact often involves the intake of the cultural values and practices associated with it. Confronted with new technological artifacts that embody alternative pedagogical cultures, teachers will be confronted with inconsistencies and conflicts, and need to make necessary changes to accommodate the new artifacts. In a case study, Lin (2001) documented how an educational tool from the United States, The Adventures of Jasper Woodbury (Cognition Technology Group at Vanderbilt, 1992), triggered the reflective adaptation of a Hong Kong teacher. When this teacher first introduced Jasper in her classroom, she tried to maintain the routine structure of the lessons. However, this artifact afforded different patterns of interaction and disrupted the previously regimented classroom. The students seized on the open-ended structure of Jasper, and rejected the teacher's attempts to follow the routine. This raised

challenges to the teacher and caused intense self-questioning and reflections. She had to make decisions about whether to change her practice in response to the artifact and what those changes would mean for her identity as a teacher.

The effective utilizations of new technologies in schools entail both assimilation and accommodation between the existing and novel pedagogical cultures. Through assimilation, educators build deep connections between new technologies and ongoing school practices in their local contexts, fostering the historical descending of their pedagogical culture. Through accommodation, new technologies play out their effects in causing deep educational change, shaping schools towards a new paradigm to which the technologies have greater affordances. However, too often we observe the disparity between these two: educational practitioners tend to choose and assimilate ''domesticated technologies'' that do not affect life in classroom much, hence reject the opportunities for substantial accommodations to take place. A paradox thus becomes evident: The more a technology, and its usages, fits with the prevailing educational philosophy and its pedagogical application, the more it is welcome and embraced, but the less of an impact it has (Salomon & Almog, 1998). This might be one of the most important reasons why the expected dramatic and profound impacts of new technologies (e.g., computer-assisted instruction, multimedia, and the Internet) are so hard to fulfill.

There might be a number of factors preventing educators from modifying their practice to accommodate new technologies. Among them are the risks of facing conflicts with robust educational tradition and administrative systems, which are often not in favor of technological innovations. For example, in the current curriculum reform in China, teachers experience deep conflicts and discrepancies between technology-supported innovative pedagogies and many aspects of the educational system. Wide concerns arise regarding the challenges of facilitating inquiry activities in large, crowded classes and the weakness of inquiry- and activity-based learning in preparing students for high-stake public examinations. As a result, some teachers choose to only use new technologies and design participative, inquiry-oriented classes for events like inspections, but maintain traditional teaching practices and strategies within their daily routine. Students are even asked to use old version textbooks as supplements. Sustaining deep pedagogical change requires coherent and connected planning of reform programs (Fullan, 2001) and aligning technological initiatives with related changes in school objectives (Demetriadis et al., 2003), assessment, and leadership (Fishman, Marx, Blumenfeld, & Krajcik, 2004). The change process needs to additionally engage teachers' agency and support their efforts to adapt technology to their diverse contexts and improve their practice based on their reflective reconciliation of various factors and demands in education (Zhang, 2007).

Conclusions

The Eastern cultural tradition, together with other social factors, has shaped a group-based, teacher-dominated, and centrally organized pedagogical culture. This article reviews the development of ICT in Eastern schools, including issues of ICT planning and management, hardware infrastructures, software resources and services, professional development, and ICT-supported educational practice, with a special focus on the impact of the pedagogical culture on technology design and use. The review suggests a number of challenges that Eastern educators need to deal with, including: (a) diffusing ICT to the practices of all teachers in all schools in both developed and underdeveloped regions; (b) developing partnerships between schools, research institutions, public organizations, and business

sectors to build cost-effective ICT infrastructures and create pedagogically-sound software resources; (c) re-shaping professional communities that are willing to experiment with new ideas and technologies, in service of reflective and continual improvement; and (d) orchestrating ICT into systemic efforts for school change, contributing to the evolution of the Eastern learning culture into the Knowledge Age. Further research is needed to achieve a deeper understanding of the cultural interactions underpinning ICT application, which can help us making sense of educators' reactions to ICT in different school contexts and aligning efforts for deep and lasting change.

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