Three Waves of Teacher Education and Development: Paradigm Shift in Applying ICT

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This keynote speech aims to report how the worldwide efforts of teacher education and development, echoing the movements of various education reforms, are experiencing three waves with different paradigms for conceptualizing teacher role, teacher effectiveness and teacher education practice. With the characteristics of these three waves with different emphasis on teachers' internal effectiveness, interface effectiveness and future effectiveness, the implications for paradigm shift in applying information and communication technology (ICT) in teacher education and development are discussed. It is hoped that the presented waves of teacher education and related paradigm shifts in using ICT would provide a comprehensive typology for understanding the complex and dynamic relationships among education reform, teacher education and application of ICT and for formulating effective strategies for professional development and practice with ICT for the 3rd wave education in the new century.

Introduction

The impacts of globalization, international competitions, and local social-political demands have induced rapid changes in many countries in different parts of the world since the turn of new millennium. In such an era of fast transformation, education reform inevitably becomes necessary and teachers and their schools have to face numerous new problems, uncertainties, and challenges rising from their internal and external environments. In addition to teaching, teachers are often required to take up expanded roles and responsibilities related to school management, curriculum planning and development, new teacher mentoring, staff development, school-based action projects, and working with parents and outside leaders and professionals (Boles & Troven, 1996; Cheng, Chow & Tsui, 2001; Murphy, 1995; Fessler & Ungaretti, 1994).

In such a rapidly changing context, how teachers can be empowered and prepared to take up new roles and perform teaching effectively to meet the challenges and new expectations from education reforms is a crucial concern in policy making, reform and practice of teacher education and professional development in the Asia-Pacific region and its counter parts (Cheng, Chow & Mok, in press). Particularly in a context of growing emphasis of applying and integrating information and communication technology (ICT) in education, a key issue confronting educators and leaders is how ICT should be applied in teacher education and development to enhance professional

learning and support teachers effectively to perform new roles and face up to new challenges in education for the future.

According to Cheng (2001a; 2002a; 2003a, b, c, d), the world-wide education reforms are experiencing three waves since the 1970s. These waves of reforms are mainly based on different paradigms and theories of education effectiveness, and they result in employing different strategies and approaches to changing schools and education. In general, the first wave emphasizes on *internal effectiveness* with the focus on internal process improvement through external intervention or input approach. The second wave pursues the *interface effectiveness* in terms of school-based management, quality assurance, accountability and stakeholders' satisfaction. In facing the challenges of globalization, information technology, and knowledge-driven economy in the new century, the third wave is moving towards pursuit of *future effectiveness*.

Teachers are the key actors to implement educational practice and educational reform. In each wave, how teachers are effectively prepared responsive to the waves of education reforms inevitably becomes an important concern in the program implementation, policy formulation, public debate and research in teacher education and development. In particular, how the conception and practice of teacher education at different levels (including individual, site and system levels) should be changed with the support of ICT to meet the challenges of reforms is a crucial issue in ongoing policy debate, effort and research for ensuring teacher effectiveness.

This keynote speech aims to report how the worldwide efforts of teacher education and development, echoing the movements of various education reforms, are also experiencing three waves with different paradigms for conceptualizing teacher role, teaching effectiveness and practice of teacher education and development at different levels of education system. With the characteristics of these three waves, the speech highlights the implications for paradigm shift in applying ICT in teacher education and development.

It is hoped that the presented waves of teacher education and related paradigm shifts in using ICT would provide a comprehensive typology for understanding the complex and dynamic relationships among the major trends of education reform, teacher education and application of ICT and formulating effective strategies for professional development and practice with ICT for the 3rd wave education in the new century.

First Wave: Teacher Internal Effectiveness

Assuming goals and objectives of education are clear and consensus to all, the first wave of school reforms and initiatives since the 1970s focuses mainly on *internal effectiveness*, with efforts made to improve internal performance particularly the methods and processes of teaching and learning in educational institutions. Many changes are government-directed and top-down, with the aim to improve school

arrangements and education practices, thus enhancing their effectiveness in achieving the goals and objectives planned at either the site level or the system level. Improvement of teacher and student performance up to identified standards obviously had been a popular and important target for educational reform.

Following the emphasis on internal school effectiveness, the discussion of teacher education in the first wave focuses heavily on preparing teachers to ensure their effectiveness for internal school processes particularly teaching and learning. In this line of thinking, ensuring teacher effectiveness mainly refers to the teacher's achievement of planned education goals particularly in terms of students' education outcomes. The higher achievement in planned education goals implies the higher teacher effectiveness. Therefore, efforts of teacher education often focuses on developing or improving teachers' competence and performance to achieve the planned school goals often in terms of students' learning performances and other school outcomes (Cheng, 1997a). To a great extent, *teacher education of the first wave aims to ensure teacher internal effectiveness*.

First Wave Models of Teacher Internal Effectiveness

Cheng and Tsui (1999) proposed seven models for understanding and ensuring teacher effectiveness. Each model represents an important perspective that describes and emphasizes certain aspects or factors that are closely related to teachers' performance and contribution in a school organizational context. As shown in Table 1, the goal and task model, the working process model, and the absence of problems model are the first-wave models with focus mainly on teachers' internal and personal improvement for *teacher internal effectiveness*.

The Goal and Task Model. The goal and task model is very often used in assessment of teacher effectiveness in school. It is generally believed that teachers have their planned goals and assigned tasks and they should make their best efforts to accomplish them. It assumes that a teacher is effective if he / she can accomplish the planned goals and assigned tasks in compliance with school goals. The extent to which the goals and tasks have been accomplished is often perceived as the measure of teacher effectiveness. The typical examples of teacher effectiveness indicators include achievement of teaching objectives, fulfillment of job specifications and performance standards, student learning outcomes (such as academic achievements in public examinations), and etc.

Therefore, teacher education and staff development should help teachers:

- to understand education aims, school goals, standards and benchmarks of professional practices;
- to have the competence to set clear, meaningful, long-term and short-term goals and standards for their teaching and professional practices;
- to communicate these goals and standards to students, colleagues, and parents and form collective forces to achieve them ;
- to have the knowledge, skills, and commitment to achieve these goals and standards; and

- to have competence to monitor and assess whether they have achieved stated goals or conformed to given professional standards.

The Working Process Model. In a system perspective, teachers' efforts are transformed to educational outcomes through their working processes. The working process model assumes that smooth teaching and working processes enable teachers to perform their teaching and assigned tasks effectively resulting in valuable and fruitful student learning outcomes or school achievements. Therefore teachers are seen as effective if they can ensure the quality of teaching and working process in discharging their duties. The important areas for monitoring teacher effectiveness are in terms of the characteristics of working process, including teaching style, teachers' job attitudes and behaviors, relationships with students and colleagues, classroom management, contribution to decision making and school planning, and etc. According to this model, teacher education and development aim at helping teachers:

- to understand the meaning and contribution of educational practice or working process to the achievements of school outcomes;
- to have the competence and commitment to ensure the quality of their working process;
- to have the relevant knowledge and skills to design and strengthen the teaching process which encourages students' active participation in learning, team work, and trusting relationship;
- to monitor and evaluate the strengths and weaknesses of their working and teaching activities; and
- to develop a positive classroom culture and a high quality environment for students' learning.

The Absence of Problems Model. Since there is often lack of a clear conception and criteria for teacher effectiveness, it is often easier to identify the weaknesses, problems, and defects (indicators of ineffectiveness) than the strengths of a teacher (indicators of effectiveness). The absence of problems model assumes that teachers are basically effective if there is absence of problems, troubles, defects, weaknesses, and misbehaviors when they are discharging their duties. Particularly, when assessing new and inexperienced teachers, the main objective would be to identify the problems and weaknesses for improvement, rather than excellence in performance. Therefore, teacher education should help teachers:

- to be aware of the existing or potential problems and defects that affect their practices;
- to have the knowledge and skills to monitor, identify, evaluate, and prevent different types of problems existing in their working and teaching processes;
- to have positive attitudes towards problem identification and solving in their work;

Table 1: 1st Wave Models of Teacher Internal Effectiveness

Model of Teacher Effectiveness	Conception of Teacher Internal Effectiveness	Teacher Education and Development for enabling teachers to….	Implications for Applying ICT in Teacher Education and Development
Goal and Task Model	• Achievement of planned goals and assigned tasks in work or teaching	• to understand education aims, school goals, & professional standards; • to have the competence to set goals and standards for their practices; • to have the knowledge, skills, and commitment to achieve these goals and standards; and • to have competence to monitor and assess the achievements of goals & standards.	The use of ICT in teacher education is limited, mainly on improving the efficiency of delivery of planned curriculum and professional competence, particularly for: • achieving the given goals and standards, • improving the internal process and environment of teacher work, and • avoiding potential problems and defects in teaching and professional work Whether ICT can be used to facilitate paradigm shift in professional learning and teacher education is not a major concern.
Working Process Model	• Maintenance of smooth teaching and working processes	• to understand the contribution of educational practice to school outcomes; • to have the competence and commitment to ensure the quality of their working process; • to have the knowledge and skills to design teaching process for students' active learning; • to monitor and evaluate their working activities; and • to develop a positive classroom culture and a high quality environment for students' learning.	
Absence of Problems Model	• Absence of problems and defects in their teaching and work	• to be aware of the existing or potential problems and defects that affect their practices; • to have the knowledge and skills to monitor, identify, evaluate, and prevent problems existing in their work and teaching; and • to have positive attitudes towards problem identification and solving in their work;	

Applying ICT in the First Wave

The use of ICT in teacher education is often limited and superficial, mainly on improving the efficiency of delivery of planned curriculum and professional competence, particularly for achieving the given goals and standards, improving the internal process and environment of teacher work, and avoiding potential problems and defects in teaching and professional work. To a great extent, ICT is mainly used as an efficient tool of storage, transfer and delivery of professional knowledge and skills from teacher educators or central sources to individual teacher learners. Whether ICT can be used to facilitate paradigm shift in professional learning and teacher education is not a major concern in the first wave.

Second Wave: Teacher Interface Effectiveness

Responding to concerns with the accountability to the public and stakeholders' expectation in the 1990s, the second wave of education reform emphasizes *interface effectiveness* in terms of education quality, stakeholders' satisfaction, and market competitiveness, with most policy efforts aim to ensure quality and accountability to the internal and external stakeholders (Evans, 1999; Goertz & Duffy, 2001; Coulson, 1999; Headington, 2000; Mahony & Hextall, 2000; Heller, 2001). Quality assurance, school monitoring and review, parental choice, student coupon, parental and community involvement in governance, school charter, and performance-based funding are some typical examples of measures to pursue and enhance effectiveness at the interface

between the educational institution and the community (Cheng & Townsend, 2000). How to improve the existing structures, organizations, and practices in education at different levels to meet stakeholders' needs and expectations, is a major concern in the second wave of reforms.

Second Wave Models for Teacher Interface Effectiveness

Similar with the second wave models of school effectiveness, the resource utilization model, the school stakeholder satisfaction model, the accountability model, and the continuous learning model in Table 2 are the second-wave models of teacher effectiveness with emphasis on managing and handling the interface between teachers themselves and their working environment. These models pursue *teacher interface effectiveness*.

The Resource Utilization Model. Facing the pressure of diverse expectations of multiple school constituencies and the challenges from the changing educational environment, teachers are often required to accomplish different tasks with diverse goals and objectives within a tight time frame. Resources (e.g. available time, high quality teaching materials, equipment, facilities, expert and technical support, new teaching methods, etc) often become a critical factor in accomplishing the assigned tasks and meeting diverse goals and expectations. Therefore, teachers are deemed effective if they can maximize the use of allocated resources in their work processes and procure the needed support to overcome difficulties and accomplish different tasks even with diverse and competing goals. Therefore, teacher education aims at helping teachers:

- to understand the nature & importance of resource-input to working and teaching processes and achieving planned tasks and education outcomes
- to have the professional competence to procure and manage scarce resources and maximize their use for teaching and school work; and
- to have social power and skills to win the support and resources from colleagues, parents or the community for their work.

The School Constituencies Satisfaction Model. This model is now attracting more attention of school leaders and practitioners in using it to assess teacher effectiveness. The reasons are twofold. First, in the recent school reform movements, there is a strong emphasis on educational quality. The concept of quality is closely related to the satisfaction of clients' needs or expectations. Second, the objective measurement of task achievement, job performance, or working process is often technically difficult and conceptually controversial. Therefore, the satisfaction of school's strategic constituencies (e.g. principals, school supervisors, members of school management council, the officers or inspectors of Education Department, leaders of parents association, etc.) is often used as the critical element to assess teacher effectiveness. Teachers are effective if the major school constituencies are at least minimally satisfied with their performance. Therefore teacher education programs should help teachers:

- to understand how key school constituencies can influence the goals, inputs, processes, and outcomes of their work and teaching;

- to identify and understand what are the major expectations and needs of powerful school constituencies;
- to have professional commitment, knowledge and skills to perform tasks that can meet the needs and expectations of major constituencies effectively;
- to be aware of the changes in needs and expectations of different constituencies particularly students and parents and have the ability to adapt to these changes; and
- to have the necessary social skills to work with various school constituencies.

Table 2: 2nd Wave Models of Teacher Interface Effectiveness

Model of Teacher Effectiveness	Conception of Teacher Interface Effectiveness	Teacher Education and Development for enabling teachers to….	ICT in Teacher Education and Development
Resource Utilization Model	• Utilization of allocated resources and acquisition of inputs for working processes, completing tasks and achieving outcomes	• to understand the nature & importance of resource-input to working and teaching processes and achieving planned tasks and education outcomes • to have the professional competence to procure and manage scarce resources and maximize their use for teaching and school work; and • to have social power and skills to win the support and resources from colleagues, parents or the community for their work.	The use of ICT in teacher education is limited, mainly on delivery of the necessary knowledge and skills for teacher interface effectiveness, particularly competence and skills on: • effective acquisition and use of resources for work, • satisfying the key stakeholders' expectations and needs, • showing accountable to the public and stakeholders, and • adapting to challenges from the changing environment Whether ICT can be used to facilitate paradigm shift in professional learning and teacher education is not a major concern.
School Constituencies Satisfaction Model	• Satisfaction of important school constituencies' expectations and demands	• to understand how key school constituencies can influence the goals, inputs, processes, and outcomes of their work and teaching; • to identify and understand what are the major expectations and needs of powerful school constituencies; • to have professional commitment, knowledge and skills to perform tasks that can meet the needs and expectations of major constituencies effectively; • to be aware of the changes in needs and expectations of different constituencies particularly students and parents and have the ability to adapt to these changes; and • to have sufficient social skills to work with different school constituencies.	
Accountability Model	• Demonstrating evidence of their accountability	• to understand the significance of their work related to community services, public relations, school image and accountability to perceptions of the public; • to have the professional ethics, knowledge and skills to ensure accountability in practice and build up professional image and reputation during working process; • to have competence to develop internal and external social networks to support their professional practice and status; and • to maintain a good relationship with various stakeholders in the community. •	
Continuous Learning Model	• Adaptation to the challenges from changing environment including external and internal teaching contexts.	• to be aware of the impacts of environmental changes, societal developments, policy trends, and community needs on their work and teaching; • to have techniques to collect relevant information and perform the SWOT (strengths, weaknesses, opportunities, and threats) analysis of their professional situation and work; • to have the professional competence to adapt their working process and performance to the changing needs and expectations of students, parents and the community according to the results of environmental analysis; • to identify the gaps between theory and practice and change their operations or governing values; and • to have regular monitoring and evaluation to provide feedback information for their continuous improvement and professional learning.	

The Accountability Model. In pursuit of an open and democratic society, the public has now a greater concern with schools' performance and accountability because of the large investment into schools. Schools and teachers are required to provide educational services "worth for money" and they should be more accountable to students, parents, and other major school constituencies. The accountability model focuses on teachers' accountability and reputation in assessing teacher effectiveness. This means that teachers are required to demonstrate their competence and responsibility in discharging teaching and school activities and making related professional decisions. The current emphasis on accountability and quality assurance in educational reforms in both Western and Eastern societies seems to support the importance of the accountability model to understanding, assessing and monitoring teacher effectiveness. To be responsible and accountable, teachers should provide more information about their work standards, performance and consequences to school constituencies. With this model, teacher education should help teachers:

- to understand the significance of their work related to community services, public relations, school image and accountability to perceptions of the public;
- to have the professional ethics, knowledge and skills to ensure accountability and build up professional image and reputation during working process;
- to have competence to develop internal and external social networks to support their professional practice and status; and
- to maintain a good relationship with various stakeholders in the community.

The Continuous Learning Model. Currently, the changing educational environment is producing great impacts on nearly every teacher. From the perspectives of the satisfaction model and the accountability model, teachers should meet the changing requirements and needs of multiple school constituencies and should be accountable to them. From the perspectives of the working process model and the goal and task model, teachers are required to improve the teaching and working process continuously in achieving the assigned tasks effectively in a rapidly changing teaching environment. It seems that teachers should adapt to the external and internal changes, cope with the different challenges, meet the diverse expectations, and develop themselves through continuous learning if they want to be effective.

The continuous learning model assumes that impacts of environmental changes are inevitable and therefore, a teacher is effective if he/ she can learn how to make improvement and adaptation to his/ her environment (Senge, 1990; Fullan, 1993). The model considers teacher effectiveness as a dynamic concept involving continuous improvement and development. Therefore, programmes of teacher education and development should help teachers:

- to be aware of the impacts of environmental changes, societal developments, policy trends, and community needs on their work and teaching;

- to have techniques to collect relevant information and perform the SWOT (strengths, weaknesses, opportunities, and threats) analysis of their professional situation and work;
- to have the professional competence to adapt their working process and performance to the changing needs and expectations of students, parents and the community according to the results of environmental analysis;
- to identify the gaps between theory and practice and change their operations or governing values; and
- to have regular monitoring and evaluation to provide feedback information for their continuous improvement and professional learning.

Applying ICT in the Second Wave

From the above 2nd wave models of teacher education, it seems that the use of ICT in teacher education is also limited as in the first wave, mainly on enhancing the delivery of the necessary knowledge and professional skills for teacher interface effectiveness, particularly technical competence on effective acquisition and use of resources for work, satisfying the key stakeholders' expectations and needs, showing accountable to the public and stakeholders, and adapting to challenges from the changing environment. Whether ICT can be used to facilitate paradigm shift in professional learning or build up a locally and globally networked environment for teacher education may not a major concern.

Third Wave: Teacher Future Effectiveness

At the turn of the new century, people began to doubt whether the second wave of education reforms can meet the challenges in a new era of globalization, information technology, and new economy. Even if the existing stakeholders may be satisfied with the quality of education services and the schools are accountable to the community, education may be still ineffective or "useless" for our new generations in the new millennium as the aims and outcomes of education are once found nothing to do with the future needs in such a rapidly changing environment.

Particularly when knowledge-driven economy and information technology are strongly emphasized in the new millennium, many people urge paradigm shift in learning and teaching and demand reforming the aims, content, practice, and management of education at different levels to ensure their relevance to the future (Cheng, 2000a, b; Daun, 2001; Burbules & Torres, 2000; Stromquist & Monkman, 2000). The emerging third wave of education reforms emphasizes strongly *future effectiveness* in terms of relevance to the new education functions in the new century as well as relevance to the new paradigm of education concerning contextualized multiple intelligences, globalization, localization and individualization (Cheng, 2002a). The pursuit of new vision and aims at different levels of education, life-long learning, global networking, international outlook, and use of information and technological are just some emerging evidences of the third wave (Cheng, 2001c).

Paradigm Shift in Learning

The discussion of teacher effectiveness and teacher education for the third wave can be based on the following questions:

(1) What paradigm shift in learning is being pursued in the new century particularly in the context of globalization?

(2) What implications can be drawn for the roles of teacher and teaching in implementing the third wave reforms and the new paradigm of learning?

According to Cheng (2002a, b), the paradigm of education should be shifted from the *Traditional Site-bounded Paradigm* to *a New Triplization Paradigm*. The new paradigm emphasizes the development of students' contextualized multiple intelligences (CMI) (including technological, economic, social, political, cultural, and learning intelligences) and the processes of triplization (including globalization, localization and individualization) in education. As shown in Table 3, the characteristics of learning of new paradigm are completely different from the traditional paradigm and summarized as follows: (Cheng, 2001a)

*Traditional Paradigm of Site-bounded Learning***.** In the traditional thinking, students' learning is part of the reproduction and perpetuation process of the existing knowledge and manpower structure to sustain developments of the society, particularly in the social and economic aspects. Education is perceived as a process for students and their learning being "reproduced" to meet the needs of manpower structure in the society. The profiles of student and learning are clearly different from those in the new paradigm.

In education, students are the followers of their teachers. They go through standard programs of education, in which students are taught in the same way and same pace even though their ability may be different. Individualized programs seem to be unfeasible. The learning process is characterized by absorbing certain types of knowledge: students are "students" of their teachers, and they absorb knowledge from their teachers. Learning is a disciplinary, receiving, and socializing process such that close supervision and control on the learning process is necessary. The focus of learning is on how to gain some professional or academic knowledge and skills. Learning is often perceived as hard working to achieve external rewards and avoid punishment.

In the traditional paradigm, all learning activities are school-bounded and teacher-based. Students learn from a limited numbers of school teachers and their prepared materials. Therefore, teachers are the major sources of knowledge and learning. Students learn the standard curriculum from their textbooks and related materials assigned by their teachers. Students are often arranged to learn in a separated way and are kept responsible for their own learning outcomes. They have few opportunities to mutually support and learn. Their learning experiences are mainly institutional experiences alienated from the fast changing local and global communities. Learning happens only in schools within a given time frame. Graduation tends to be the end of students' learning.

New Paradigm of Triplized Learning. In the new paradigm, learning should be borderless and characterized by individualization, localization, and globalization.

Student is the centre of education. Students' learning should be facilitated to meet their needs and personal characteristics, and develop their potentials particularly CMI in an optimal way. Individualized and tailor-made programs (including targets, content, methods, and schedules) for different students are necessary and feasible. Students can be self-motivated and self-learning with appropriate guidance and facilitation, and learning is a self-actualizing, discovering, experiencing, and reflecting process. Since the information and knowledge are accumulated in an unbelievable speed but outdated very quickly, it is nearly impossible to make any sense if education is mainly to deliver skills and knowledge, particularly when students can find out the knowledge and information easily with the help of information technology and Internet. Therefore, the focus of learning is on learning how to learn, research, think, and create. In order to sustain learning is life-long, learning should be facilitated as enjoyable and self rewarding (Mok & Cheng, 2001).

Students' learning should be facilitated in such a way such that local and global resources, support, and networks can be brought in to maximize the opportunities for their developments during learning process. Through localization and globalization, there are multiple sources of learning. Students can learn from multiple sources inside and outside their higher institutions, locally and globally, not limited to a small number of teachers in their institutions. Participation in local and international learning programs can help them achieve the related community and global outlook and experiences beyond education institutions. Now, more and more examples of such kind of programs can be found in Japan, Hong Kong, France and USA. Also their learning is a type of networked learning. They will be grouped and networked locally and internationally. Learning groups and networks will become a major driving force to sustain the learning climate and multiply the learning effects through mutual sharing and inspiring. We can expect that each student can have a group of life long partner students in different corners of the world to share their learning experiences.

It is expected that learning happens everywhere and is life-long. Education is just the preparation for a high level life-long learning and discovery (Mok & Cheng, 2001). Learning opportunities are unlimited. Students can maximize the opportunities for their learning from local and global exposures through Internet, web-based learning, video-conferencing, cross-cultural sharing, and different types of interactive and multi-media materials (Ryan, Scott, Freeman, & Patel, 2000; Education and Manpower Bureau, 1998). Students can learn from world-class teachers, experts, peers, and learning materials from different parts of the world. In other words, their learning can be a world-class learning.

Table 3: Paradigm Shift in Learning

New Paradigm of Triplized Learning	Traditional Paradigm of Site-Bounded Learning
Individualized Learning: • Student is the centre of education • Individualized Programs • Self-Learning • Self-Actualizing Process • Focus on How to Learn • Self Rewarding	**Reproduced Learning**: • Student is the follower of teacher • Standard Programs • Absorbing Knowledge • Receiving Process • Focus on How to Gain • External Rewarding
Localized and Globalized Learning: • Multiple Sources of Learning • Networked Learning • Life-long and Everywhere • Unlimited Opportunities • World-Class Learning • Local and International Outlook	**Institution-Bounded Learning:** • Teacher-Based Learning • Separated Learning • Fixed Period and Within Institution • Limited Opportunities • Site-Bounded Learning • Mainly Institution-based Experiences

Paradigm Shift in Teacher Education and Development

The paradigm shift in learning implies that the quality and role of a teacher in the new century is completely different from the traditional one, as summarized in Table 4 (Cheng, 2001b).

Table 4: Paradigm Shift in Teaching

New Paradigm of Triplized Teaching	Traditional Paradigm of Site-Bounded Teaching
Individualized Teaching • As Facilitator: Teacher is the facilitator or mentor to support students' learning • Contextualized Multiple Intelligence Teacher • Individualized Teaching Style • Arousing Curiosity • Teaching as Facilitating Process • Sharing Joy • Teaching as Life-long Learning	**Reproduced Teaching** • As Centre: Teacher is the centre of education • Partially Competent Teacher • Standard Teaching Style • Transferring Knowledge • Teaching as Delivery Process • Achieving Standard • Teaching as a Practice of Previous Knowledge
Localized and Globalized Teaching: • Multiple Sources of Teaching • Networked Teaching • World-Class Teaching • Unlimited Opportunities in Teaching • Teaching with Local and International Outlook • As World-Class and Networked Teacher	**School-bounded Teaching:** • Limited and Bounded Teaching • Separated Teaching • Site-Bounded Teaching • Limited Opportunities in Teaching • Teaching Providing Mainly School Experiences • As School-bounded and Separated Teacher

Different from the first and second waves, teacher effectiveness of the third wave should be a type of "*Teacher Future Effectiveness*" that aims at facilitating and ensuring the aims and practices of learning effective and relevant to the future of new generations in an era of globalization, transformation and intelligence-based economy. With paradigmatic changes in the role of teacher and teaching, inevitably, there is also a similar paradigm shift in teacher education and professional development. The paradigm shift of teacher education and professional development can be summarized as follows (Cheng, 2001b): (Table 5)

Table 5: Two Paradigms of Teacher Education

New Triplization Paradigm For Teacher Education (3^{rd} wave)	**Traditional Site-Bounded Paradigm For Teacher Education** (1^{st} wave & 2^{nd} wave)
Aims of the New Teacher Education To develop teachers as triplized CMI and life long learning teachers who will creatively contribute • to development of students' triplized life long self learning as a CMI citizen of a CMI society and a CMI global village with multiple developments; and • to schools' triplized development as a CMI school and learning organization.	**Aims of the Traditional Teacher Education** To equip teachers with the necessary competence to deliver knowledge and skills to students such that students can survive a local community or meet the manpower needs of a society in the economic and social developments
New Teacher Education Curriculum • CMI & Triplization-Focused Curriculum • Triplized Curriculum Structure The structure is often hybrid, integrative, and interactive with the support of IT, networking, local and global exposure, and field experience and virtual reality. • World-Class and Globalzied Curriculum • Localized Curriculum • Individualized Curriculum	**Traditional Teacher Education Curriculum** • Subject Focused Curriculum • Standard Subject Curriculum Structure The structure is often linear, step by step, and subject dependent. • Subject-Bounded Curriculum
New Teacher Education Pedagogy • Facilitating Teachers' Life Long Self Learning • Multiple Sources of Teacher Learning • Globally and Locally Networked Teacher Learning • ICT Pedagogical Environment including: 1. World-wide networking through internet 2. Web-site learning 3. Interactive self learning 4. Multi-media facilities and learning materials 5. Video-conferencing for local and international sharing and exposure • Boundless and Unlimited Opportunities for Learning Inside and Outside Teacher Education Institution • Pedagogy is Based on Pentagon Theory of CMIs Development:	**Traditional Teacher Education Pedagogy** • Delivering Knowledge and Skills to Teachers • Site-bounded of Teacher Learning • Separated Teacher Learning • Absence of IT, Classroom-Bounded Pedagogical Environment • Limited Opportunities for Learning, Fixed Period, Within Teacher Education Institution • Pedagogy lacks a clear linkage with CMIs development and it is often driven by the delivery of subject knowledge and external standards in examinations

Aims of the New Teacher Education.

Traditionally, teacher education often aims to equip teachers with the necessary competence to deliver knowledge and skills to students such that students can survive a local community or meet the manpower needs of a society in the economic and social developments. But with the triplization paradigm, the aims of new teacher education should be to develop teachers as a triplized life long learning teacher. They will creatively contribute to students' triplized life long self learning and development as a contextualized multiple intelligence (CMI) citizen of a CMI society and a CMI global village with multiple developments in technological, economic, social, political, cultural, and learning aspects and to schools' triplized development as a CMI school and learning organization.

New Teacher Education Curriculum

CMI/Triplization-Focused Curriculum: In the traditional paradigm, the focus of the design of curriculum is on the content and delivery of subject knowledge. The structure of a curriculum is mainly based on the structure of subject knowledge and the needs for same standard contents and same arrangements for the same subject teacher group. Therefore, the curriculum is often linear, step by step, and subject dependent. Whether the teacher education curriculum is globalized (or world-class), localized and individualized is not the concern. On the contrast, the new paradigm focuses the design of curriculum on developing teachers' contextualized multiple intelligences and ability to make triplization for their own teaching and learning, students' learning and development, and school's development. Therefore, the design is based on characteristics of development of contextualized multiple intelligences and maximizing development opportunities for teachers' individualized, localized, and globalized learning and teaching**.** The curriculum structure is often hybrid, integrative, and interactive with the support of IT, networking, local and global exposure, and field experience and virtual reality.

World-Class and Globalzied Curriculum**:** The curriculum content of teacher education should be the world-class and globalized, pooling up the world-class materials and designs for learning and teaching and maximizing global relevance and exposure in different development areas. The content is also related to technological, economic, social, political, cultural, and learning globalization. Whether it is subject-based is not the major concern.

Localized Curriculum**:** The curriculum of teacher education also includes local resources, materials and concerns to ensure the local relevance and community involvement to maximize opportunities for teachers' localized learning and teaching. School-based/Community-based teacher education is one typical practice to increase the local relevance and support in the field. Technological, economic, social, political, cultural, and learning localization is also important area of new teacher education curriculum.

Individualized Curriculum: The curriculum of teacher education and professional development is flexible and adaptable and can be indivdualized - in terms of learning targets, content, methods, and schedules - to meet the developmental needs of individual teachers, facilitate their self learning and actualization, and optimize their potentials as a triplized CMI teacher.

New Teacher Education Pedagogy

The traditional teacher education emphasizes delivering subject knowledge and professional skills to teachers. Inevitably, the pedagogy is mainly to ensure teachers' learning as a disciplinary, receiving, and socializing process and assumes that close supervision is necessary during the training process. The opportunities for traditional teacher learning are often very limited in a fixed period within an institutional bounded or site-bounded but IT-absent environment. Also, the pedagogy has no clear linkage with development of teachers' CMI, and it is often driven by the delivery of subject knowledge and external standards in examinations. Contrastingly different from the traditional paradigm, the new pedagogy has the following characteristics (see Table 5):

Facilitating Teachers' Life Long Self Learning: Same as students' self learning, the new pedagogy is to ensure teachers' learning as a self-actualizing, discovering, experiencing, enjoyable, and reflecting process. Teacher educators' inspiring and teachers' own motivation and self rewarding are crucial to this self learning process.

Multiple Sources of Teacher Learning: In addition to the teacher education institution itself, there are multiple sources of teacher learning - for example, self learning programs and packages, interactive multi-media materials, web-site learning, outside experts, community experiential programs, etc. - inside and outside the institution, locally and globally. Through different types of partnership and collaboration, schools, local, and overseas organizations, institutions and communities, including social services, business, and industry, are actively involved in in-service and pre-service teacher education and professional development programs.

Globally and Locally Networked Teacher Learning: Teacher learning is locally and globally networked through, for example, the Internet, e-communications, visiting programs, local and global exchange programs, and sharing by video-conferencing. The networked learning can provide a wide spectrum of learning experiences and maximize opportunities for teachers to benefit from various settings and cultures. With the help of globalized learning, teachers can learn the world-class experiences from different parts of the world and various cultural settings. Therefore, the opportunities for teachers can be maximized to enhance the quality of their learning and teaching from local and global networking and exposure. In the new triplization paradigm, teacher education institutions are conceptualized as world-class and networked learning organizations.

World-wide IT Pedagogical Environment: In order to make triplizing teacher education possible, it is necessary to build up a world-wide IT pedagogical environment for teacher learning. It should include some typical and important components such as world-wide networking through the Internet, web-site learning, interactive self learning, multi-media facilities and learning materials, and video-conferencing for local and international sharing and exposure**.** Through the help of this environment**,** boundless and unlimited opportunities can be provided to teachers' learning and professional development inside and outside teacher education institutions and schools.

Based on CMI Development: The pedagogy should encourage teachers' CMI

development and facilitate intelligence transfer among learning, economic, political, social, cultural, and technological intelligences. Also, developing teachers' learning intelligence should be at the core part of teacher education. Teachers should be facilitated to learn how to learn, think, and create particularly in the local and global contexts. Teacher educators themselves should set a CMI model for facilitating and stimulating teachers' self learning. Teacher education institutions and schools should become a CMI pedagogical environment, in which teachers are immersed and inspired to be self actualizing and developing in CMI. Team/group learning, open-end learning projects, problem-based learning, and integrative and thematic learning are typical examples of pedagogic approaches in the new teacher education.

Paradigm Shift in Applying ICT in Teacher Education

Given the paradigm shift in teacher education and development and the change towards teacher future effectiveness, there is also corresponding paradigm shift in applying ICT in teacher education and development in the third wave. (Table 6)

Since the traditional paradigm in the 1st wave and 2nd wave of teacher education emphasizes the delivery of professional knowledge and skills and the satisfaction of stakeholders in educational practice, the application of ICT in teacher education is often focused on the following questions:

1. How well the use of ICT in teacher education and professional learning is organized to deliver the necessary professional knowledge and skills to teachers?
2. How well the delivery of professional knowledge and skills to teachers can be ensured through the improvement of teaching, learning and field experience of teacher education programs with the new ICT?
3. How well teacher educators' teaching can be improved through the use of ICT in a given time period?
4. How well teacher learners can arrive at given professional standards with the support of ICT in the professional qualification examination or certification?
5. How well can ICT be used to ensure the performance of teachers or student teachers satisfying the key stakeholders' expectations and needs?
6. How accountable can be the teacher education services with the use of ICT to the public and stakeholders?

Clearly, the first four questions are concerned with ensuring *teacher internal effectiveness* that focuses on the internal improvement in teaching and delivery of knowledge and skills. The last two questions come from the concern of *teacher interface effectiveness* that focuses on the stakeholders' satisfaction with teacher performance and the accountability of teacher education services. In other words, the traditional paradigm of applying ICT in teacher education reflects the line of thinking of the first and second waves.

But the paradigm shift towards triplization in teacher education induces a new thinking of applying ICT because the aims, content, and process of teacher education

are completely the traditional thinking. The application of ICT can be based on the following major questions:

1. *How well can ICT globalize, localize and individualize teachers' professional learning and development*? This question is proposed to ensure how the use of ICT effectively places teachers' professional learning in a globalized, localized, and individualized context. Teacher education only for teacher internal effectiveness at the site level is not sufficient to ensure education relevance to the globalization, localization, and individualization for the future development of students. Also teacher education satisfying stakeholders and accountability at the interface of school may contribute to localization of education but cannot promise globalization and individualization for learning and teaching.

2. *How well can the use of ICT maximize teachers' professional learning opportunities through establishing the borderless ICT environment, local and international networking, and various types of innovative learning programmes?* This question is proposed to ensure how effective is ICT in maximizing opportunities for teachers' learning and development in a triplized learning environment. The concern is not only on how much internal process can be improved and how much strategic stakeholders are satisfied, but on how large and how many opportunities can be created for teachers' professional learning and CMI.

3. *How well can the use of ICT facilitate and ensure teachers' professional learning to be sustained as potentially life long?* This question focuses on ensuring how the use of ICT can effectively facilitate and ensure professional learning sustainable to life long that is a core part of the new paradigm of teacher education. It is assumed that short-term internal improvement and short-term stakeholders' satisfaction with teacher standards or performance may not be so important and relevant to the future effectiveness of teachers if teachers themselves cannot sustain their professional learning as a life long process with the support of ICT.

4. *How well can the use of ICT ensure and facilitate the development of teachers' ability to triplize their professional learning and development?* This question is proposed to ensure the influence of applying ICT teacher education relevant to the development of teachers' ability of triplizing their own professional learning. It is very important and necessary for teachers to achieve their own ability for maximizing learning opportunities and sustaining their professional learning through globalization, localization and individualization.

5. *How well can the application of ICT facilitate the development of a CMI pedagogical environment, in which teachers are immersed and inspired to be self actualizing and developing CMI themselves*. The question focuses on how the use of ICT can ensure the outcomes of professional learning relevant to the development of CMI including technological, economic, social, political, cultural, and learning intelligences that are crucial for teachers and their students to meet the challenges in the future. This is one of the main concerns of the new

paradigm education.

From the above discussion, the implications for paradigm shift in applying ICT in teacher education and development are substantial. *The effectiveness of applying ICT depends heavily on whether ICT can facilitate teachers develop successfully to carry out the 3rd wave of educational reforms and paradigm shift of education towards development of students' contextualized multiple intelligences and triplization in education.*

Table 6: Paradigm Shift in Applying ICT in Teacher Education

New Paradigm of Applying ICT in Teacher Education (3rd Wave)	**Traditional Paradigm of Applying ICT In Teacher Education** (1st & 2nd Waves)
The effectiveness of applying ICT in teacher education depends on:	The effectiveness of applying ICT in teacher education depends on:
1. How well can ICT globalize, localize and individualize teachers' professional learning and development?	1. How well the use of ICT in teacher education and professional learning is organized to deliver the necessary professional knowledge and skills to teachers?
2. How well can the use of ICT maximize teachers' professional learning opportunities through establishing the borderless ICT environment, local and international networking, and various types of innovative learning programmes?	2. How well the delivery of professional knowledge and skills to teachers can be ensured through the improvement of teaching, learning and field experience of teacher education programs with the new ICT?
3. How well can the use of ICT facilitate and ensure teachers' professional learning to be sustained as potentially life long?	3. How well teacher educators' teaching can be improved through the use of ICT in a given time period?
4. How well can the use of ICT ensure and facilitate the development of teachers' ability to triplize their professional learning and development?	4. How well teacher learners can arrive at given professional standards with the support of ICT in the professional qualification examination or certification?
5. How well can the application of ICT facilitate the development of a CMI pedagogical environment, in which teachers are immersed and inspired to be self actualizing and developing CMI themselves.	5. How well can ICT be used to ensure the performance of teachers or student teachers satisfying the key stakeholders' expectations and needs?
	6. How accountable can be the teacher education services with the use of ICT to the public and stakeholders?

Networked Human and ICT Environment for Teacher Education

Given the paradigm shift in applying ICT from the first and second waves towards the third wave in teacher education and development, how should ICT be designed and applied to provide an effective learning environment for teachers' continuous professional learning? Mok and Cheng (2001) have proposed a theory of teacher self-learning in a networked human and technology environment. We can use this

theory to illustrate how ICT can be integrated with human network to form a networked human and ICT environment that can powerfully support triplization (globalization, localization and individualization) of teacher education and development at both individual and group levels in the institutional, local and global contexts.

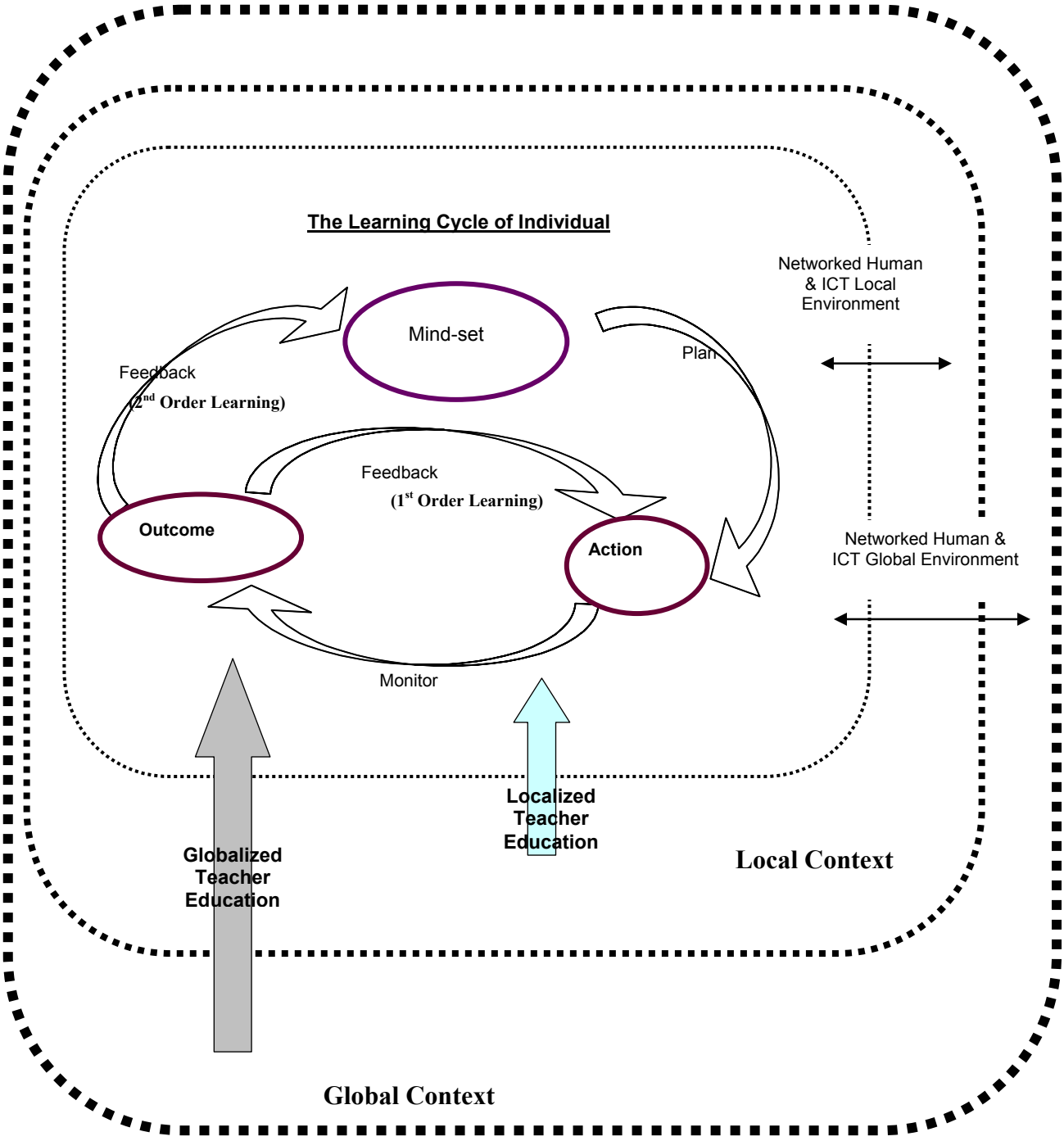
Professional Learning Cycle

Based on the concepts of action learning (Yuen & Cheng, 1997, 2000; Argyris & Schön, 1974; Argyris, Putnam, & Smith, 1985), Mok and Cheng (2001) conceptualised the process of teacher professional learning as a cyclic process in a networked human and ICT environment as shown in Figure 1. It subdivides a learning episode into a sequence of three components such as mental condition (mind-set), action, and outcome, linked by four processes including planning, monitoring, feedback to mental condition and feedback to action. There are two types of feedback from the monitoring process and outcomes to the teacher learner: One to the mind-set and the other one directly to action. The feedback to mind-set will help the learner to reflect on and change his/her own mental models including meta-cognition, thinking methods, meta-volition, and knowledge and then to change the planning process as well as the action of learning. The learning associated with change in mental-set or mental models is often referred as "***the second order learning"***.

The feedback directly to action of learning will help the teacher learner to adapt his/her professional learning behaviors. The learning associated with change in behaviors or actions is often referred to as ***"the first order of learning"***. Since this type of learning has not changed the mental conditions of the learner, it may not produce long lasting learning effects at a higher level.

As illustrated in Figure 1, teacher education & development can be globalized and localized with the support of networked human and IT environment in both local and global contexts. In the first order learning, teachers can achieve the types of operational knowledge and skills that are directly relevant and contributive to their professional developments and practices. In the second order learning, teachers can achieve the types of high-level knowledge such as wisdom, meta-cognition, values and beliefs that are crucial and necessary to the long-term development of their own profession and the local and global education.

Figure 1: Triplization of Teacher Education and Development in a Networked Human and ICT Environment



Professional Learning in Networked Human and ICT Environment.

The discussion of professional learning in a networked human and ICT environment may be related to the following clusters of literature: the literature on adult learning (e.g. Caffarella, 1993; Flannery, 1993; Merriam & Caffarella, 1999); the literature on learning psychology or motivation psychology (e.g. Schunk, 1996); the literature on self-directed learning or self-regulated learning at a separated individual level from a psychology perspective (e.g. Boekaerts, Pintrick & Zeidner, 2000; Brockett & Hiemstra, 1991; Caffarella, 1993; MacKeracher, 1996; Schunk & Zimmerman, 1998;); the literature on learning environment (e.g. Cheng, 1994; Tam & Cheng, 1995; Walberg, 1997); the literature on collaboration and networking in learning (DuFour, 1999; Fullan, 1997; Lieberman, 1996; Saltiel, Sgroi, Brockett, 1998; Saltiel, 1998; Cowie & van der Aalsvoort, 2000); the literature on information and communication technology in education (e.g. Basto, 1999; Bennett, 1999; Burbules & Callister, 1999; Chung & Baker, 1997; Lu, Wan, & Liu, 1999) and the literature on life long learning and learning society (e.g. Knasel, Meed, & Rossetti, 2000).

Mok and Cheng (2001) gave a theory to explain how the human and ICT environment can be designed, developed, networked and used to facilitate such a continuous life long learning for teachers. Some key ideas are summarized as follows: (for the detail, please refer to the original document)

IT Environment

Due to the tremendous developments in technology, ICT makes it possible for multiple teachers to be networked and participate in the learning task, thus greatly enhancing the social interactions, sharing of learning experiences and resources in a very convenient way. ICT can also facilitate and accelerate the monitoring, assessment, and feedback processes during professional learning in a very fast and efficient way (Embretson & Hershberger, 1999). There may be four important aspects in which ICT can contribute to the development of a powerful ICT environment that can facilitate the teachers' professional learning cycle at both individual and group levels locally or globally:

1. The computer technology revolutionalized both the speed and access to information (Hallinger, 1998). Information is interpreted in its broadest sense, including resource materials for the teacher as well as feedback concerning how well the teacher has learned. With the help of internet, learners can access the best quality of web-based learning materials in different parts of the world. Also, because of the high speed of information technology, feedback can be immediately generated for each step of learning tasks and activities as well as for the overall proficiency of learning. The fast feedback to teacher's mental conditions and learning behaviors in fact accelerates the speed of learning, including cognitive changes and behavioral changes of the teacher;
2. Developments in ICT make it possible for the application of measurement theory to assessment tasks during the teacher professional learning process no matter in formal teacher education programs or not. Technology is now available for real-time scoring (Herl, Baker, & Niemi, 1996), computer adaptive testing (CAT), automated data logging (Chung & Baker, 1997), and computer item construction

(Bennett, 1999). The advanced assessment methods can greatly improve the quality and accuracy of monitoring and feedback such that the quality and opportunity of learning can be ensured. Since assessment is an integral part of learning, teacher education programs can ideally expose teachers to new approaches to assessment, including new computer aided assessment methods;

3. Developments in ICT enable learning to move away from the paper-pencil format to rich imagery multimedia task presentation and submission (Bennett, 1999; Chung & Baker, 1997) that can capture richly contextualized performance in learning process (Bennett, 1999; Chung and Baker, 1997). The information would be powerful to understanding the complex nature of learning process and improving learning strategies, activities, and outcomes; and
4. ICT environment breaks down distance barriers of access to education and creates connectivity amongst teachers as learners (Mok & Cheng, 2000a). When teachers, mentors, peers, resource people, and other related experts can be networked through ICT, it will create more opportunities for social interactions, experience sharing, and information flow. With this, a networked human environment can be created to sustain and support self learning of individual teachers.

Networked Human Environment

It is easy to misinterpret a self-directed learner to be an isolated learner (Brockett, 1994). Learning has inevitably to be pursued by the individual: the learner has to make sense of the new learning and integrates the new learning with existing knowledge. As well, the learner has to engage in individual reflection. Notwithstanding, social interaction gives room for new insights and synergy. The importance of the social milieu to teacher self learning is acknowledged by such researchers as Garrison (1997), taking a "collaborative constructivist" perspective. The meaningfulness of teacher self learning should be constructed within a human environment that comprises the teacher as learner, , peer teachers, the mentor or facilitator (if any), and such other people as the principal or even students. The human environment plays a significant role in all aspects: pedagogical, psychological and behavioural, of self learning (Schunk, 1998).

The human environment can be designed in the learning endeavor as an important resource. The mentor, often perceived as an experienced peer or expert in the human environment of learning, can help the teacher learner to develop attitudes and skills for goal-setting, self-management, self-monitoring, and self-evaluation which are essential to the success of self learning. The teacher also learns from peers and other experts by observation and emulation (Schunk, 1987; as cited in Schunk, 1998).

Teacher self learning is a complex process and the endeavor can result in non-accomplishment, frustration or even failure. In such instances, the empathy and social support from the mentor and peers acts as an emotional safety net for the teacher . A strong social climate gives strength to the teacher in self learning to continue engagement in the task, analyse strategies and manage the failure and frustration in a positive way. A collaborative human environment is particularly important for adult self-directed learning.

Individually, Locally & Globally Networked Human and ICT Environment.

With the advances in ICT and global networking, it is now much possible to establish an individually, locally and globally networked human and ICT environment for teacher learners to learn with/ from mentors, peers, experts, scholars, other professionals, social leaders, various education and social agents, multiple sources of latest knowledge and resources in different parts of the local and international communities.

When teachers are networked through the networked human and ICT environment as shown in Figures 2 and 3, there may be multiplying effect on the amount of available professional knowledge and information as well as human touches and interactions that will become fruitful stimulus to teachers' professional learning. The networked teacher learners, mentors, peers, other professionals and various sources of knowledge and expertise may form a learning system to support teachers' continuous professional learning individually, locally and globally.

In a school, each teacher is self-motivated and generates a learning cycle of self-learning and self-evaluation. Teacher learners, mentors, peers, outside experts and sources of local and global resources are networked to form a learning group; learning groups are networked to form a learning community; learning groups and learning communities are networked to form a learning society; learning societies are networked across nations (Mok & Cheng, 2000b).

ICT speeds up the process of providing social and professional messages and informative feedback to the teacher learners and other members in the learning system. This speed, coupled with the massive amount of professional information and knowledge available via the informative network, not only means that this will be the information-rich era, but also, it implies that a closely networked social environment needs to be in place for promoting and supporting professional learning of teachers. Teacher learning is no longer the acquisition of knowledge and skills of teachers in an isolated context. Instead, effective teacher learning occurs in the individually, locally and globally networked human environment that can facilitate higher level of intelligence and motivation of teachers as well as other local and global members in the human network in the selection, management, transfer, creation and extension of knowledge.

Figure 2. Networked human & ICT environment:
(Networked teacher learners and learning groups)

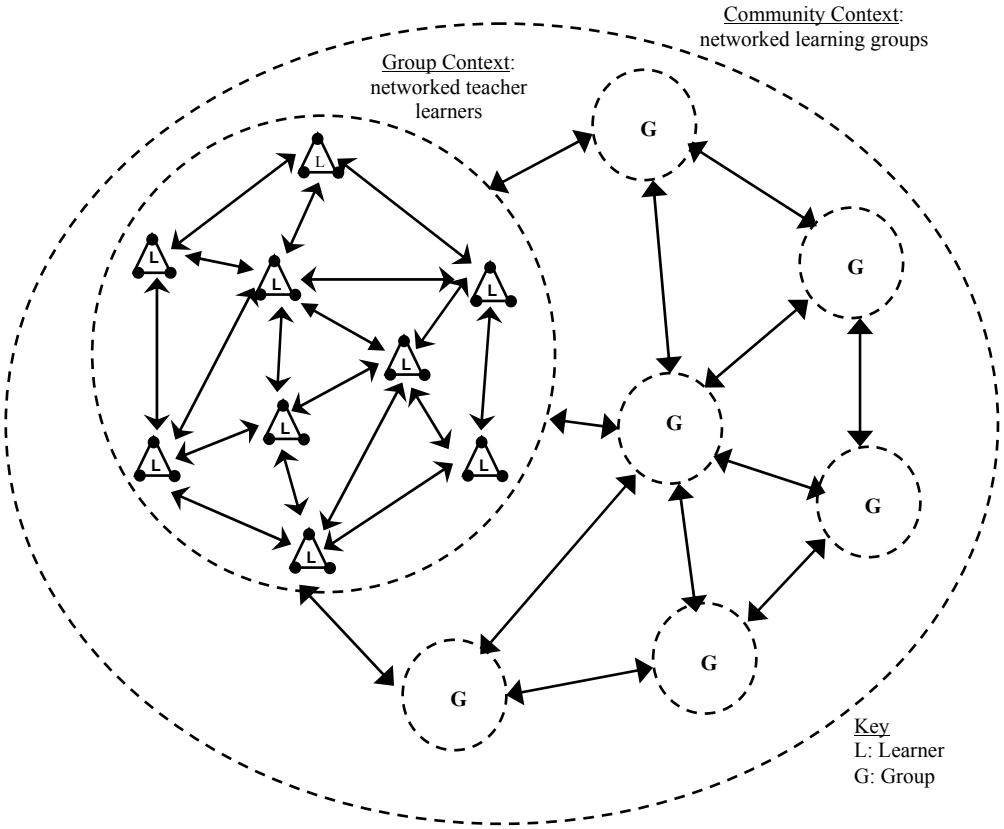
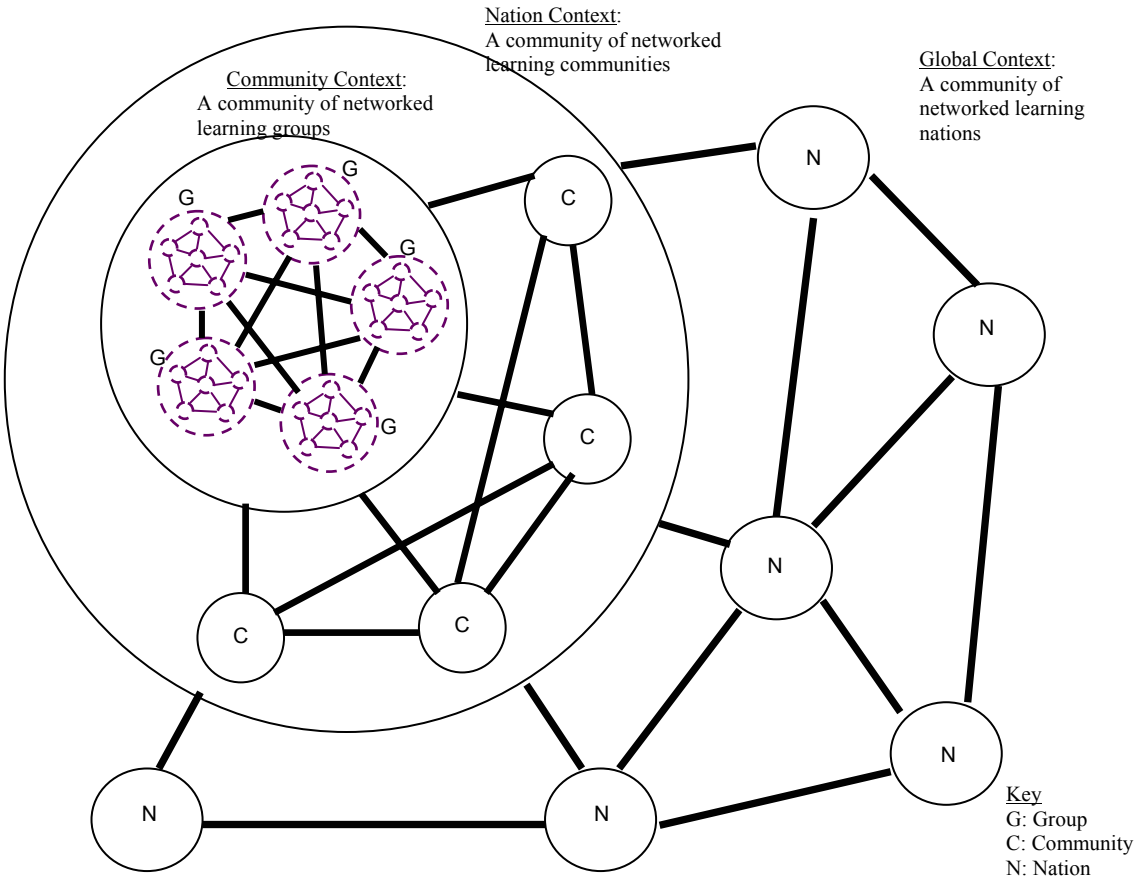


Figure 3. Networked human & ICT environment:
(Networked learning groups, communities and nations)



Facilitating Teacher Learning Cycle

Building up a strong and direct linkage between each stage of teacher professional learning cycle and networked learning environment should be an important issue in teacher education and development. From the above nature of learning cycle and networked human and ICT environment, Mok and Cheng (2001) further explained how each stage of teacher self learning cycle can be initiated and sustained continuously to achieve effective learning with the support of a networked human and ICT environment. The learning cycle includes the following stages:

Stage1: Initiating learning from mindset
Stage 2: Planning for learning action
Stage 3: Learning action
Stage 4: Monitoring, evaluation and modification
Stage 5: Outcomes
Stage 6: Feedback to induce changes in the teacher mind-set
Stage 7: Feedback to induce changes in learning action

For example, Tables 6 and 7 summarize the key ideas on how the networked human and ICT environment can facilitate stage 1 (mental condition for initiating learning) and stage 3 (learning action) of the learning cycle. For the detail, please refer to Mok & Cheng (2001).

Table 6. Teacher's mental condition facilitated by networked human and ICT environment to initiate professional learning

A teacher's mental condition	**Facilitated by networked human environment**	**Facilitated by ICT environment**
• Motivation: The teacher learner is motivated to initiate the learning activity and prepared to engage in it	• Inspiring: Mentor and peers provoke learning needs through challenges or identification of gap in knowledge or skill • Sustaining: supportive social environment to sustain motivation	• Stimulation: ICT provides information rich and stimulating environment to instill learning desire • Facilitation: ICT facilitates speedy and frequent correspondence between teacher learner, mentor and peer
• Meta-cognition: The teacher learner has a clear idea of one's own prior knowledge and the learning activities to be engaged in.	• Cognitive capacity building through social support: Mentor and peers help the teacher learner to develop: - clear expectation of learning outcomes - understanding about the teacher learner's level of prior knowledge - understanding on the amount of learning effort to be spent to achieve expected outcomes	• Information generation: ICT provides information that facilities the teacher learner to establish understanding: - Information on prior achievement recorded and stored using ICT helps teacher learner to develop a realistic expectation of learning outcomes -The teacher learner's level of knowledge can be established through self-administered tests and checklists on the web
• Meta-volition: The teacher learner is willing to engage in learning activities and make good use of all available resources.	• Engendering volition: Mentor cultivates amongst teacher learners a collaborative learning culture in order to: - enhance the teacher learner's willingness to engage in the learning activities - increase the teacher learner's confidence in the mentor and peers as resource people to support learning	• Supporting volition: User-friendly and enticing learning environment enhances volition: - Well designed teach-ware can reduce resistance and fear in using technology to support learning, which in turn enhance willingness ofthe teacher learner to participate - ICT increases the frequency of group communication, thus help build rapport amongst learners for further collaboration.

Table 7. Teacher's professional learning action facilitated by networked human and ICT environment

A teacher's learning action	**Facilitated by networked human environment**	**Facilitated by ICT environment**
• Control: The teacher learner chooses the best course of action, exercises self-control in continual engagement in the learning activities and regulates learning strategies to achieve learning goal	• Expert support: Networked mentor provides expert advice on possible learning paths and scaffolding to the teacher learner and facilitates him or her to focus on learning task	• Knowledge accumulation: ICT helps keep track of learning path, attempts, success and failures such that learning is focused and grounded on knowledge accumulated
• Task engagement: Accretion of knowledge through a series of learning activities, including assimilation, accommodation, integration, extrapolation and origination.	• Discourse on new knowledge: Mentor facilitates and promotes discourse about the learning experience among networked teacher learners such that learning of an individual learner can have a multiplicative effect on other learners through observation and emulation.	• Plurality of learning experience: Through IT, a dialogue on the learning experiences can be shared easily, thus enabling plurality of learning experience. Accumulation of knowledge through documented in e-format for later learners.
• Appreciation:The teacher learner appreciates the new knowledge gained and is further motivated to continue engagement in the learning task	• Emotional safety net: Networked mentor and peers share the joy of achievement and display empathy in case of failure, thus providing a safe environment for the teacher learner to experiment with learning	• Positioning against internal and external frame of reference: ICT facilitates voluminous storage and speedy retrieval of previous achievement records made by this and other teacher learners such that the learner appreciates where s/he is.

Conclusion

From the above discussion, we can see that the three waves of education reforms in different parts of the world require different types of teacher effectiveness including internal effectiveness, interface effectiveness and future effectiveness, that are based on completely different paradigms in education. Correspondingly, the major characteristics of three waves of teacher education and their application of ICT are contrastingly different as summarized in Table 8.

The first wave of education reforms emphasizes internal improvement and effectiveness. Therefore the paradigm of teacher education conceptualizes teacher effectiveness mainly as the internal effectiveness of teaching and work to achieve the planned goals. According to the structure of internal teaching effectiveness, there are three major strategies for teacher development: short-term strategy, long-term strategy and dynamic strategy. In practice, there are three models often used to enhance teacher internal effectiveness, including the goal and specification model, the work process model, and the absence of problem model. The efforts of teacher education and development of the first wave are often short-term orientation, related to teachers' daily practices and improvement in teaching and work particularly for the delivery of knowledge and skills to students. The use of ICT in teacher education and development is limited, mainly on improving the efficiency of delivery of planned curriculum and professional competence. There is lack of systematic intention to apply ICT to facilitate any paradigm shift in teacher education in particular or education in general.

Table 8: Paradigm Shift in Teacher Education & Applying ICT

	First Wave	Second Wave	Third Wave
Conception of Teacher Effectiveness	**Internal Effectiveness for** Improving the internal environment and processes to achieve the planned goals of work	**Interface Effectiveness for** Ensuring education services satisfying the needs of stakeholders and accountable to the public	**Future Effectiveness for** Ensuring the relevance of aims, content, practices, and outcomes of education to the future of new generations in a new era of globalization, information technology, and knowledge-driven economy
Major Models of Teacher Effectiveness & Teacher Education	**Internal Models:** • Goal and specification model • Work Process model • Absence of problem model	**Interface Models:** • Resource-input model • Constituencies satisfaction model • Accountability model • Continuous learning model	**Relevance to Paradigm in Education:** • Development of contextualized multiple intelligences • Triplization in education: Globalization, localization and individualization
Implications for Applying ICT in Teacher Education	• The use of ICT in teacher education is limited, mainly on improving the efficiency of delivery of planned curriculum and professional competence. • Whether ICT can facilitate paradigm shift in teacher education is not a concern. • The effectiveness of using ICT depends on: 2. How well the use of ICT in teacher education and professional learning is organized to deliver the necessary professional knowledge and skills to teachers? 3. How well the delivery of professional knowledge and skills to teachers can be ensured through the improvement of teaching, learning and field experience of teacher education programs with the new ICT? 4. How well teacher educators' teaching can be improved through the use of ICT in a given time period? 5. How well teacher learners can arrive at given professional standards with the support of ICT in the professional qualification examination or certification?	• The use of ICT in teacher education is limited, mainly on delivery of the necessary knowledge and skills for teacher interface effectiveness. • Whether ICT can facilitate paradigm shift in teacher education is not a concern. • The effectiveness of using ICT depends on: 1. How well can ICT be used to ensure the performance of teachers or student teachers satisfying the key stakeholders' expectations and needs? 2. How accountable can be the teacher education services with the use of ICT to the public and stakeholders?	● The extensive application of ICT in building up a networked environment for teachers' individualized, localized and globalized professional learning and CMI development is crucial and necessary. ● ICT plays a key role to facilitate paradigm shift in education & teacher education. ● The effectiveness of using ICT depends on: 1. How well can ICT globalize, localize and individualize teachers' professional learning and development? 2. How well can the use of ICT maximize teachers' professional learning opportunities through establishing the borderless ICT environment, local and international networking, and various types of innovative learning programmes? 3. How well can the use of ICT facilitate and ensure teachers' professional learning to be sustained as potentially life long? 4. How well can the use of ICT ensure and facilitate the development of teachers' ability to triplize their professional learning and development? 5. How well can the application of ICT facilitate the development of a CMI pedagogical environment, in which teachers are immersed and inspired to be self actualizing and developing CMI themselves.

The second wave of education reforms focuses on the interface between the school and the community. School effectiveness is interface effectiveness, mainly defined and assessed by the satisfaction of stakeholders with the education services of the school and by the accountability to the public and stakeholders. Therefore the conception of teacher interface effectiveness is to provide education services satisfying the needs of stakeholders and accountable to the public. Depending on the approaches used to deal

with interface issues and achieve interface effectiveness, there are four models for ensuring teacher interface effectiveness, including the resource utilization model, the school constituencies satisfaction model, the accountability model, and the continuous learning model. The focus of the second wave of teacher education is mainly to prepare teachers have the knowledge and skills to deal with the interface expectations and issues. Similar to the first wave, the application of ICT in the second wave of teacher education is quite limited, mainly on delivery of the necessary knowledge and skills for teacher interface effectiveness. Whether ICT can facilitate paradigm shift in teacher education and development is not a major concern in the application.

Responding to the challenges of globalization, information technology and knowledge-driven economy in the new millennium, the third wave of education reforms urges paradigm shift towards school future effectiveness relevant to the future needs of individuals, the community, and the society. Therefore, the conception of teacher future effectiveness is on ensuring the relevance of aims, content, practices, and outcomes of teacher work to the future of new generations in facing up challenges of new millennium. Correspondingly, the third wave of teacher education aims at creating unlimited opportunities for teachers' continuous life-long learning and development with the support of individually, locally, and globally networked human and ICT environment. Contrastingly different from the first and second waves, the extensive application of ICT in building up a networked environment for teachers' individualized, localized and globalized professional learning and CMI development is crucial and necessary for the third wave of teacher education and development. ICT plays a key role to facilitate the paradigm shift in school education and teacher education.

Although teachers' internal effectiveness, interface effectiveness, and future effectiveness are based on different paradigms and they have different strengths and focuses, all of them are important and necessary to provide us a comprehensive framework to the practice of school education and teacher education in the new century. They are mutually supplementary to each other, taking internal improvement, interface satisfaction and accountability, and future relevance into consideration. We believe, if teachers can ensure internal effectiveness, interface effectiveness, and future effectiveness for their schools, they have *total teacher effectiveness*.

From this line of thinking, the efforts of research, development, and policy formulation in ongoing teacher education and ICT application should focus not only on teachers' internal and interface effectiveness but also on their future effectiveness if total teacher effectiveness is pursued. It is hoped that the analysis and discussion in this speech can provide a new comprehensive framework for local and international educators, researchers, and policy-makers to develop teachers and apply ICT in teacher education for education effectiveness in the new century.

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