A FRAMEWORK OF TRAINING STRATEGIES FOR ICT TEACHERS

Qinglong Zhan
Department of Computer Science
Tianjin University of Technology and Education
Tianjin 300222, P.R.China

Abstract

In order to improve every learner's quality for responding to an information society, information communication and technology (ICT) exists as an independent and compulsory curriculum in China middle schools. If we hope for teachers to succeed in implementing an ICT curriculum, we need to reconsider training practices at present and the training strategy framework of underlying change of training practice for ICT teachers. This paper describes an innovative training strategy framework based upon advanced philosophy, a total architecture, and the integration of ICT teacher's teaching effectiveness. Five components are included in the framework: establishing learning teams, creating training culture, theme-motivated games, activating training contents, and reflection-sublimation. The five components are stated and their relationships are also discussed.

Keywords

Information communication and technology; teacher training; training strategy

Introduction

The basic philosophy of our ICT curriculum is to improve students' information literacy, to emphasize solving practical problems through cooperation, to master information technology, to experience information culture, to strengthen information consciousness, to internalize information ethics, and to make the student develop into a citizen with good information literacy for meeting the needs of an information age. Because our ICT curriculum emphasizes information literacy, teachers accustomed to traditional computer curricula and instructional methods will feel confused about teaching in an ICT curriculum. Therefore, if we expect teachers to succeed in implementing our ICT curriculum, we need to reconsider training practices.

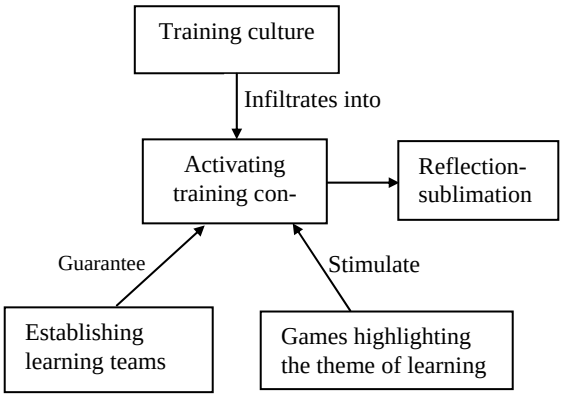

Figure 1: A Strategy Framework of Training for ICT Teachers.

Generally, the underlying change of training practice for ICT teachers includes three avenues: training thinking, training curriculum structure, and training strategies. This paper discusses the innovative training strategies. The traditional training strategies for ICT teachers are characterized by scattered features because of lack of advanced philosophy and a total architecture. This paper is based on China MOE Microsoft®"Partners-in-learning Plan" (PiL) and presents an innovative training strategy framework (Figure 1) composed of five components: establishing learning teams, creating training culture, game-motivated themes, activating training contents, and reflection-sublimation. Among these components, both activating training contents and reflection-sublimation are key ones. This framework allows two functions: one is to guarantee the realization of innovative training thinking and of the training curriculum structure, thus incorporating and facilitating ICT teacher's teaching

effectiveness; the other is, as a carrier of sustaining new instructional theories and instructional design and instructional methods.

Establishing Learning Teams

A learning team is a small collaborative learning group made up of two or more individuals who have complementary knowledge and skills and are willing to undertake duties when they learn together for achieving common learning goals and performance objectives as well as methods. In such a team members have a common goal, a relatively small team scale, a kind of dependent, complemental and interactional relationship, a collective success, and are willing to maximize their own and the team's achievements. Two factors are key when establishing such a learning team: team member's traits and the team size. Team member's traits include many aspects, such as gender, age, knowledge base, cognitive styles, school district, technology abilities, and teaching experiences etc. According to these traits, learning teams can be divided into homogeneous teams and heterogeneous teams. When establishing a learning team, we often abide by the principle of heterogeneous team. Members in a heterogeneous team may express different perspectives, promote the incorporation of different perspectives in communicating, thus developing deep knowledge and skills. As to the team size, according to Hellriegel, Slocum and Woodman[1], Johnson, Johnson and Holubec[2], we think a four-member team is optimal. A learning team with four members is possessed of the following advantages: forming a team easily, reaching the common vision and objectives rapidly, participating in activities and interacting with others conveniently, making a decision in a short time, abolishing the phenomenon of free riding, requiring a relatively low level of leadership. There are four methods used to build a learning team.

Self-establishment

On the base of every ICT teacher's traits, preferences, objectives and activities, the learning team is built by themselves without the trainer's support or the restricted conditions enforced by the trainer. During this kind of establishment process, the trainer should not participate in the establishment of the learning team or decide everything except the team size, nor can he/she provide support directly. When ICT teachers apply the self-establishment method, they can be empowered with more flexibility, voluntaries and alternative. The established team possesses a stronger cohesion and a longer persistence and ensures it works for each team member. The members in a self established learning team will work actively for the team development, for the vision-forming, and for the realization of objectives. They can also take on responsibilities actively and support each other. The possible problem of using a self established method is homogeneity.

Trainer-establishment

Trainer-establishment means the trainer should collect in advance ICT teachers' background information, (gender, age-length of teaching, professional knowledge, cognitive ability, learning style, character tendency such as introversion and extroversion, verbal expression ability). The trainer then rationally analyzes and combines these materials according to the heterogeneous principle, thus organizing a learning team based on the trainer's opinions. The learning team built by this kind of method may be developed into a pseudo one easily.

Statistics-establishment

This kind of establishment method is firmly rooted in probability and randomicity. According to the pre-defined team size, the trainer

makes several cards different in colors or flashcards different in types. Each ICT teacher draws one at random from these cards or flashcards; those who have the same color/type will be in the same learning team. We call this procedure a statistics-establishment method. This kind of establishment method is better suited to the situation when ICT teachers do not adopt the self-establishment method voluntarily, or if the trainer is not willing to organize a group in advance.

Progressive-style establishment

This is a method of reorganization. At the early period of forming a new learning team, through observing and investigating the development state of every team and member's behavior, the trainer reorganizes those members in a pseudo or high homogeneity team by the method of rational readjustment and optimal regrouping. Generally speaking, a progressive-style establishment should be performed early so as to get the sound development of the team along with the perfect state of each member and strong cohesion of the team.

When the trainer adopts the above-mentioned, self-establishment, trainer-establishment and statistics-establishment methods, he/she needs to define the team size in advance for the sake of ensuring the equilibrium of every team. He/She also needs to provide activity opportunities for ICT teachers to get to know each other.

Creating Training Culture

Training culture may deeply affect ICT teachers' values, ideas, as well as professional knowledge, skills and behaviors. That is to say training culture can infiltrate into all training aspects. Training culture is a kind of training based temporary organization culture, and is also the summation of value ideas understood, approbated and followed by team members and reflecting a special training feature of behavioral regulations, thought patterns and training symbol/artifacts. Training culture has strong functions of guidance, norm, cohesion and motivation to team members, and enables ICT teachers to understand interrelationships among training values, training activities and ICT course teaching theories, thus forming a shareable basic hypothetical mode which can be used to solve problems of outer adjustment and inner integration. Activities in a well designed training culture not only exert an important influence on training performance and a longer validity but also facilitate the ICT teacher's professional development after training in a better transferring way. A model designed for creating training culture includes three layers: idea/value layer, behavioral layer and symbol/artifact layer.

Idea/value layer bottomed in that model, and acted as the criteria to decide what behaviors are good, valuable and ideal, and to decide what rationality instead of reality is. Values (we can feel but can't express in words) often built on the idea of what is important can guide ICT teachers to discover the significance of studying/working and enforcing personal efforts. The idea of "enjoy learning, potential is great" that embodies the humanistic thought is the core one among training ideas for PiL ICT teachers (Table 1). It is the most distinctive mark of the Program of PiL as well as the objective of this program. And it has become a special terminology printed in the training materials and other relative documents as a slogan. We can feel its existence in the training activities.

Table 1: Training Ideas for PiL ICT Teachers

Procedural Idea	Outcome Idea
Enjoy learning, Potential is great; Your potential, Our Passion; Combining your wisdom, Surmount myself	Famous ICT Teacher; A whole new learning culture

Behavioral layer covers behavioral models, training ceremonies and collective activities that contain a special cultural significance. It can be divided into ceremonial behaviors and practical behaviors. Ceremonial behaviors, as a kind of supplementary behavior, aim to display the core idea, to consolidate those practical behaviors, and to directly form the sense of identity which enables team members to consciously engage into activities and produce a common view. Ceremonial behaviors include opening ceremony, welcome party, get-together, farewell banquet, closing ceremony, awarding, training uniforms, wearing insignia and so on. Practical behaviors are those various learning activities unfolded with training, including theme games, micro-lectures, teaching method seminars and technology practice, blog-writing and e-portfolio.

Training symbols or artifacts are symbols, characters or objects containing a kind of special culture significance. Slogans, signs, technologies, products, training uniforms, spatial layout of buildings and so on are included. Symbols are the most symbolic and observable things in culture but the meanings behind them are hard to explain. Cultural artifacts of ICT teachers training include the following two parts: (1)Training curriculum resources (which infiltrate into every training culture layer and embody the core training idea) the practical behavior criteria, and some program symbols. These kind of resources include textbook, handbook for trainers, handbook for learners, supporting CD-ROM and websites; (2) PiL artifacts, which include the name of program, slogans, logos, colors, trainer's and ICT teachers' clothing, brochures, souvenirs, awards, properties, insignias, the layout of training classrooms and so on.

Designing Games Reflecting the Theme of Learning

Gaming is becoming a new form of interactive content worthy of exploration for learning goals. It can also help adults study new concepts, obtain expert knowledge and practical knowledge. Viewed from the course idea and value angle, the method of gaming enables ICT teachers to obtain a profound understanding of course idea and change their own attitudes and values. Viewed from the training course design, an effective training course needs to combine ICT teachers with curriculum and pedagogical knowledge, key concepts, theories, facts and process in a purposeful and interesting way. How to guarantee achieving the goals and interesting of the training course? Gaming is a way of building bridges between the goals of training course and interests and can provide a practical field for ICT teachers to interact with the training theme, while displaying their knowledge and abilities of applying information. Meanwhile, it also helps ICT teachers to construct meanings, to inquire into the rationality of subject and the experimental intelligence in a more individualized way, and to conceptualize training/education back into a happy, beneficial competition, while developing cooperation and developing teaching and learning.

Game Type

Icebreaking-type game. The main function or goal of this type of game either enables participants to share their information and get to know each other as soon as possible in order to build team amicability and enhance team cohesion or requires participants as a team unit to comprehensively utilize their collective knowledge to complete concrete tasks. It is appropriate to use icebreaking-type games when ICT teachers

got together first or at the beginning of team formation. This kind of game is non-minatory and should last less than 20 minutes.

Theme-entering game. Generally, it is mainly used before starting to learn a new theme. Its main goals or functions are to improve ICT teachers' consciousness of a learning theme, to motivate their learning interests, to understanding the value of the learning theme and to introduce new thoughts.

Exploratory game. It is generally used in the settings in which ICT teachers are required to explore a certain learning theme. The main goals or functions are that the trainer wishes ICT teachers to deeply and continuously understand and explore the theme idea and then let them be aware of some other ideas or events. Two preconditions should be mentioned when using this kind of games: one is to provide ICT teachers with the choice of subject content; the other is that there should be a brief background introduction to subject content.

Reinforced game. It is usually used after ICT teachers have learnt a certain theme, possesses the main goals or functions such as consolidating, intensifying ICT teachers' knowledge maintenance for a long time and applying what they learned. Effective training is needed to reinforce what ICT teachers learned, such as concepts, principles, thoughts, technologies and teaching methods, which can be easily and effectively realized in an amusement world by applying reinforced games.

Evaluative game. It can be divided into pre-testing and post-testing games. A pre-testing evaluative game is generally used before instructional themes and to check which theme contents does the ICT teacher master or not; this helps the trainer decide what must be covered in the training activity and what can be neglected. A post-testing game, usually used after the theme instruction has finished, aims at grasping the degree of the ICT teacher's understanding and applications, thus enabling the trainer to evaluate the validity of training methods applied by him/her.

Game Design

Designing games for ICT teachers' training activity is based upon flow theory[3] and experimental learning that can help the game designer to understand the mechanism of game-based learning and then to design a game embodying the pleasure of learning experience. If we combine the main elements of games (i.e. theme, goal/objective, competition, challenge, interaction/ feedback) with learning motivation, flow theory and learning environments, we can get a design strategy of training games as shown in Figure 2. This kind of design strategy will engender double effects: game-based learning and learning-based gaming, which will take learning and gaming back to human nature. That is to say, education and training must place human nature on centre.

Implementation of Game

The implementation process of the training game can be divided into three stages: pre-gaming, on-gaming, and post-gaming. The pre-gaming stage emphasizes on gaming preparation, basically which includes the identification of game theme, game idea and game type, the choice of game, the preparation of resources and the rehearsal. The on-gaming stage means the implementation of a concrete game, which includes game introduction, assignment of roles and tasks, trainer's tasks in the gaming process and so on. Post-gaming stage emphasizes those tasks and learning activities that ICT teachers are required to further complete when the gaming process is over; this includes writing debriefing, sharing information gained from gaming, comparing the validity of game strategies and other learning strategies.

	Motivation	Flow	Learning environments	Game design
Theme	Attention strategies: arouse and sustain curiosity and interest.	Attention is completely absorbed in the activity	Avoid distractions and disruptions that intervene and destroy the subjective experience	Sensory and cognitive curiosity within the learner
Goals or objectives	Relevance strategies: link to learners' needs, interests, and motives	The activity has clear goals or objective	Have specific goals or objectives and established procedures	Goals or objectives reaching and feedback
Challenge or competition	Confidence strategies: help learners develop a positive expectation for successful achievement.	Challenges or competitions are optimized	Provide a continual feeling of challenge /competition that is neither so difficult as to create a sense of hopelessness and frustration ,nor so easy as to produce boredom	The learner should continually feel challenged as difficulty increases in concordance to increased skills
Interaction and feedback	Satisfaction strategies: provide extrinsic and intrinsic reinforcement for effort.	The activity provides clear and consistent interaction and feedback	Provide a high intensity of interaction and feedback	The learner should feel a sense of control through endogenous feedback provided by the game

Figure 2: A Design Strategy of Training Game (Adapted from [4]).

Activating Training Contents

Activating training contents means a unitive process of external practical activities and internal psychological activities. In this process: activities are acted as the mediation; the training contents are sequenced into a series of activities according to their logic relationships; and then those activities are interrelated. The following learner's aspects must be embedded into the activities: ideas needed to be changed; knowledge needed to be internalized; skills needed to be mastered; emotions, attitudes and values needed to be improved. Four intentions are included in this unity process: (1) translating training content into a series of modules and activities and endowing the training content with the characteristic of module and activity; thus ICT teachers' different practical experiences can be viewed as the logic starting point and produce a strong affinity for training, eventually develop their learning curves, knowledge, skills and mental abilities; (2) putting the activated training contents into a real world, enabling the presented contents and skills to produce a powerful psychological and intelligent interaction with practical experiences; (3) although the ICT teacher can translate the training activities into concrete professional knowledge and skills in an activated self-oriented learning situation, yet lectures, brief guidance, skill demonstrations and practice by doing are vital to them; and (4) multi-perspectives, initiative in participation and practice, collaborative sense-making, debate and reflections are important components because they can guide ICT teachers to adopt purposeful actions to construct meanings during the learning process.

Principles of activating training contents

The following principles are included: (1) as to the activity design and implementation, it should aim at ICT teacher individuals and the whole learning team, emphasizing attention to active participation as well as to develop interests and internal demands, mining ICT teachers' potentials of creativity, communication, performing and inquiry, empowering ICT teachers to control the stipulated spatio-temporal activity process by themselves, building activities upon the experience which is meaningful, direct and concrete to ICT teachers and upon ICT course teaching practice. ICT teachers may obtain and rebuild their experiences continuously by actively participating in serial activities, thus realizing the integration of the transformation of psychological activities and the process transformation of practical activities and gaining a development eventually; (2) applying the principle of participating and experiencing, emphasizing attention to the communications and dia-

logues between experts and ICT teachers, as well as among ICT teachers, thus reaching the effects of touching the emotion, of inducing pondering, of raising question, of obtaining common understanding, and of forming transferring; (3) updating ICT teachers' teaching ideas. The following teaching ideas must be applied to the training activities successfully for the goal of changing their teaching ideas: activating course content; taking learners as the subject of learning and the instructor as an organizer, guider, helper and promoter; establishing an active learning team and taking full advantage of the wisdom of the learning team; fostering the culture of ICT teachers' professional development as well as promoting their professional development; teacher and learning partners are all learner's learning evaluator; enjoying learning, potential is great and so on; (4)combining "part and whole". Paying attention to overall coverage as well as further analysis aiming to concrete problems, for example, paying close attention to the whole method on higher aspect as to the concrete learning activity on lower aspect; (5) leading competition and encouraging mechanism, and promoting ICT teacher's learning enthusiasm; (6)adopting team learning method, which lies on considerations of various discussions, of practice with guidance, of personalized feedback and of sharing with participants, thus guaranteeing the realization of activating training content; (7) activity design that should focus on activating continuous learning exceeding the life period of course, raising a profound and overall critical experience, creating a collaborative, constructive, reflecting and dynamic learning environment, improving confidence, enhancing the development of knowledge and understanding; (8) integrating content with instruction, which contains three benefits. Firstly, discussing and checking subject concept, ideology and technology appeared in the activity. Secondly, ICT teachers can design a similar lesson in the light of the activities finished by them. And the last one is reflection, that is to say, ICT teachers should deeply examine teaching ideas and principles supporting the activities, and then discover the value of activities and various problems occurred in their own classes; and (9) training activities should be designed with novelty so as to inspire ICT teachers with curiosity and creativity, thus producing innovative ideas and behaviours.

Design Training Activities

The essential principle of activating training content is translating training contents into training activities and eventually realizing the integration of contents with activities. Training activities are the summation of learning behaviours and operations, which were finished for special learning objectives by teachers in a certain learning environment.

Design Objectives for Training Activity.

There must be one or more activity objectives in any activity, and different objectives may influence the understanding to activity in different forms. We can use Gammon's classification for learning objectives (Table 2) to design training activity objectives. This classification not only can be used to define training objective, it is also helpful to choose training activity type.

Design Environments for Training Activity.

For a long time, human's practice and understanding to activity/learning environments is only limited to the entity aspect, and has ignored the concept aspect. A highly effective activity circumstance should include the entity aspect and the concept aspect, so the circumstance design of training activity for ICT

Table 2: Objective Classification of Training Activity [5]

Objective	Description
Cognitive	Acquire and assimilate new knowledge into existing schemas, apply existing knowledge, connect concepts, draw analogies.
Affective	Challenge beliefs and values, appreciate view-points in other people, inspire interest, curiosity, awe and wonder, associate curiosity and thinking with enjoyable experiences.
Social	Develop skills of co-operation and communication.
Developing skills (mental and physical)	Prediction, deduction, problem-solving, investigation, observation, measuring, classification, testing theories, making and telling stories, decision-making, manual dexterity, craft skills, etc.
Personal	Increasing self-confidence and self-efficacy; motivating to investigate further.

teachers should apply this principle. Environments in the entity aspect should include for accomplishing activity. The design of the spatial allocation of activity as well as various resources and tools that are important may generate a certain influence on the ongoing training activity and on the effect of training activity. Frequently, there are 6 types of methods used to design activity space, such as rows of tables and chairs, hollow U, banquet/fishbone style, round table style, chair circle style, triangle style, etc. Each type has its own advantages and disadvantages, so we should choose rationally and rebuild them according to training activity type. As to the environment design in the concept aspect, it should put the ICT teacher in a constructive, collaborative, contextual, communicative and reflective learning world [6].

Design Structure for Training Activity.

Each activity possesses hierarchical characteristics according to activity theory. In other words, man's activity can be divided into three levels: activity, action and operation. Therefore, in order to reach an ideal activity objective, an activity must be made up of several actions required to be accomplished during the period of learning activity. Jonassen & Rohrer-Murphy[7] have raised a framework used to design activity structure, to a certain degree which is still ambiguous, so it is necessary for us to further expand this framework: (1) identifying actions appearing in the learning activity, and then organize them (in a purposeful and reasonable way) into a learning flow to enhance more effective learning; (2) taking into account of what are the thinking forms, theory types and bases of the activity, which means activity design needs to be reflected by its intrinsic instruction thoughts and learning patterns; (3) learning flow, which is formed by different combinations of actions of the same kind of learning activity, can achieve different teaching strategies or meet the needs for special learners. Based on the above analyses, the author attempts to raise a new approach to the design training activity structure-transplanting method. The fundamental thoughts of the transplanting method are as follows: There will emerge many learner-centred learning patterns in the research of learning theory and practice and, all learning patterns have their own corresponding activity procedures. Viewed from the hierarchical structure of activity theory, these activity procedures should contain actions and operations; thus we may look upon these activity procedures as the shell. When training contents are embedded in the shell, there will be produced a certain activity structure aimed at different training contents. Some more should be noted: (1) some training contents cannot be adapted for activity structure for lack of corresponding ready-made learning patterns. The solution to that situation is that

we should absorb those appropriate components from various learning patterns to generate a kind of new activity structure; (2) some learning patterns which possess the characteristic of individuality need to be adapted for the team-based or collaborative activity structure; (3) not all activity structures are linear, and they also may be circular or branch one; and (4) although some activity structures may appear as linear structure this does not mean that they must be performed according to its order.

Design Roles for Training Activity.

In the training period ICT teachers may be assigned to act as different characters, (learner, participator in team, demonstrator). An ICT teacher may act as different characters in different training activities in order to achieve relevant actions and operations.

Sequencing Training Activity.

Sequencing training activity means a process which depicts training activity sequences and defines the dependency between activities. That is to say, we must ensure the related activities have been finished before starting a new activity. Building relationships between every carefully planned activity and others is necessary, thus forming activity sequences or learning activity flow. The relationship between activities can be optional or complementary (for instance, a certain activity emphasizes attention to reinforcing knowledge and skills, and the following activities should emphasize attention to applying these knowledge and skills into teaching). Sequencing can be done artificially or by computer software; it also can be done in the two ways together. PDM (Precedence Diagramming Method) is a main method used to order activities and uses nodes to represent activity and arrows to represent the logical relationship between activities. ADM (Arrow Diagramming Method) uses arrows to represent activity, and the logical relationship between activities can be represented by nodes linked by arrows. All activities are marked on arrows rather than nodes, the tail of the arrow represents the starting of an activity and the head of the arrow represents the accomplishment of an activity. The advantage of ADM is that the length of the arrow can be changed pro rata with activity time; this is beneficial to identify the duration of time of each activity.

Sublimation in Reflection

Reflection-sublimation means the ICT teacher reflects the theories-in-use according to activity experiences and the espoused theories so as to effectively question fundamental hypotheses and practices, to reflect his own values and ideas, and to rebuild or revise personal action theory for the goal of reaching the coherency between theories-in-use and espoused theories, forming new understandings and evaluations, developing knowledge and constructing theories as well as producing an authentic change process. During the training process, reflection-sublimation covers the following implications: (1) developing the ICT teacher's pedagogy practical theory and technology rational theory, enhancing the integration of experience reflection and theory-practice and striving for the changes of profession development and profession practice; (2) revising misconcepts and distortions of value and norm of activities or supporting activities; (3) reconstructing total experiences, understanding and extracting meanings from experiences and generating synthetic, appropriate and valid personal new knowledge by utilizing integral, individual and flexible methods; (4) identifying and depicting the solutions to practical problems and the understandings to practical situations in a purposeful and rational way, visualizing the value of ICT instruction; and (5) transferring the acquired knowledge to the real ICT instructional situation, producing a more synthetic knowledge base that directly aims to the practice needed to master. The process of sublimating

Table 3: Process of Sublimating Reflection

Process	Description
Imaging	Activities-Depicting (i.e. actions, thoughts, feelings); Authenticity, synthesis, integrity, context; Scaffolding-notes, graphics, videos, mind map.
Reflecting	Reflect upon personal theory; Reflect upon context; Reflect upon intention.
Criticizing	Practical criticism about conflict, misinterpretation and dissonance; Engage into the process of liberation and change.
Sublimating	Generating new theory; Learning and innovating practice; Practicing process and applying knowledge; Self- consciousness.

reflection is shown in Table 3.

Tools of reflection-sublimation include reflective blog and e-portfolio. The format of reflective blog should be simple, practical and of value to ICT teachers. An ICT teacher may utilize e-portfolio to incorporate those continuously evolved thoughts and actions for the goal of forming an e-portfolio reflecting training experiences and acquired knowledge and skills. Although there are various e-portfolio structures, yet we should choose one according to the goals we want to achieve and the skills needed to be evaluated. The following should be covered when choosing an e-portfolio structure: paradigms, collected resources, information used to support and extend knowledge base, completed program, articles, works, process and outcomes of self-reflection, the display of practical outcomes and special performance ability. No matter what kind of structure, the following two should be emphasized: (1) the formation of e-portfolio reflects the integration between process and outcome [8]. Process provides the entry point for the ICT teacher to reflect and check his/her own understandings to instruction and learning; and (2) demonstrating a dynamic picture of the 3-D interaction between knowledge, skills and values in what is essentially a 2-D static snapshot [9].

Conclusion

Training strategy, without question, is an important research domain in the field of ICT teacher training. Training strategy framework synthesizing various strategies in an advanced philosophy can integrate and improve ICT teacher's teaching efficiency, which can't be reached by using a single strategy. The strategy framework introduced in this paper, as a new research and practical domain, can be used in practice for ICT trainers as well as to conceptualize and to construct a new training strategy pedigree for researchers.

References

1. D.Hellriegel, J. W.Slocum, and R. W.Woodman, *Organizational Behavior (8th Ed.)*, Ohio: South-Western College Publishing, 1998.

2. Johnson, D. W., Johnson, R.T., and Holubec, E. J., *The Nuts& Bolts of Cooperative Learning*. Edina, MN: Interaction Books, 1994.

3. M.Csikszentmihalyi, "Finding flow", *Psychology Today*, vol.30, no.4, pp.46-51, 1997.

4. B.Paras, and J.Bizzocchi, "Game, Motivation, and Effective Learning: An Integrated Model for Educational Game Design", http://www.digra.org:8080/Plone/dl/db/06276.18065.pdf.

5. "Interactive Design for Online Learning Activities", http://www.eduweb.com/ Eduweb_Design_Process.pdf.

6. D.H.Jonassen, "Designing constructivist learning environments", http://www.coe.missouri.edu/~jonassen.

7. D.H.Jonassen, and L.Rohrer-Murphy, "Activity Theory as a Framework for Designing Constructivist Learning Environments", *ETR & D*, vol. 47, no. 1, pp.61-79, 1999.

8. L.F.Darling, "Portfolio as practice: the narratives of emerging teachers". *Teaching and Teacher Education*. Vol. 17, no.1, pp.107–121, 2001.

9. I.Taylor, J.Thomas, and H.Sage, "Portfolios for learning and assessment: laying the foundations for continuing professional development". *Social Work Education*. Vol. 18, no.2, pp.147–160, 1999.

Biographical Information

Dr. Qinglong Zhan is an associate professor at Tianjin University of Technology and Education. His main research interests include online-learning, architecture of educational software system, computer-supported knowledge innovation, and information technology-based teacher education.

ASEE MEMBERS

How To Join Computers in Education Division
(CoED)

1) Check ASEE annual dues statement for CoED Membership and add $7.00 to ASEE dues payment.

2) Complete this form and send to American Society for Engineering Education, 1818 N. Street, N.W., Suite 600, Washington, DC 20036.

I wish to join CoED. Enclosed is my check for $7.00 for annual membership (make check payable to ASEE).

PLEASE PRINT

NAME: _____

MAILING ADDRESS: _____

CITY: _____

STATE: _____

ZIP CODE: _____