

Using the problem-based learning to enhance student's key competencies

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From the trends of educational reforms in recent decades, many advanced countries have viewed the key competencies as important assets of people. The key competencies are important features of working life and therefore essential to boost and maintain employment, so that the promotion of the key competencies has become an integral part of secondary and even in higher educational systems in many countries. This paper aims to compare the key competencies among different countries, including the SCANS of America, the key skills of UK, the key competencies of Australia, and the ten basic competencies of 1-9 integral curriculum of Taiwan. This paper also explores the key competencies that can be developed in the problem-based learning (PBL) and how to use the PBL to enhance student's key competencies.

INTRODUCTION

Because of the rapid changes in technology, economy and working environment nearly two decades, many advanced countries have been emphasizing on the development of key competencies of people to maintain employability and continuing learning. Raizen (1989) indicates that general skills are new workforce competencies that enable people working in different workplaces. Such skills, not restricted in specific workplaces, are the concept of key competencies. Hereafter, many researches emphasize the importance of key competencies, such as "generic skills" of Stasz (1990), "work force basics" of Department of Labor (SCANS, 1991), "new work skills" of Resnick & Wirt (1996), and "new model worker" of Flecker & Hofbauer (1998). All skills or competencies listed above, though in different terms, are the concept of key competencies. Many recent researches also emphasize the importance of the key competencies. OECD (2000) suggests that a country should enhance the human capital to meet the globalization and knowledge based economy by increasing the key competencies of people. Hesketh (2000) points out that communication skills, learning abilities, problem solving skills, teamwork skills and selfmanagement skills are considered first by the England employers. Those key competencies are even more important than the professional competencies. Stasz (2000) suggests that people in the new economical era should have twodimensional skills, inter-personal skills and intra-personal skills. The former includes teamwork and leadership and the latter includes motivation, attitude, continuing learning, problem solving, negotiating with colleagues and customers, analytical ability and applying technology. The scholars in Taiwan also have the same views. Du (1999) indicates that the technical and vocational education should promote both the professional competencies and the key competencies concurrently. If there are no professional competencies there are no prospect for students. If there are no key competencies, the future of students will be restricted. Hong & Tseng (1999) concludes in their studies that the employee owned key competencies enables Taiwan to have the same competitiveness as advanced countries in high technology. Traditional teaching is teacher-centered and teachers always teach subject area knowledge and students pursue unique answers. There is lack of opportunities to solve problems related to real life situations, lack of teamwork trainings, and also lack of knowledge-sharing mechanisms. The problem-based learning, changing the ways of teaching by teachers and the ways of learning by students, provides good opportunities that may be helpful to enhance the students' key competencies in the learning process.

CONCEPT OF KEY COMPETENCIES

Definition of key competencies

In the past two decades, a lot of researchers tries to integrate the terms and definitions of "key competencies". Due to the diversities, there is no consensus reached so far. But there is no doubt at all that key competencies are recognized as cognitive, learned and behavior attributes (Weinert, 1999; Kearns, 2001). Table 1 shows different terms of key competencies. Some are using skills and some competencies. This paper uses "key competencies" instead.

In spite of different definitions and notions, key competencies have the following characteristics:

1. Key competencies are multifunctional: Key competencies are needed for different facets of life such as family life, social life, professional life, and even daily life.
2. Key competencies are transferable across different fields: Key competencies are used not only in school, society and workforce market, but also in the personal life including career development, lifelong learning, inter-personal attributes and intra-personal attributes.
3. Key competencies are higher of cognitive abilities: The construction of key competencies involves individual active reflections and mental processes. They include critical thinking, problem solving, self-directed learning, creativity and innovation.
4. Key competencies are multidimensional: Key competencies are composed of different competency clusters including cognitive cluster, interpersonal cluster, enterprise cluster, and work readiness cluster.
5. Key competencies are learned: Acquiring key competencies is an on-going learning process through different settings including schools, social networks and workplaces.
6. Key competencies are broader than knowledge: Key competencies are expansions and applications of knowledge. They should be applied in real life situations to get experiences. Key competencies are the product of knowledge and experiences.

Development of key competencies in different countries

In the late 1980s and early 1990s, because of the workplace change and consequent need, three main countries, Britain, Australia and the United States, have put a lot of efforts to the development of key competencies. Nowadays, many countries have developed their own key competencies from different perspectives. The main outputs from these efforts can be described briefly as follows:

1. ASTD/DOL Skills of the United States: In the late 1980s, due to the development of new technology and knowledge-based economy, American employers asked for new workplace skills intensively. Therefore, the Department of Labor (DOL) and the American Society for Training and Development (ASTD) issues a research and tries to find the essential generic skills needed by the employers. Three reports are published, "ASTD/DOL report" (ASTD/DOL, 1988), "Workplace basics: The essential skills employers want" (Carnevale, Gainer & Meltzer, 1990), and "American and the new economy" (Carnevale, 1991). ASTD/DOL provides a series of competencies and skills and suggest that those skills should be integrated into school education and should be learned through the whole life. The ASTD/DOL skills include seven dimensions: learning to learn, academic basics, communication, adaptability, personal development, group effectiveness and influential skills.

2. SCANS of the United States: Secretary's Commission on Achieving Necessary Skills (SCANS) is established in 1991 to identify essential workplace competencies and foundation skills. The first discussion paper is published in 1991 (SCANS, 1991) and the final report in 1992 (SCANS, 1992). SCANS includes three foundation skills and five workplace competencies:

Foundation skills:

Basic skills: reading, writing, arithmetic, mathematics, listening and speaking
Thinking skills: critical thinking, decision making, problem solving, visualization, ability to learn and reasoning

Personal qualities: responsibility, self-esteem, sociability, self-management, integrity, honesty and flexibility
Workplace competencies:

Resources: management of time, management of budget, management of materials and management of human resources

Information: acquiring information, organizing information, interpreting information, distributing information and use of information technology

Interpersonal skills: participation, helping others learn, serving customers, exhibiting leadership, negotiating and valuing diversity
Systems: understanding the organization system, monitoring and correcting system performance and improving system performance
Technology: selecting appropriate technology, applying technology and maintaining technology

3. Key Skills of UK: Key skills, issued in 1990, include improving own learning and performance, communication, working with others, application of number, problem solving and information technology (<http://www.dfes.gov.uk/key/>, Feb. 01, 2002).

4. Mayer Key Competencies of Australia: The Mayer Committee suggested seven key competencies in 1992 (Mayer, 1992a; Mayer, 1992b) including collecting, analyzing and organizing information, communication ideas and information, planning and organizing activities, working with others and in teams, using mathematical ideas and techniques, solving problems and using technology.

5. Employability Skills 2000+ of Canada: Employability Skills 2000+ are the critical skills individual needs whether in the workplace or self-employed. They include communication, problem solving, positive attitudes and behaviors, adaptability, working with others, science, technology and mathematics (<http://www.conferenceboard.ca>, Mar. 08, 2002).

6. Ten basic competencies of 1-9 integral curriculum of Taiwan: The new 1-9 integral curriculum, beginning implementation in 2001, ensures consistency of national compulsory education and aims to foster the student's basic skills. It starts from everyday life and experiences of students, combining subject area knowledge, and arranging learning activities around it. It not only connects the learning of elementary to junior high schools, but also integrates various learning experiences. In this new curriculum, the traditional subject are replaced by seven major domains of learning, so as to avoid confining students within the boundaries of a subject and overlooking the students' ability to integrate what they have learned. The seven domains of learning include language and literature, health and physical education, social studies, arts and humanities, mathematics, nature and technology, and integrated activities. The ten basic competencies that will be developed under seven major domains of learning are self-understanding and potential development; appreciation, expression and innovation; career planning and lifelong learning; presentation, communication and sharing; esteem, concern and teamwork; cultural learning and international understanding; planning, organizing and practicing; applying technology and information; active exploration and research; and independent thinking and problem solving.

Comparisons of key competencies

1. Broad approach: ASTD/DOL and SCANS of the United States, and the ten basic competencies of Taiwan have broader concept of competency. They include more flexible, and more holistic set of generic skills, which not only include basic skills, personal attributes, value judgment and ethic ideas, but also maintain lifelong learning skills and employability skills just like Mayer type competencies.

2. Narrow approach: Both the key skills of UK and the key competencies of Australia, emphasizing on the workplace competencies, are instrumental set of competencies. Those competencies related to personal attributes and value judgments are excluded from both countries.

Although the key competencies among countries have different terms and contents, there still exist similarities. Table 2 shows the comparisons of the key competencies. The Australia Mayer type key competencies that have more explicit meaning are essential for effective participation in the emerging patterns of work and work organization today. They focus on the capacity to apply knowledge and skills in an integrated work situation. They also emphasize the further education and lifelong learning. Those competencies should be learned and fostered in educational institutions.

ENHANCING STUDENT'S KEY COMPETENCIES USING THE PBL

Definition of the PBL

Regarding true problems from different facets of life as a starting point, using the encouraged materials to stimulate students' learning motive, the teacher does not provide solution, but help the resource allocation and guide from the beside. The students cooperate and learn by group, together exert creativity and solve problems. The teacher changes his role from teaching to facilitating and the student also changes the role from passive to active (Boud & Feletti, 1997). Woods (1997) points out that the PBL is one of the most effective teaching methods in recent 30 years. Its reason is that the learning environment of the PBL includes every kind of factor currently known which can improve the efficiency of learning, such as active, cooperation, feedback, adaptability and accountability. On the learning motive, the PBL promotes the learning of the student basing on the need of solving problems. On the learning scope, the PBL emphasizes the learning of the subject area and also provides opportunities for students to practice and apply many key competencies. On the learning type, the PBL contains research, case study, directed--design, project, engineering design and medical college mode. Some are good for big class teaching, the other must be divided into group. For example, the commerce college uses cases study more often, may suit big class teaching, but the medical college mode should be better if divided into group teaching (Biggs, 1999; Biggs, 2000; Boud & Feletti, 1997). Most people learn through hearing, speaking, reading, writing, and doing, different way may acquire different efficiency, among them that reading is the less efficiency, and practicing by doing contains the highest efficiency. The PBL therefore, based on the problems, must solve problems in real situation, so need to use various learning types that can memorize more and longer. Synthesize above standpoint, the PBL has following characteristics:

1. The PBL is an integral teaching method, it is also a coordinated learning environment, not only make a point of the result, but also the process
2. The strategy of PBL is to launch the learning by resolving problems, and through the process, knowledge can be applied to reach the independence management, and cultivate the attitude of sharing knowledge.
3. With open, true, valuable topic, coping with related problem of living scenario to motivate the learning. The problem should begin with small to big, from structured to ill-structured, match the students' preparing knowledge, and enhance the interaction ability as well as students' will.
4. Practicing communication skills through the teamwork, integrating thinking skills through independent learning and reflection, applying the idea through the problem solving, creativity and innovation, in the long run sharing the knowledge to reach the synchronously growing up for every student. However the students need steadily self-requested and the teachers speed up the improvement from beside.

Planning for the PBL

The PBL is student-centered and learning-centered, but traditional teaching is teacher-centered and teaching-centered. It contains tremendous difference between the PBL and the traditional teaching, therefore the teacher must be detailed planning previously. The following steps may be adopted:

1. Estimate the need: What is the reason? Is traditional teaching method not good? Is the demand on the research? Want to promote various abilities of the student? Or has no purpose, only want to change a kind of teaching method? Teacher should clarify the purpose first and take the gauge of whether real demand or not, if confirm the demand, then must establish the target, and look for the support on the administration.
2. Proceeding literature collection: Although the PBL has already been used extensively in different fields, besides the field of medical science has been proven the success. If the teacher likes to use the PBL on other realm, it's the best to collect related literature in advance as the reference of the planning and teaching.
3. Choose the mode of the PBL: Include students participating mode, the tutorial mode, and small group discussion mode. Different mode may need different environment, different administration supporting, different curriculum designing, different interactive ways, and different assessment methods.
4. Review the course content and assessment method: No matter which mode has been adopted, course contents reviewing is an absolute necessity, revising the contents of the curriculum to cope with the chosen mode, can make teaching process more smoothly. And the assessment method may also be modified.
5. Review the teaching strategy: In the PBL, a teacher's role is just like a coach, from traditional teaching contents become a learning promoter. And the students' role changes from sitting, listening, and taking notes, to active learning. Teacher and student both need to adjust the roles' changes to meet expectations.
6. Devising the problem: The key successful factor of the PBL is "problem", the problem has to be related with the contents of the curriculum, can be applied for real life, can cover the knowledge of the courses, and may also promote various abilities of the student. To devise the problem, the teacher can search related literature, case study, or collections related to the PBL, and the problem that brings up should through detailed valuation and assure can promote the learning of the students.
7. Preparing the teaching handbook and the guideline for students: Before implementation, the teacher had better edit related handbook and guideline as the basis of the teaching and learning. The possible items containment are following: introduction to the PBL, objectives and rationale of the PBL, process of the PBL, teacher's responsibilities in the PBL, student's responsibilities in the PBL, assessment in the PBL.
8. Making the assessment tools: Making the tools for peers assessment, process assessment, and key competency assessment. After completing the teaching, the teacher had better investigate the responding questionnaire, to acquire the whole reaction of the students, and the teacher can review the improvement accordingly.
9. Leading student's learning: During proceeding the PBL, the teacher must guide from beside to see if deviate the target or not. Besides, how to do a group discussion leader, how to interact with classmates and teacher, how to communicate, and how to solve problems also need the teacher to elucidate. Regarding to the mode chosen, basically, the teacher throws problems to students,

let students self-learning, when acquiring related knowledge of the problem, students participate in the group discussion, then discuss with teacher and share to other teams. Therefore, it exists quite a lot of knowledge delivery and sharing function. The whole PBL groups may operate on the following four ways:

1. Mode 1: Students self-learned-group discussion-discussion with teacher- group discussion again-the whole class discussion.
2. Mode 2: Students self-learned-group discussion-discussion with teachers student self-learned-group discussion again-the whole class discussion.
3. Mode 3: Group discussion-self-learned-group discussion-discussion with teacher-the whole class discussion.
4. Mode 4: Group discussion-discussion with teacher-students self-learned-group discussion with teacher-students self-learned--group discussion again-the whole class discussion.

The mode chosen may depend on student's knowledge level and the depth of the problem. Generally, for simple problems, take the first two modes as good, since the student has already understand the definition of the problem, so can instantly construct the solution by self-educated, then confirm the solution through the group discussion again. For complicated problems, then the latter two modes are good. Because students lack of the preknowledge, can't understand and define the problem right away, they need to have the group discussion in advance, clarify problems or decide the direction, keep going the self-educated or discuss with teacher, then proceed followup learning.

Development of key competencies in the PBL

Greening (1996) thought the upper-grade students of the university should have developed many key competencies. But in real scenario of the teaching, Greening finds many third-grade students do not have key competencies in aspects of information science curriculum. In searching an alternative teaching method, his teaching experiment of the PBL shows that it really helps the improvement of the key competencies. Yip (2001) indicates that the PBL can enhance both the professional competencies and key competencies in information science teaching. He designs the course objectives for the improvement of the key competencies for different subjects as shown in table 3. Students work in teams and practice self-learning and teamwork, develop communication skills, problem solving skills and management skills.

Moy, Brown, Winchester, Stone & Schwenke (1996) proceeds a national project for Australia which tries to find ways to improve key competencies in education and training. The project identifies 5 effective approaches for integrating the key competencies and the first three approaches were related to the PBL: using critical incidents in on-the-job-training, problem based learning and working with training scenarios, project learning in on-the-job-training, performance review using the key competencies, and mapping for key competencies.

In the PBL, the achievements in the subject areas are related to the key competencies the students have. As the students have higher key competencies, the process of the PBL will operate smoothly and the teaching and learning effectiveness will also be raised. However, the PBL provides very good opportunities that may be helpful to improve the key competencies, it is not assured that using the PBL will enhance key competencies definitely. Research has shown that skill in problem solving is not assured to rise by just watching others solve problems. Neither is skill developed by having students solve many problems in the PBL (Woods, 1993). What is needed is practice with feedback about the problem solving process, the teamwork process, the communication process, self-directed skills and self-assessment skills. Therefore, providing

explicit objectives for key competencies, guiding students and giving feedbacks, and assessing the key competencies are important factors to improve the

key competencies. Table 4 lists the key competencies may be developed in the PBL and the facilitating methods and assessment items for each competence. For example, in the development of teamwork skills, teachers may help students to organize groups and create group rules. In order to urge every student to involve in the problem solving process, teachers may use peer assessment to assess the contributions to the group for each student. Whenever the group discussions are proceeding, teachers may monitor the processes and give students guidance and in-time feedback. The assessment items may include participation, leadership, organization, preparation, and progress towards goals.

CONCLUSION

Key competencies, the foundations of professional learning, continuing learning and lifelong learning, have been emphasized by many advanced countries and integrated into the course content and teaching process. The PBL, driven learning with problems related to real life situations, is emphasizing independent learning and small group cooperative learning, provides environments and opportunities to improve the key competencies. But the key competencies are not developed and enhanced by giving students opportunities. The developments of key competencies require explicit activities and in-time feedback. Teachers may need to learn those key competencies first in order to coach students to develop them. Besides, teachers had better gather related resource for improving the key competencies and put them into the student guidelines for references. The key competencies are valued outcomes, which should be described in the PBL course objectives and should be assessed.