Applications of Competency-based Education: In the Context of Diversity and Change

Weerayute Sudsomboon[1]

1. Introduction

In a knowledge economy, a country's national competitiveness is transformation that affects the quality of its education system. This periodic review necessitates the Ministry of Education of Thailand amended the National Education Act B.E. 2542 (1999). The main purpose of National Education Act is to provide a basis for developing quality and standards by offering student-centered learning, school-based management, pre-service teacher reform and knowledge construction. Moreover, the teaching and learning methods of vocational teachers' should emphasize competency-based education, and understanding of knowledge and professional development of teaching [1].

Competency-based education (CBE) is aimed at providing students with the knowledge, skills, and attitudes to enable them to recognize and solve complex problems in their domain of study or future work, i.e., authentic tasks [2]. Arguelles & Gonczi [3] proposed that the advantages of CBE are learned and how it can be used in solving a complex problem, which have considered important. Knowledge application, problem-solving and heuristics are key points of CBE. The successfully realization of CBE heavily relies on the teachers, who are expected to give up their role as 'knowledge transmitter' and adopt the new role of 'coach' and 'instructional designer'.

The emerging workforce should have the excellent technical skills in more than one technical area - (e.g. database and web). Both breadth and depth has had employability skills, process knowledge and technical skills. The responsible work includes in term of habits and ethics, and then initiative and willingness to learn. As well as, the effective approaches to problem solving are necessary [4].

Consequently, teachers are renovated with the different pedagogy approach to translate occupational/competency standards into competency- based curriculum as a meaningful sequence of learning outcomes. In addition, the Vocational Education is now involved in a real educational reform, in which CBE is the central axis. New direction and strategies are proposed and new methods of the teaching-learning-evaluation process are taken into account. In the paper there is specifically focus on vocational

[1] Lecturer, Department of Mechanical Technology Education, Faculty of Industrial Education and Technology, King Mongkut's University of Technology Thonburi, Tel. 08-9477-6487, E-mail: weerayute.sud@kmutt.ac.th

Received 19 November 2009; Accepted 17 February 2010

teachers, will be provided. The changing nature of instructional design and its implement on the focus and availability is discussed.

2. Competency Standards

One of the human resource development policies in many advanced countries establishes competency standards which are agreed-upon, and are industry-identified knowledge, skills, and abilities required for a person employed in the workplace market. First of all, teachers should be developed a competency-based curriculum in the context, as teacher education plays an increasingly role in perspectives on optimizing of the industrial sector.

The National Skill Standards Board of America proposes a common framework [4], as shown in Table 1, to be followed by each state or industry sector which desires to develop skill standards.

From Table 1, able to describe as follow as:

1. **Occupational title** is synonymous to job title, which specifies the domain of competency standards.

2. **Critical work function**, equivalent to collective competency, is the major responsibility in a job area.

3. **Key activity**, synonymous to a single skill, is the major duty or task involved in carrying out a critical work function.

4. **Performance indicator** provides information how to determine when someone is performing each key activity competently.

5. **Technical knowledge** is the related knowledge needed to perform the key activity.

6. **Employability knowledge and skill** is a general competency used to help perform the key activity.

Table 1 Competency Standards Framework of America

Occupational Title:	occupational name in industry sectors
Critical Work Function:	main responsibilities associated with occupation
Key Activity:	identifiable and measurable competencies
Performance Indicator:	effective performance in key activity
Technical Knowledge:	Knowledge associated with key activity
Employability Knowledge and Skill:	general competencies for key activity

The competency standards framework of Australia [5], as shown in Table 2, is similar to that of America. Several related units of competency are grouped under a functional area heading. From Table 1, able to describe as follow as:

1. **Unit of competency** is a set of element of competency performed.

2. **Element of competency** is a measurable professional competency which can be done by oneself.

3. **Performance criteria** specify the level and standard to be reached when performing unit of competency.

4. **Range statement** describes the environments, conditions, and knowledge involved in unit of competency.

5. **Evidence guide** tells the assessors to collect competency evidence for assessment.

6. **Key competency** is a general competency which can support the development of unit of competency.

Table 2 Competency Standards Framework of Australia

Function Area Heading:	title of functional area
Unit of Competency:	unit name, purpose and introduction
Element of Competency:	observable, measurable, and identifiable competency
Performance Criteria:	criteria to be reached when performing unit of competency
Range Statement:	environment and knowledge associated with unit of competency
Evidence Guide:	guidance for gathering evidence and assessment
Key Competency:	seven key competencies

In Table 3, show comparisons between the competency standards framework of America and Australia. It seems the same structures and elements in spite of the different terms used. Also, the most importantly, competency standards emphasize on professional competencies instead of general competencies.

Table 3 Comparisons of Structure of Competency Standards

General Term	America	Australia
Competency	Critical Work Function	Unit of Competency
Skill	Key Activity	Element of Competency
Performance Criteria	Performance Indicator	Performance Criteria
Knowledge	Technical knowledge	Range Statement
Ability	Employability knowledge and skill	Evidence Guide

"Competency" has various definitions. It is divided into seven categories according to the Australian Competency Standard [5], including ability to

1. Collect, analyze, and organize information.
2. Communicate ideas and information.
3. Plan and organize activities.
4. Work with others and in teams.
5. Use mathematical ideas and techniques.
6. Solve the problems.
7. Use technologies.

Moreover, the Texas Skill Standard of the United States: **"academic knowledge and skills"** [6]. Academic knowledge and skills include knowledge and skills in four categories: 1) reading, 2) writing, 3) mathematics, and 4) science. Competence knowledge and skills include know the ability to 1) adapt, 2) analyze and solve problems, 3) reach consensus, 4) collect and analyze, 5) lead, 6) listen, 7) make decisions, 8) organize and plan, 9) develop personal career and life, 10) speak, 11) apply information and communication technologies, 12) use interpersonal skills, and 13) participate in team work [6].

3. Competency Standards Development

In Figure 1 shows the approach that ibstpi (The International Board of Standards for Training, Performance and Instruction) has followed to develop and validate competencies [2]. In addition, author concentrates the competency development concept which involved identifying the knowledge, skills, attitudes, capabilities, and tasks associated with a particular job role such as instructional design. The first one is defined; current practices and existing standards are identified to curricular content through competency (knowledge and skills). Furthermore, the ethics and values commonly used to evaluate performance-related behaviors must also be determined (Attitudes). Finally, a vision of the

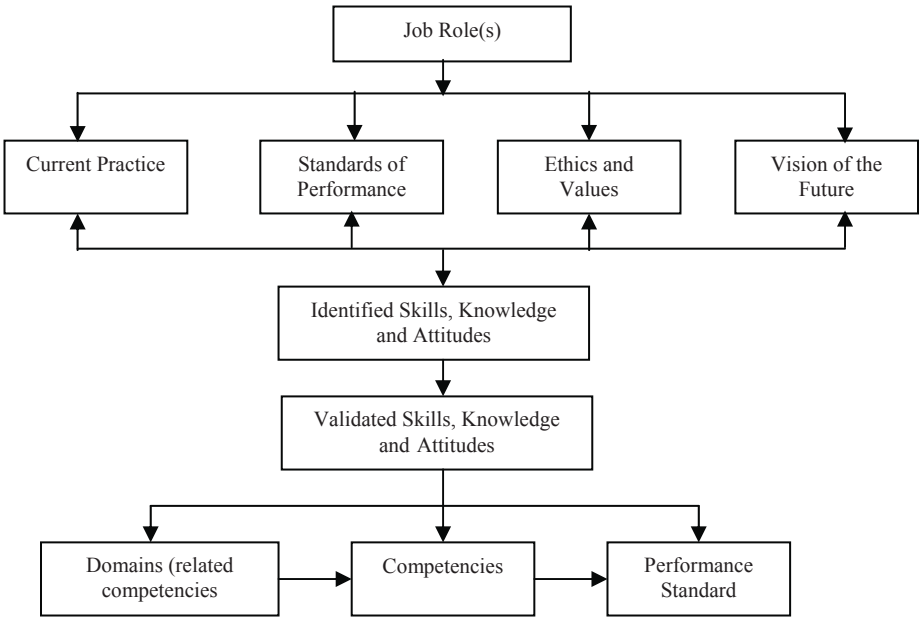

Figure 1 The ibstpi competency development model.

evolving nature and the future job role is articulated. Current practice, existing standards, ethics, values, and a vision of the future collectively provide the major input into the identification and validation of knowledge, skills, and attitudes believed to be critical to effective performance in a particular job role. Researcher applied this competency model, and modified its on conceptual framework with construct a competency analysis profile.

According to Spencer and Lyle [1] proposed that the content validity is co-responded to the present regarding study and development a competency model. Only two concepts were selected and synthesized: the classic study design suing criterion samples and a short study design using expert panels that can be applied in Figure 2.

The experts should be identified the general areas of job responsibilities called duties (typically 8-12 per job), then specified tasks (competencies) performed in connection with each duties (typically 75-125). Modified and structured small group brainstorming techniques are used to obtain the collective expertise and consensus of the training instructors. High quality task and duty statements usually result from this interaction.

4. Competency-based Curriculum Design

The effectiveness and efficiency of any educational programme is largely dependent on the philosophy of the curriculum design followed. The curriculum is the one that drives the engineering technology programme to its destination. If specific competencies are not focused in the curriculum design philosophy, the products of the engineering technology programme may not be “work-ready” and therefore not readily accepted by the industry. Therefore, to reduce the unemployment and ‘under employment’ levels, it becomes necessary to consider

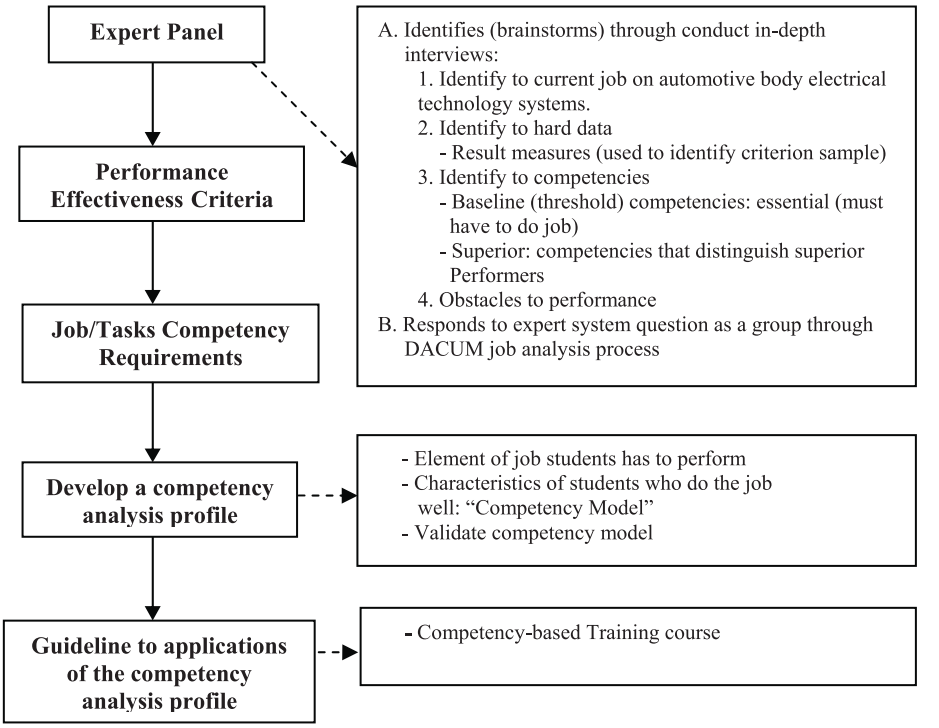

Figure 2 Designing of Competency Frameworks.

'occupation-specific competencies' in the curriculum designs. Since different persons understand the term 'competency' differently. Earnest [7] defined the term competency to bring in more clarity for all concerned, especially with reference to engineering and technical education as shown in Figure 3.

It states that 'the competency is a statement which describes the integrated demonstration of a cluster of related knowledge, skills and attitudes that are observable and measurable, necessary to perform a job independently at a prescribed proficiency level'.

This definition is illustrated in Figure 1 as a complete system comprising of several broad skills and sub-skills (like the practical skills, cognitive skills and social skills and/or attitudes required in performing a given job/task). This definition means; (1) that the competency is an overt and measurable performance in terms of quantity, quality, time, cost or a combination of any of these, for which 'action' or 'performance' oriented verbs are to be used in writing competency statements; (2) a cluster of broad skills consisting of cognitive (intellectual) skills, practical skills, and social skills/attitudes, skillfully weaved together into an integrated whole; (3) the skill also involves higher order cognitive skills of Bloom's Taxonomy [8] required to analyze, interpret, design, evaluate, create, plan, troubleshoot, diagnose etc. as well as lower level practical skills of Dave's taxonomy [9] such as cut, join, machine, measure, solder, paint etc; (4) a 'job' is an activity, which has a definite beginning and

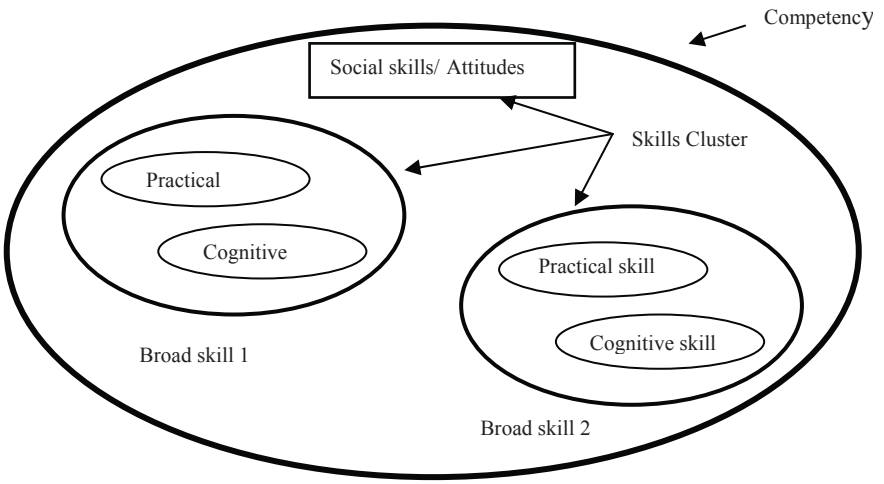

Figure 3 Concept of Competency.

ending point, that can be performed over a short period of time, independent of other work and which results in a product, service or decision; and (5) 'perform' a job at a specified proficiency, means performing a given job successfully every time he/she is asked to do. In other words, tending towards more 'reality' and 'validity'. The 'proficiency level' here is the 'threshold level' i.e. at the entry level to the industry after 4 years of study in the schools/colleges of engineering.

For the industry, the competency logically precipitates out in terms of cluster of broad skills as shown in Figure 1 for each job to be performed. On the other hand, the curriculum developer/teacher thinks still further in terms of practical skills, cognitive skills and social skills/attitudes within each broad skill, as they are the basic building blocks that make up a competency. Tiechler [10] indicated that curricula, teaching and learning for higher education should be more applied in nature or more practice oriented in various ways. Practice oriented higher education was advocated particularity in order to understand and tackle the complexity of real "phenomena" intellectually rather than take theory as an excuse for addressing the real phenomena only as far as the theoretical approaches seem to allow.

Hsiao and Chen [11] proposed that the five stages in of curriculum development for engineering education. The first stage is to search occupational titles for which the field wants to cultivate. These occupations can be got by newspaper advertisement, classification of occupations and visiting senior engineers. The second stage is to solicit representative occupations for competency analysis. The third stage is to analyze competencies needed by these occupations through DACUM technique or Delphi method. It can invite senior workers in relative business, professionals and senior instructors to find importance and frequency for these general competencies and professional competencies for these professionals. The fourth stage is to synthesize these general and professional competencies. The fifth stage is to transfer these competencies into courses design.

For instance, Sudsomboon and Anmanatarkul [12] have been developing 'Competency-based curriculum development on automotive subjects for mechanical technology education program' at Department of Mechanical Technology Education, Faculty of Industrial Education and Technology, King Mongkut's University of Technology Thonburi. They found that the competency frameworks. The competencies profiles of industries and academic experts' requirements are 10 units framework as follow as:

1. Automotive workshop safety,
2. Automotive engine repair,
3. Automotive automatic transmission and transaxle systems technology,
4. Automotive manual drive train and axles systems technology,
5. Automotive suspension and steering systems technology,
6. Automotive brakes systems and supplementary systems technology,
7. Automotive electrical and electronics systems technology,
8. Automotive air conditioning technology,
9. Automotive engine performance, and
10. Learning innovation in automotive technology.

These competencies and competency builders are designed to be the basis for curriculum development to ensure industry input that is relative and meaningful to the workplace. The minimum undergraduate credit is not less than 12 credits. It includes specific obligatory course 9 credits and professional obligatory course 3 credits. It should not identify in selective course because it necessary to linking for social demands in the future. That is when undergraduate to operate in mechanical engineers, trainers in industry, vocational and technical education professional teachers, and studying broad to graduate program. The subject includes start at 2nd year, 3rd year, and 4th year on MTE 271 Automotive Technology I is in ***unit 1 and 2;*** MTE 272 Automotive Technology II is in ***unit 3, 4, 5 and 6;*** MTE 373 Automotive Technology is in ***unit 7 and 8;*** and MTE 474 Automotive Technology IV is in ***unit 9 and 10***.

In the key terms of competencies profile as follow as:

Competency – an observation and measurable behavior that has a define beginning and end; can be performed within a limited amount of time; and consists of two or more competency builders.

Competency builders – the skills, knowledge, and attitudes (written in measurable terms) needed to perform a given competency.

Entry level – position of students that requires no previous experience, but may require some training and/or specific skills, knowledge, or attitudes.

The core competencies of Undergraduate Mechanical Technology Education Students as purposed and listed below were discussed:

1. Ability to apply knowledge of basic science and engineering fundamental;
2. In-depth technical competencies more than one technology discipline such as electro technology, electronic, mechatronic, computer programming for engineers, training skills, and instructional design development based on automotive technology;
3. Ability to undertaken problem solving, formulation and solution;

Table 4 Competencies framework of automotive technology subjects on attributes competencies

Knowledge and Understanding	Skills	Attitudes
1. Knowledge of basic engineering and fundamental of automotive mechanics 2. Knowledge of chosen field of automotive technology 3. Good Understanding to automotive technology concepts. 4. Good Understanding to explorer the document, fix manual, advanced tools for inspection and guideline to solve problems. 5. Good understanding to applied engineering practice 6. Appreciate relevance to other fields 7. Knowledge requires students to engage in complex thinking and reasoning processes as they complete long-term, meaningful tasks.	1. Ability to application the knowledge. 2. Ability to Communication skills, both oral and written in Thai, English and universal language. 3. Ability to Brain-based education. 4. Possess problem solving skills 5. Skills on critical thinking, creative thinking and self-regulated thinking. (System thinking) 6. Adaptability 7. Have safety management ability. 8. Possess technical skills	1. Ethics, moral, and care full Thai culture. 2. Professionalism role. 3. Desire for life-long learning. 4. Openness to new ideas. 5. Positive attitudes. 6. Involves with community. 7. Have conscious in energy conservative and save environmental. 8. Have discipline itself.

4. Ability to function effectively as an individual and in multi disciplinary terms with the capacity to be a leader or teacher as well as effective team member;

5. Understanding of social, ethics, moral, culture, global, environmental and social responsibilities all of the professional vocational and technical education teacher, and the need for industry/social demands;

6. Understanding of and a commitment to professional and ethical responsibilities;

7. Ability to leadership in vocational and technical education and related field of instruction.

8. A potential to undertake lifelong learning.

Students are expected to syndicate responses on attributes competencies in Table 4.

In the curriculum frameworks, Sudsomboon [13] have been developing in order to teaching and learning. The research topic is 'A development of competency analysis profile on automotive transmission service course for training under graduates'. Hence, the result can be described the competency frameworks, learning activities and assessment and evaluation. Everyone can access more information at available online: http://www.kmutnb-journal.net/journal/43295255215324.pdf

5. Instructional Strategies

Competency can be described as using a precise language to specify performance. This precision involves the consistent use of an "action verb" as the beginning word [14]. The action verb, also called active verb, has the meaning of acting, performing, or executing, and always provides important information about the content of a competency or skill. An action verb is usually used to describe skill, competency, basic academic ability, educational objective, curriculum design, learning assessment, learner profile, curriculum vitae, and recruitment advertisement [15].

An action verb also needs an object. The object, a noun or a noun phrase, is the performing target of the action verb. Aside form this, it may need to specify the condition or circumstance to increase precision. Hence, a competency statement has the form of "action + verb + object + condition" [15]. The emphasis on workplace tasks has been accompanied in many cases by a competency-based

education (CBE) approach to teaching. In the CBE classroom students learn to accomplish the actual tasks that they will be expected to perform on the job.

When students master one task, they move on to another, working at their own speed. Moreover, CBE calls for the use of authentic assessment methods in evaluating student achievement; often actual evaluation tools or methods from the workplace are used in the classroom, and frequently industry standards are used to measure student performance. Generally, the form of a task analysis, in which each job task is made teachable by being placed in a framework that contains some or all of the following components [16]:

1. ***Duty Areas*** – Represents a category or job responsibilities, a grouping of similar tasks.

2. ***Task Statements*** – Describes a measurable item of knowledge, skill, or behavior related to the occupational area.

3. ***Performance Objectives*** – Explain what the student must do to demonstrate that he/she has mastered this task/competency.

4. ***Criteria-Referenced Measures*** – Tells how the student performance will be assessed.

5. ***Enabling Objectives*** – Offers suggested steps leading to mastery of the performance objective, including:

- subskills
- related skills
- supporting concepts
- theory behind a psychomotor skills
- reinforcement of prior learning
- parts of the performance required

6. ***Instructional Activities*** – Presents suggested assignments contributing to the student's mastery, including such activities as

- group project (research, site visit)
- individual project (research, site visit, model)
- written work (reports, charts, portfolio)
- oral work (reports, panels)
- critical thinking activities (case study, role-play)
- demonstrations / simulation
- guest speakers with student preparation / response
- audiovisual presentations with student critique
- visual presentations (bulletin boards, posters, print-outs, video, multimedia show)

7. ***Resources*** – Lists a variety of aids for teaching the task

As a result, the framework gives teachers a basic plan of organization, recommended methods and standards for evaluation, and suggested teaching strategies.

6. Implications

Implications of a systematic approach for instructional system and design can be proposed the following components [15]:

Stage 1: First is a needs analysis, in which actual needs are determined and sound of social demands, for improve curriculum, for updated automotive technology, for change in automotive procedures, or some combination of needs. If the need for training is confirmed, a job analysis is next (the DACUM approach is recommended). Next is task verification, which can extend involvement in the job analysis from experts' workers and can provide a means of rating the importance and difficulty of each task and obtaining other valuable decision-making information. It provides into sixth components:

1.1 Conduct needs analysis

1.2 Conduct job analysis

1.3 Conduct task verification

1.4 Select tasks for training

1.5 Conduct standard task analysis

1.6 Conduct literacy task analysis

Stage 2: Based on information collected in stage 1. The instructional programs and materials to be developed, which instruction will be individualized, and support instructional media. The development of learning must focus on objectives for each task or group of tasks, followed by the competency analysis profile. Then, the development of learning can apply to student competency measures. It provides into fourth components:

2.1 Determine training approach

2.2 Develop learning objectives

2.3 Develop performance measures

2.4 Develop training plan

Stage 3: Should develop main components, although depending on the type of materials to be produced. It provides into sixth components:

3.1 Perform competency profile

3.2 Draft learning guides/modules

3.3 Construct learning aids

3.4 Construct curriculum guide/lesson plan

3.5 Construct supportive media

3.6 Pilot-test/revise materials

Stage4: It provides into fourth components:

4.1 Implement training plan

4.2 Conduct training

4.3 Conduct formative evaluation

4.4 Document training

Stage 5: The final stage should be done the formative evaluation complete. The important step is to conduct the summative evaluation to collect data for use in decisions on maintaining or improving the education. This involves gathering data on the overall instructional process, program outcomes, student follow-up, and cost-effectiveness. Completion of the evaluation stage produces the performance data and feedback vital to any education or training system concerned with quality and improving its worth. It provides into third components:

5.1 Conduct summative evaluation

5.2 Analyze information collected

5.3 Initiate corrective actions

7. Vocational Teachers Attributes

Author classified teachers' competency into six categories by referring and integrating the theoretical frameworks suggested in previous research [17]-[20]. The categorization system, including:

1. ***Mental capacity:*** the ability to discover and solve problems by using analytical thinking, forward thinking, deductive reasoning, and creative thinking skills.

2. ***Value systems:*** the ability to be responsible and pro-active, implement and follow through plans, tolerate fraction and stress, plan long-term, and maintain a consistent belief system.

3. ***Interpersonal skills:*** the ability to be respectful and caring, and to use the right tones and registers for the communication context.

4. ***Management ability:*** being able to plan, do, check and delegate work, and use a systematic decision-making process, standard operating procedures, and a reward and punishment system.

5. ***Professional capacity:*** including declarative and procedural knowledge embedded in one's

long-term working memory that can be retrieved when necessary.

6. ***Personality traits:*** being adventurous, curious, caring, confident, innovative, problem-solving, open-minded, and motivated.

8. Conclusion

This article deals a context for the special issue and a framework for the discussion in this issue are provided. A broad interpretation of terms is postulated, e.g., competency standards systems includes methods and techniques of the human resource development policies in many advanced countries establishes competency standards which are agreed-upon, and are industry-identified knowledge, skills, and abilities required for a person employed in the workplace market.; competency-based curriculum design showed the integrated demonstration of a cluster of related knowledge, skills and attitudes that are observable and measurable, necessary to perform a job independently at a prescribed proficiency level; instructional strategies refers to a process of combining various distinguishable parts to create a systematic approach; implications of a systematic approach for instructional system and design changes in directly aspects to promote learning outcomes; and teachers' competency that require effort and are aimed at achievement goal orientation. The implications of CBE can be applied to change new model for Thai vocational education and training system which emphasis on teaching and learning method.

References

[1] Office of The National Education Commission. (2008, May 18). *A Study of Manpower Needs of Industrial Sectors in Thailand, 2006*, [Online] Available from: www.onec.go.th/ publication/49047/ index_49047.htm.

[2] J. D. Klein & R.C. Richey, "Improving individual and organizational performance: The case for international standards," *Performance Improvement*, vol.44, no. 10, pp. 9-14, 2005.

[3] A. Arguelles & A. E. Gonczi, *Competency based education and training: a world perspective*, Mexico City: Grupo Noriego Editores. 2000.

[4] The Washington Skill Standards. [Online] Available from: http://www.wa-skills.com

[5] The Australia's National Training Information Service. [Online] Available from: http://www.ntis.gov.au

[6] The Texas Skill Standards. [Online] Available from: http://www.tssb.org

[7] E. Joshua, "Competency-based Engineering Curricula," in *An Innovation approach: Proceedings of the International Conference on Engineering Education*, August 6-10 2001. Oslo. Norway: Session no. 439.; http:// www.ineer.org/welcome.htm/icee-2001.

[8] B.S. Bloom, *Taxonomy of Educotional Objectives Handbook. I : The Cognitive Domain,* NY : David Mckay, 1956.

[9] R.H. Dave, *Developing and writing Behavioral Objectives*., (R.J. Armstrong, ed.). Tucson Arizona Educational Innovators Press, 1975.

[10] U. Teicher, "New perspectives of the relationships between higher education and employment," *Teritary Education and Management*, vol. 6, pp.79- 92, 1998.

[11] H.C. Hsiao, S. C. Chen & K. K. Huang,

"Practice based curriculum development for technical institute in school," International Conference on Information Technology Based Higher Education and Training: Kumamoto. Japan, pp.451-457, 2001.

[12] W. Sudsomboon & A. Anmanatarkul, "Competency-Based Curriculum Development on Automotive Subjects for Mechanical Technology Education Program," in *Proceedings of the 5th International Conference on Developing Real-life Experiences: Education Reform through Educational Standards (ERES 2007)*. King Mongkut's Institute of Technology Ladkrabang. Bangkok. August 2-3, pp.35-44. 2007.

[13] W. Sudsomboon, "A Development of Competency Analysis Profile on Automatic Transmission Service Course for Training Undergraduate Students," *Journal of King Mongkut's University of Technology North Bangkok*, vol. 19, no. 1, pp. 43-54, 2009.

[14] The Illinois Occupational Skill Standards. [Online] Available from: http://www.ioes.org/etecurriculum-skillsstandards.cfm

[15] R. E. Norton. [On line] Available: http://www.dacumohiostate.com/SCID.htm

[16] M. C. Grattan & S. B. Trevvett, *Writing competency-based frameworks: A workbook for teachers*, Virginia Department of Education. 2005.

[17] F. Korthagen, "In search of the essence of a good teacher: toward a more holistic approach in teacher education," *Teaching and Teacher Education*, vol. 20, no.1, pp. 77-97, 2004.

[18] B. Koster, M. Brekelmans, F. Korthagen. & T. Wubbels, "Quality requirements for teacher educators," *Teaching and Teacher Education*, vol. 21, no.2, pp. 157-176, 2004.

[19] A. Stoof, R. L. Martens, and J. J. G. Van Merrienboer, "What is competence? A constructivist approach as a way out of confusion. 2000," in *Paper Presented at the Conference of the Dutch Educational Research*, Leiden.

[20] R. D. Tennyson, "An educational learning theory for instructional design," *Educational Technology*, vol. 32, no.1, pp. 493-514.