

Towards Sustainable Development Regardless of Professional Competency: A Study of Automotive Air Conditioning Service Course

Weerayute Sudsomboon¹⁾ Anusit Anmanatarkul²⁾ Sompob Panyasompun³⁾

^{1) 2) 3)} Academic Lecturer,

Department of Mechanical Technology Education, Faculty of Industrial Education and Technology, King Mongkut's University of Technology Thonburi, 126 Pracha-utis Rd., Bangmod, Toong-kru, Bangkok 10140, Thailand.

Phone: (662) 470-8526, (6689) 477-6487, Fax: (662) 470-8527

Email: weerayute.sud@kmutt.ac.th

ABSTRACT

This research presents a practical discussion on promoting the students professional competency. The purposes of this research were to develop a competency analysis profile on automotive air conditioning service course, and to examine the essential core competency for training undergraduate students of Mechanical Technology Education program at King Mongkut's University of Technology Thonburi. The qualitative and quantitative data was collected through observations, in-depth interviews, document analysis, and DACUM (Developing a Curriculum) job analysis process with 12 training instructors from 8 well-known the car automobile companies in Thailand. The triangulation method was referred to validate a competency analysis profile. The results of this study indicated that were 11 job duties, 83 tasks and 7 core competencies framework. Moreover, the importance of 56 core competencies as rated by respondents and the mean rating was calculated for each competencies item. The quality of the resulting had to apply the systematic curriculum and instructional development to effective implementation guidelines. They can be applied to change the training program of prospective the mechanical technology education to enhance future students' competency.

Keyword: Automotive Technology Education, Automotive Air Conditioning Service Course, Competency Analysis Profile, Professional Competency

INTRODUCTION

A country's national competitiveness is contingent upon the quality of its education system, and a country's quality of teachers is arguably the single most important factor that affects its education quality. Hong et al. (2008) defined such rationale underscores as "the necessity for a country to improve the quality of its teaching faculty during education reform in order to increase its national competitiveness" (as cited in Reid and Donoghue, 2004, p. 561). In dealing with national competitiveness, the ministry of Education of Thailand amended the National Education Act of B.E. 2542 (1999). According to Chapter 4, the National Education Guidelines in Section 22 described "Education shall be based on the principle that all learners are capable of learning and self-development, and are regarded as being most important". The teaching-learning process shall aim at enabling the learners to develop themselves at their own pace and to the best of their potentiality. Moreover, Section 24 described "In organizing the learning process, educational institutions and agencies concerned to provide training in thinking process, management, how to face various situations and application of knowledge for obviating and solving problems".

In recent decades, the effectively training in automotive technology areas can be provided in the field of higher education from knowledge-oriented to competency-based education (Achtenhagen, 2001; Arguelles & Gonczi, 2000; Hong, Horng, Lin, & Chanlin, 2008; Hooveld, Pass, & Jochems, 2005; Samuelowicz, 2001). Competency-based Education (CBE) is focused on Student learning outcomes with the knowledge, skills, and attitudes to enhance them to skill development and solving the problems in their domain of study or future work, i.e., authentic tasks (Keens, 1992). It provides the tools to extend Mechanical Technology Education (MTE) Program at King Mongkut's University of Technology Thonburi (KMUTT). As technology assumes an increasingly dominant role in society, technology literacy is becoming as essential as students' competency and the ability to service, repair and diagnosis. In providing the fundamentals of technological literacy, technology education increases capability prepare to live and work in a world of continuously evolving technologies. Current automobiles are a challenge to service and repair because of this advanced technology, but the future automobile will be even more complicated (Riley, 1985). This advanced and continuously evolving technology will require students' competencies to have greater knowledge, skills, and attitudes. In the area of triple service, repair, and diagnosis that a technologically literate student uses tools, materials, training systems, and processes in an informed, ethical, and social responsible. To be responsible members of society, students must be aware, attempt and achievement that ever changing technology has on their lives (Oklahoma Department of Career and Technology Education, 2006).

The MTE program at KMUTT separates into 5 areas are: 1) applied engineering mechanic; 2) thermal engineering; 3) dynamic systems and control; 4) automotive technology; and 5) applied educational technology. The nature of MTE program requires the integration of different disciplines such as general education (e.g., mathematics, science, social science, computer programming, information technology, language arts, leadership and management), mechanical engineering, electrical engineering, electronic engineering, industrial engineering and industrial education and training, etc. Therefore, the purposed education development is motivated by the need for a systematic MTE educational curriculum between mechanical engineers and technical teachers/trainers (Technologist/Experts in training). The concept of teacher training in MTE program is to stress implementation of teaching technique principle and to emphasize the knowledge, skills and attitudes in field of mechanical engineering and educational technology. Derived from the concept of industrial education is a terminology used more specifically in this research to describe social demands that need competency-based learning strategy for student development. With collaborative efforts, enterprise and university jointly design learning programs to meet the demands of potential student as well as the needs of social demand.

Moreover, automotive technology changes affect adjustments in, and instructional system and design of, students' competencies. Thus, MTE program should use a suitable competency analysis model in order to establish the competency connection and standards in every domain. The intention is to find out accurate reference information for course development, instructional design and evaluation targets (Casey, 1999). Consequently, the development of an automotive technology competency analysis profile model is actually an important requirement for training undergraduate students. Thus, the purposes of this study were: 1) develop a competency analysis profile on automotive air conditioning service course; and 2) to examine the essential core competency for training undergraduate students of Mechanical Technology Education program at King Mongkut's University of Technology Thonburi. The research question included: 1. How to identify the effectively of competency analysis profile in automotive air conditioning system upon social demand? 2. What is the essential core competency for performing in automotive air conditioning system?

THEORETICAL FRAMEWORK

In order to accomplish this research, it is essential to understand the characteristics of competency analysis have the following;

- **Rationale for designing occupational competency analysis profile**

Occupational competency analysis profile identifies the essential behavior model for professionals to carry out a task or mission. This behavioral model includes motive, characteristic and skill or knowledge of the fundamental characteristic. Specially, competency refers to the performance that a person has to implement in order to work effectively, especially when adequately playing a role or undertaking a task/mission. Furthermore, it can be observed and measured (International Labour Organization, 2002). Thus, competency is not only the aggregation of knowledge, skills, and attitude, but also a dynamic concept of putting action into practice. In particular, it also means to accomplish the purpose of learning outcome under a specific need. In order to achieve the goal of automotive technology training effectively, what needs to be done first is an analysis of the content of the competency in education and training so that the items and standards concerning measuring competencies can be determined.

- **The function of occupational competency analysis profile**

The implementation of an educational training program should be based on social demands, and the competency analysis process identifies whether students have attained the competency standards proficiently. The purpose is to let graduates devote themselves to the effect of globalization and revolutions in technology within social demands and graduates' skills. The main purpose of competency analysis is to analyze one occupation to improve a learner understand and approach in the content deals of work habit, work situation, and workplace. The essential have to integrate knowledge, skills and attitudes that he/she posses.

- **The DACUM process**

DACUM was derived from the phrase "Developing A Curriculum" and DACUM approach was created in July 1968 in British Columbia, Canada. It is a competency-based approach to curriculum development and places the emphasis on the learners gaining ability to meet specific objectives formulated according to a set of standards. DACUM is based on three assumptions as follows: 1) Expert workers can define and describe their job more accurately than anyone else; 2) Any job can be effectively described in terms of the tasks that successful workers in that occupation perform; and 3) In order to be performed correctly, all tasks demand certain knowledge and attitudes from workers (Norton, 1991). The DACUM process consists of four components namely: 1) the selection of workshop participants; 2) the DACUM workshop; 3) data analysis; and 4) the development of the course. The participants in the workshop should be experts in their respective areas of specialization, articulate and forward thinking.

- **The DACUM workshop**

Norton (1991) says the DACUM workshop brings together all experts and provides the topic for identify a competency analysis profile content framework with consultation and negotiation of competency-based curriculum. The DACUM workshop includes the themes of Automotive Technology Profile through the

National Skills standards Board of America that proposes a common framework, as shown in figure 1, to be followed by each state or industry sector which desired to develop standard. Researcher was moderator explained about the overview of skills standard framework. Therefore, started at 1) Occupational title was synonymous to job title, which specifies the domain of competency standards. 2) Critical work function, equivalent to collective competency, was 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 on how to determine when someone was performing each key activity competently. 5) Technical knowledge was the related knowledge needed to perform the key activity. 6) Employability knowledge and skill was a general competency used to improve performs the key activity.

RESEARCH METHODOLOGY

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 (Klein & Richey, 2005). In addition, researcher would like to propose 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 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.

The qualitative and quantitative data was collected through observations, in-depth interviews, document analysis, and DACUM (Developing a Curriculum) job analysis process with 12 training instructors from 8 well-known the car automobile companies in Thailand. The triangulation method was referred to validate an automotive technology competency analysis profile (Creswell, 2008). The triangulation method is the strategies researcher use to collect data of corroborating evidence from different individuals (e.g., training instructors and automotive service technicians), types of data (observations and in-depth interviews), and methods of data collection (e.g., document analysis and in-depth interviews) in description and theme in this study. Common techniques of data gathering are in-depth interview, documentary analysis, and on-site observation. Just using these techniques produce a questionnaire for interpreting the reliability of a competency analysis profile. As analytic descriptions or reconstructions of training instructors symbolic meanings and pattern of utilize tools into research design. Researcher was also conducted in Figure 2. Furthermore, accuracy of the finding are varied terms that researcher use to describe, and strategies used to validate qualitative accounts vary in number (Creswell & Miller, 2000).

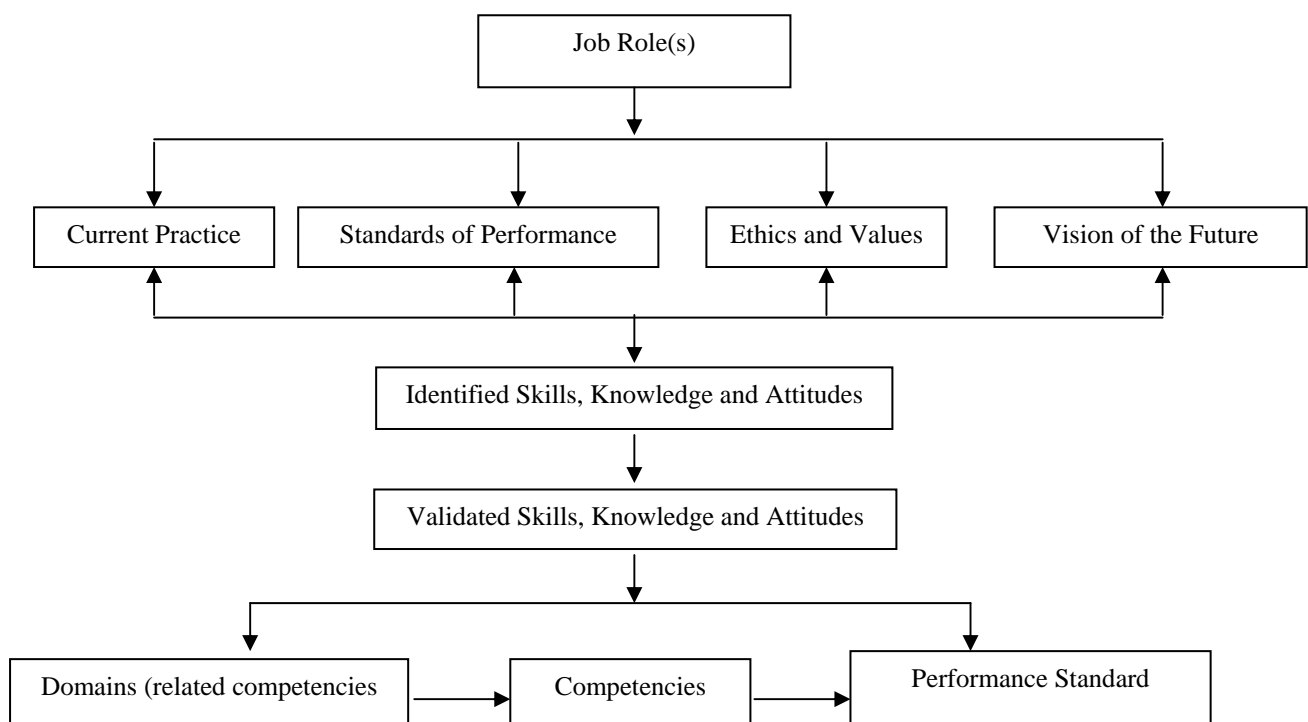


Figure 1: The *ibstpi* competency development model

Research was designed and adapted according to Spencer and Lyle (1983), since the content validity co-responded to the present study and development a model. Only two concepts were selected and synthesized: the classic study design using criterion samples and a short study design using expert panels that can be applied in Figure 2.

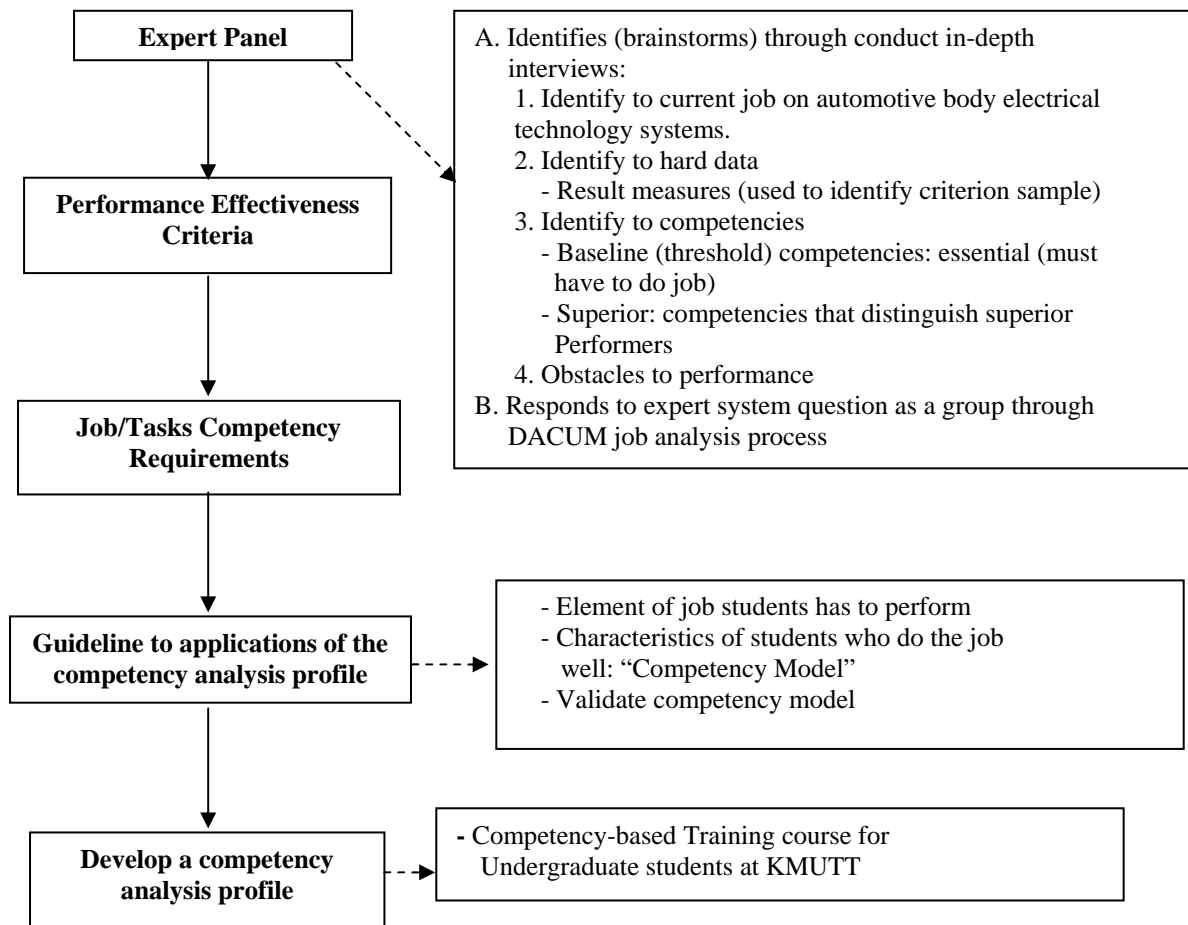


Figure 2: Designing of Competency Analysis Profile Process

The training instructors identifies 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. The three-day DACUM workshop was held in April 2008 at Department of Mechanical Technology Education at KMUTT with 8 participants. Researcher is a trained DACUM facilitator and conducted the workshop.

RESULTS

The results has shown by proposing the following students' competencies that identified and verified by a panel of subject matter experts currently employed in the field of Automotive Technology Education. The competency analysis profile of automotive body electrical technology system is divided into 11 job duties, 83 tasks and 7 core competencies framework. This panel of experts has determined that these skills will adequately prepare students for entry level positions in the context of automotive body electrical technology systems. This study is developed into module which each in core competencies are included to guide identifies the knowledge, skills and attitudes students need to perform each competency. Core competencies are designed to be the basis for training program to ensure stakeholders input that is relative and meaningful to the workplace. This competency intended to include all basic, necessary skills for this area, but may be supplemented with additional competencies as essential as students' competency and the ability to service, repair and diagnosis.

Experts are identified to training effectively into three categories:

1. Competency - an observation and measurable behavior that has a defining beginning and end; can be performed within a limited amount of time; consists of two or more core competencies; and leads to a product, service, or decision.

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

3. Entry level – position of stakeholders that requires no previous experience, but may require some training and/or specific knowledge, skills, and attitudes. All tasks have the skills level designation recognize program content requirements vary by program type and regional subject taught.

Therefore, flexibility has been built into the list by assigning each task the skills level. The skills level number simply indicates the minimum in their program in order to be taught in that area. Sudsomboon (2007) defined that skill development can be assigned 1 of 3 skills level is:

1. Elementary Skills Level (E-1) items must be taught in the training program ninety percent (90%).

2. Intermediate Skills Level (I-2) items must be taught in the training program eighty percent (80%).

3. Advanced Skills Level (A-3) items must be taught in the training program sixty-five percent (65 %).

Thus, Occupational competency analysis profile on automotive air conditioning systems describes the core competencies framework for training program on automotive technology subjects provide opportunities (Sudsomboon, 2008) to develop, reinforce, and apply. It consists of 7 core competencies framework have thus:

1) Numeracy skills as they calculate, estimate, and measure;

2) Information skills as they identify, locate, gather, store, retrieve, process, discuss, and present information;

3) Communication skills as they apply general education within technology to communicate their generate ideas, solutions, reflections, and produces;

4) Problem-solving skills as they identify, describe, and analyze problems, and test their ideas and solutions through applied cognitive approach, psychomotor approach, and affective approach;

5) Social and cooperative skills as they interact with others to solve problems and complete projects;

6) Leadership and career professional teacher skills as they set goals, plan, address challenges, resolve conflicts, and code of conduct; and

7) Competencies as they carry out technological tasks using tools, equipment, and materials correctly, safety, effectively, and efficiently.

In the each of module, researcher was collected data based on the conceptual framework of Duffy (1998). Training instructors was determined with a questionnaire in each module. The content analysis was improved to correct and appropriate in the context of now automotive technology. This study was a pilot project conducted by MTE program at KMUTT. The result revealed that:

Table 1: A questionnaire for important duty and tasks analysis through DACUM process

Duty and Task Statements	Skills Level	Importance Mean
1. Analysis of Heating, Ventilating and Air Conditioning System Tasks 4.1.1 – 4.4.8	I-2	4.34
2. Analysis of Pump, Fan, Duct, and Piping System Tasks 4.2.1 - 4.2.10	E-1	3.27
3. Visual Inspection on Automotive Air Conditioning System Tasks 4.3.1 - 4.3.7	E-1	4.56
4. Diagnosis and Repair on Refrigeration System Components (Low Side) Tasks 4.4.1 – 4.4.8	I-2	4.73
5. Diagnosis and Repair on Refrigeration System Components (High Side) Tasks 4.5.1 – 4.5.9	I-2	4.61
6. Diagnosis and Repair on Engine Cooling Systems Tasks 4.6.1 – 4.6.11	I-2	4.59
7. Diagnosis and Repair on Operating Systems and Related Controls in Electrical Systems Tasks 4.7.1 – 4.7.8	A-3	4.88
8. Diagnosis and Repair on Operating Systems and Related Controls in Mechanical Systems Tasks 4.8.1 – 4.8.6	A-3	4.42
9. Analysis of Automatic Automotive Air Conditioning Temperature Control Systems Tasks 4.9.1 – 4.9.4	A-3	4.65
10. Analysis of Environment safe with Refrigerant Recovery, Recycling, and Handling Tasks 4.10.1 – 4.10.7	I-2	5.00
11. Selected Topic of Automotive Air Conditioning System Tasks 4.11.1 – 4.11.5	A-3	4.47

Note. Important duty and tasks analysis were rated on a 3-point scale.

Essential = 5, Important = 3, and Not Important = 1.

Table 2: A questionnaire for task verification to core competencies ratings through DACUM process

Duty and Tasks Statements	Important Mean
1. Numeracy skills:	
Engineering Mathematics	3.5
Statistics	4.2
Thermal Engineering	4.8
2. Information skills:	
Identify	5.0
Locate	4.5
Gather	4.0
Store	4.5
Retrieve	4.6
Process	4.8
Discuss	4.6
Presentation	4.5
Technical writing	5.0
Comprehensive	
3. Communication skills:	
English languages and others	4.2
Learning by technology	4.8
Oral communication	4.4
Reflections	4.1
4. Problem-solving skills:	
Identify	5.0
Describe	4.7
Step for analyze problems	5.0
Critical Thinking	4.7
Creative Thinking	4.2
Systematic Thinking	4.8
Hand on experience	4.9
5. Social and cooperative skills:	
Interpersonal	4.5
Organizations	4.3
Self-awareness	4.5
Self-reliance	4.5
Self-efficacy	4.5
Time management	4.8
Ethics	4.5
Team building	4.5
6. Leadership and Career professional teacher skills:	
Set goals	4.5
Plan address	4.5
Challenge	4.2
Revolve conflicts	4.5
Code of conduct	4.8
7. Competencies:	
Using basic tools	
Using special tools	5.0
Using equipment	5.0
Using training materials	5.0
Correctly	5.0
Cleanly	4.8
Safety	5.0
Effectively	5.0
Efficiently	5.0
Integration	5.0

Note. Important duty and tasks analysis were rated on a 3-point scale.

Essential = 5, Important = 3, and Not Important = 1.

The task verification questionnaire consisted of the list of actual duties and tasks performed by entry-level training instructors in automotive engine service, repair and diagnosis as identified through the DACUM process. Respondents were asked to indicate the importance of each task and how frequently each task is

performed by entry-level training instructors using a three-point Likert's Rating scale (Essential = 5, Important = 3, and Not Important = 1). Analysis of the responses was referred to validate an automotive technology competency analysis profile. The only 7 items received a mean rating of 4.0 to 5.0 a range defined as essential, being the highest rating. These essential duty and task statement need to all items. Also included in the task verification questionnaire was the list of competencies required of training instructors. The importance of 56 core competencies as rated by respondents and the mean rating was calculated for each competencies item. Items with a mean rating of 4.0 to 5.0 were considered essential to the automotive technology competency analysis profile on automotive technology course of MTE undergraduate program at KMUTT. Items with a mean rating of 3.5 to 3.9 were classified important.

On the other hand, Susomboon (2008) found that training instructors perceived the cognitive domain competencies as more important benefits of automotive technology education program than competencies in the affective and psychomotor domains. The knowledge domain of automotive technology education program completers to: 1) identification of automotive hand tools set; 2) identify to use mechanical, electrical and electronics precision/measure equipment; and 3) knowledge to select information guide to solve problems. The essential guidelines to implement of a competency analysis profile in the context of automotive body electrical technology systems. Training instructors' consensuses the competencies/outcomes must be specifically articulated and individually addressed in terms of how the learner will acquire the desired knowledge, skills and attitudes, and how acquisition of that competency will be represented into fifth stages: (Acntenhagen, 2001; Arguelles & Gonczi, 2000; Barnett, 1994; Samuelowicz, 2001)

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 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

Stage 4: 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

DISCUSSION AND CONCLUSION

This result identified strategies for identifying and implementing of automotive air conditioning system. It is identifying the tasks required of competent undergraduate students in each of study. These task lists are continually validated by industry-based teams from 8 well-known the car automobile companies in Thailand, and therefore represent state-of-the-art service procedures. The competency analysis profile was also included the standards for implementing equipment, facilities, staff, and institutional support. Additionally, the academic skill content has been identified through a rigorous process for inclusion in materials.

There were 11 job duties, 83 tasks and 7 core competencies framework. The only 5 items received a mean rating of 4.0 to 5.0 a range defined as essential, being the highest rating. These essential duty and task statement need to all items. Also included in the task verification questionnaire was the list of competencies required of training instructors. The importance of 56 core competencies as rated by respondents and the mean rating was calculated for each competencies item. Items with a mean rating of 4.0 to 5.0 were considered essential to the automotive technology competency analysis profile on automotive technology course of MTE undergraduate program at KMUTT. Items with a mean rating of 3.5 to 3.9 were classified important. Furthermore, the specifically designed it cross the competencies by applied from entry level, assigned 1 of 3 skills level.

Researcher found that a precise language to specify performance. The precision involves the consistent use of an “action verb” as the beginning word. The action verb, also called active verb, was a transitive verb had the meaning of acting, performing, or executing, and always provides important information about the content of a competency. An action verb was usually used to describe skill, competency, basic academic ability, educational objective, curriculum design, learning assessment, learner profile, curriculum vitae, and recruitment advertisement. An action verb also needs an object. The object, a noun or a noun phrase, is the performing target of the action verb. Aside from this, it may need to specify the condition or circumstance to increase precision. Hence, a competency statement had the form of “action verb + object + condition” that can be proposed in Figure 3 (Mansfield & Mitchell, 1996; Norton, 2004).

<p>Occupational Title: occupational name in industry sectors Critical Work Function: main responsibilities associated with occupational 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</p>
--

Figure 3: Skill Standards Framework of America

It was provided the themes of automotive technology profile through the National Skills standards Board of America that proposes a common framework, as shown in figure 1, to be followed by each state or industry sector which desired to develop standard. Researcher was moderator explained about the overview of skills standard framework. Therefore, started at 1) Occupational title was synonymous to job title, which specifies the domain of competency standards. 2) Critical work function, equivalent to collective competency, was 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 on how to determine when someone was performing each key activity competently. 5) Technical knowledge was the related knowledge needed to perform the key activity. 6) Employability knowledge and skill was a general competency used to improve performs the key activity.

This occupational competency analysis profile is critical to competent performance by quality undergraduate students. They are also the basis for the integration of higher education and contextual or applied learning. The significant points can be proposed as follows:

1. Students must continually adapt to changing competency and technology as automotive components and systems become increasingly sophisticated.
2. Dual training program between university and enterprise is the best preparation for these challenging technology-based learning.
3. Opportunities should be done for students with operation to current situation or relative jobs. The essentially skills as well as diagnostic and problem-solving skills, knowledge of electronics and instrumentation aptitude.

The successful realization of competency-based education heavily relies on the teachers, who are expected to give up their role as ‘knowledge transmitter’ and adopt the new role of ‘coach’ (Enkenberg, 2001; Kerr, 1996; Pratt, 1998; Samuelowicz, 2001), and ‘instructional designer’ (Tennyson, 2001). Researcher hopes that this research has begun to address some of significant educational challenges of automotive technology performing. A thorough systematic curriculum and instructional development has resulted in establishment of clear, realistic and justifiable competency analysis profile. This comprehensive will facilitate common standards

of training and professional practice which iterative approach to training program development. These reasons provide a universal structure for training and assessment of automotive technology on competency-based educational development.

SUGGESTIONS

The following suggestions were derived from the results and analysis of this research:

1. This research has been developed in occupational competency analysis profile that can be used to improve capability and establish training program. It may be quicker and more effective to finish establishing the necessary competency analysis profile.
2. Each step of occupational competency analysis profile, identifies the competencies needed to enter a given automotive technology area.
3. The occupational competency analysis profile not only lists the competency but also clusters those competencies into broader instructional modules and details the knowledge, skills, and attitudes (students' competencies) needed to perform each competency.
4. Within the competency list are two levels of items: core competency and core skills. Core competency items, which are essential for entry-level students, are required to be taught. Core skills items are those needed to integrate for increasing actively in the identification and verification of additional items.

RECOMMENDATIONS

The recommendations that the two delivery methods were similar in terms of final learning outcomes:

1. Instructional system design through modules and focuses on performance-based, individual paced & needs and learning in the field with assistance of resource person.
2. Assessment and evaluation should be applied the authentic method through objective criterion, criterion-referenced and student competencies.
3. Training strategies should be applied by learning with technology and high-end tools for operating that affected to manipulate and accuracy.

REFERENCES

- Acntenhagen, F. (2001). Criteria for the development of complex teaching-learning environments. *Instructional Science*, 29, 361-381.
- Arguelles, A., & Gonczi, A. E. (2000). *Competency based education and training: a world perspective*. Mexico City: Grupo Noriega editors.
- Barnett, R. (1994). *The limits of competence: knowledge, higher education and society*. Buckingham: Open University Press.
- Casey, D. (1999). *Method and procedure for developing competency standards*. Proc. *Australian-Taiwan Seminar on Competency Based Training*. Taichung: Taiwan. 3-15.
- Creswell, J.W. (2008). *Educational research: planning, conducting, and evaluating quantitative and qualitative research (3rd ed.)*. New Jersey: Pearson Merrill Prentice Hall, 266-277.
- Creswell, J.W., & Miller, D.M. (2000). Determining validity in qualitative inquiry. *Theory into Practice* XXXIX(3), 124-130.
- Duffy, J.E. (1998). *Auto Electricity and Electronics Technology*. Illinois: The Goodheart-Willcox company, INC.
- Enkenberg, J. (2001). Instructional design and emerging teaching models in higher education. *Computers in Human Behavior*, 17, 495-506.
- Hong, Jon-Chao., Horng, Jeou-Shyan., Lin, Chan-Li., & ChanLin, Lih-Juan. (2008). Competency disparity between pre-service teacher education and in-service teaching requirements in Taiwan. Retrieved February 15, 2008, from www.sciencedirect.com
- Hoogveld, Albert W.M., Pass Fred., & Jochems, Wim M.G. (2005). Training higher education teachers for instructional design of competency-based education: Product-oriented versus process-oriented worked examples. Retrieved March 8, 2008, from www.sciencedirect.com
- International Labour Organization (ILO). (2002). *What is Competence?*. [On line] Available at <http://www.iol.org/public/englesn/region/ampro/cinterfor/complab/xxxx/1.htm>

- Kerr, S. T. (1996). Visions of sugarplums: The future of technology, education and the schools. In S. T. Kerr (Ed.), *Ninety-fifth yearbook of the National Society for the study of education: Part II. Technology and the future of schooling* (pp. 1-27). Chicago: National Society for the Study of Education.
- Klein, J. D. & Richey, R.C. (2005). Improving individual and organizational performance: The case for international standards. *Performance Improvement*, 44 (10), 9-14.
- Lyle M. and Spencer, S.M. (1993). *Competency at work: models for superior Performance*. Massachusetts: John Wiley & Sons, Inc.
- Mansfield, B. & Mitchell. L.1996; Aurora University. 2003; Michelin Career Center. (2004); Norton, R.E. 2004.
[On line] Available at <http://www.dacumohiostate.com/SCID.htm>
- Norton, R.E. (1991). *SCID systematic curriculum and instructional development. Workshop Manual. Center on Education and Training for Employment*. Columbus: The Ohio State University.
- Oklahoma Department of Career and Technology Education. (2006). Automotive Electrical/Electronics Systems Technicians Skills Standards.
[On line] Available at <http://www.natef.org>
- Pratt, D. (1998). *Five perspectives on teaching in adult and higher education*. Malabar, FL: Krieger Publishing Company.
- Reid, A., Donoghue, M.O., (2004). Revising enquiry-based teacher education in neo-liberal times. *Teaching and Teacher Education* 20(6), 559-570
- Riley, R.Q. (1995). Specialty cars for the 21st century: Downsized cars with upscale appeal. *The Futurist*, 29(6), 8-12.
- Samuelowicz, K. (2001). Revisiting academics' beliefs about teaching and learning, *Higher Education*, 41, 299-325.
- Sudsomboon, W. (2007). The Unit of Competence Development on Automotive Electricity and Electronics Systems Technology Subject for Learner Capability Improvement of Faculty of Industrial Education and Technology at King Mongkut's University of Technology Thonburi. *Khon Kaen University, Journal of Education*, 30(4), pp. 56-64.
- Sudsomboon, W., Hemwat B., Seehamat T., & Sudsomboon J. (2008). The appropriateness of automotive technology education curricular content through competencies as perceived by training instructors. Retrieved November 10, 2008, from <http://www.kmutt.ac.th/rippc/pdf/abs51/513002.pdf>
- Sudsomboon, W. (2008). Construction of an Automotive Technology Competency Analysis Profile for Training Undergraduate Students: A Case Study of Automotive Body Electrical Technology Systems. Retrieved November 25, 2008, from <http://educom2008.scis.ecu.edu.au/papers.php>
- Tennyson, R. D. (2001). Defining core competencies of an instructional technologist. *Computers in Human Behavior*, 17, 335-361.