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Construction of an Automotive Technology Competency Analysis Profile for Training Undergraduate Students: A Case Study of Automotive Body Electrical Technology Systems

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ABSTRACT

The purposes of this study was to construct an automotive technology competency analysis profile for training undergraduate students of Mechanical Technology Education program at King Mongkut's University of Technology Thonburi and to identify the tasks list of automotive body electrical technology systems. The qualitative and quantitative data was collected through observations, in-depth interviews, document analysis, and DACUM (Developing a Curriculum) job analysis process with 17 training instructors from 12 well-known car automobile companies in Thailand. The triangulation method was referred to validate an automotive technology competency analysis profile**.** The results of this study indicated that were 7 job duties, 86 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 mechanical technology education to enhance future students' competency.

Keywords: Automotive Technology Education, Competency Analysis Profile, Students' Competency

INTRODUCTION

Is Thai automotive technology education ready for the challenges of the future? Technology is embodied in devices that extend human capacities. 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 to 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, a technologically literate student uses tools, materials, training systems, and processes in an informed, ethical, and social responsibility.

The MTE program at KMUTT separates into 5 areas, these 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 programs 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 programs 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 programs should use a suitable competency analysis model in order to establish the competency connation 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) to construct an automotive technology competency analysis profile for training undergraduate students of Mechanical Technology Education program at King Mongkut's University of Technology Thonburi; and 2) to identify the tasks list of automotive body electrical technology systems that are performed by training instructors.

The research question included:

1. How to identify effectively a competency analysis profile model depending on social demand?
2. What are the essential guidelines to implement a competency analysis profile in the context of automotive body electrical technology systems?

REVIEW OF THE LITERATURE

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

- Rationale for designing competency analysis profile

Competency analysis identifies the essential behaviour 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 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 analyse one occupation to improve a learners understand and approach in the content deals of work habit, work situation, and workplace. It is essential to have to integrate knowledge, skills and attitudes that he/she possesses.

- 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 identifying 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 desire 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 performance of the key activity.

RESEARCH METHODOLOGY

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 behaviours 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 it on conceptual framework to construct a competency analysis profile.

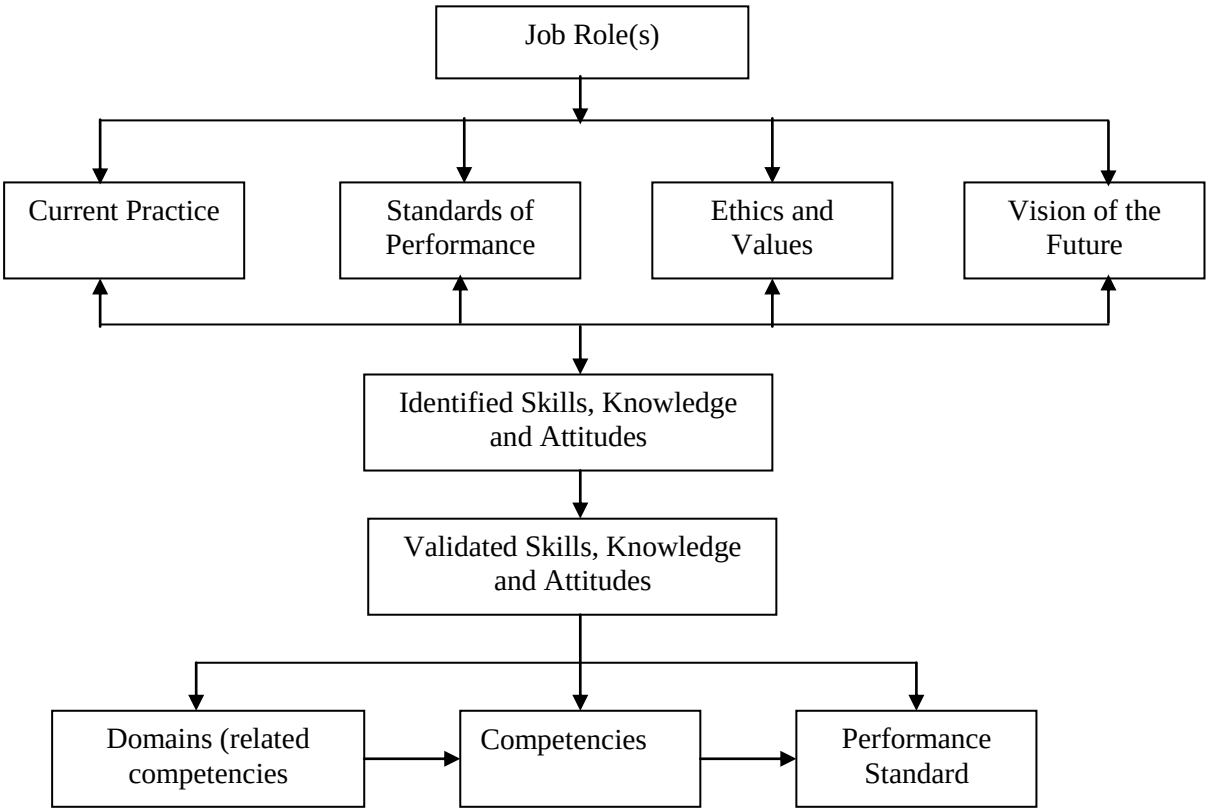

Figure 1: *The ibstpi competency development model*

The qualitative and quantitative data was collected through observations, in-depth interviews, document analysis, and DACUM (Developing a Curriculum) job analysis process with 17 training instructors from 12 well-known 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 strategy the researcher used 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).

Research was designed and adapted according to Spencer and Lyle (1983), since the content validity co-responded to the present study and development 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.

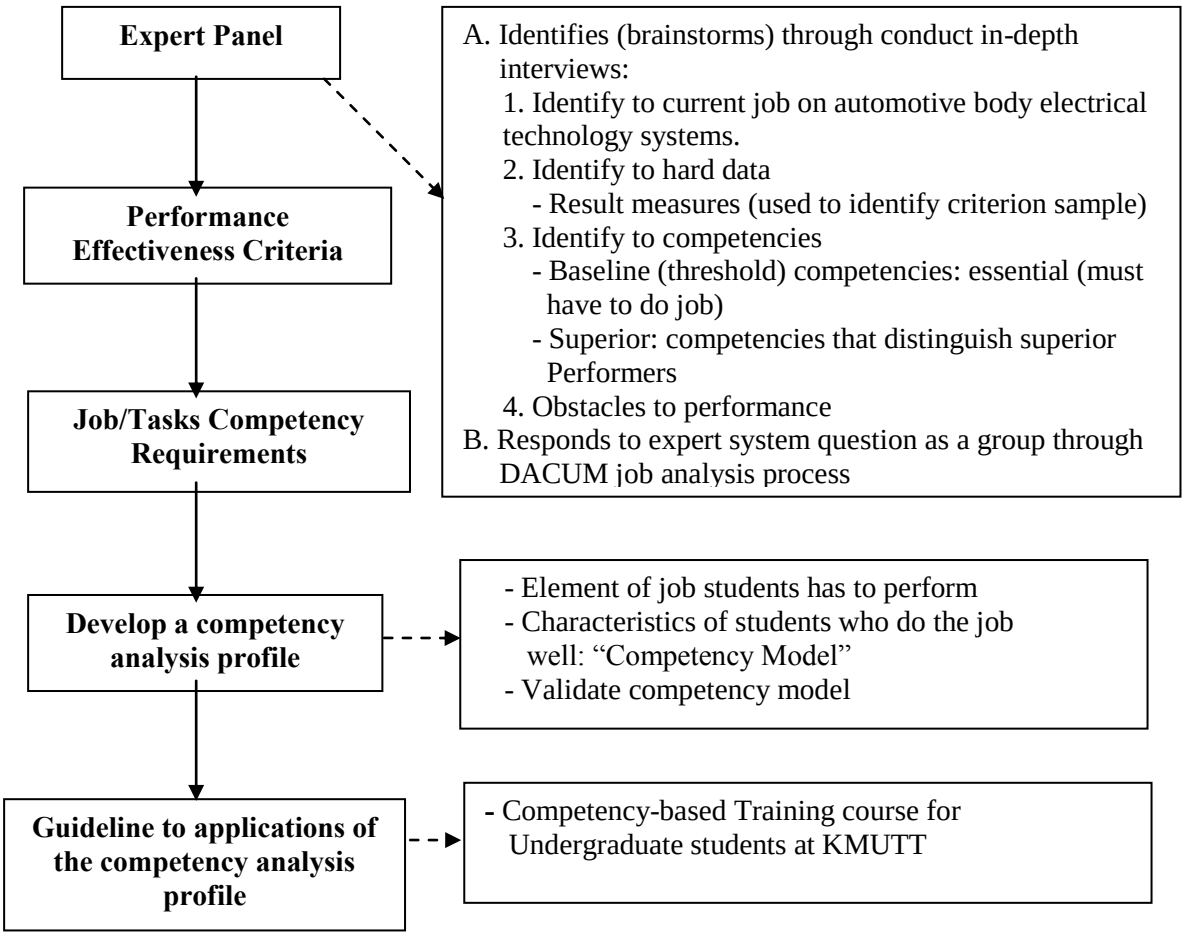

***Figure 2**: Designing of Competency Analysis Profile Process*

The training instructors 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. The three-day DACUM workshop was held in September 2007 at Department of Mechanical Technology Education at KMUTT. Researcher is a trained DACUM facilitator and conducted the workshop.

RESULTS

The results have 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 7 job duties, 86 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 modules which each in core competencies are included to guide and identify the knowledge, skills and attitudes students need to perform each competency. Core competencies are designed to be the basis for training programs to ensure stakeholders input what 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 train effectively in three categories:

1. Competency - an observation and measurable behaviour 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 which 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. It assigned 1 of 3 skills level:

1. Elementary Skills Level (E-1) items must be taught in the training program ninety-five percent (80%).
2. Intermediate Skills Level (I-2) items must be taught in the training program eighty-five percent (70%).
3. Advanced Skills Level (A-3) items must be taught in the training program seventy percent (50%).

In each module, researcher collected data based on the conceptual framework of Duffy (1998). Training instructors were 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:

Module 3: Automotive Body Electrical Systems

Job Duty 3.1 General Automotive Body Electrical System Diagnosis

Task lists:

3.1.1	E-1	Interpret and verify shop safety rules and procedures
3.1.2	E-1	Interpret and verify environmental protect, energy conservations, public mind, and procedures
3.1.3	E-1	Inspect the procedure as follow as instructional module
3.1.4	E-1	Check and prepare tools, equipment, and materials correctly
3.1.5	E-1	Read and use wiring harness diagram of body electrical circuits problems
3.1.6	I-2	Check electrical circuits with a test lamp; determine necessary action
3.1.7	E-1	Check voltage/voltage drop, current, resistance in body electrical circuits and components by using an analog multimeter (AMM) and a digital multimeter (DMM); determine necessary action
3.1.8	E-1	Check current flow in body electrical circuits and components by using ammeter; determine necessary action
3.1.9	E-1	Check continuity and resistances in body electrical circuits and components by using ammeter; determine necessary action
3.1.10	I-2	Explore shorts, grounds, open-close circuit, and resistance problems in body electrical circuits and components; determine necessary action
3.1.11	E-1	Repair wiring harness, sockets, and connectors body of electrical circuits and components
3.1.12	E-1	Perform solder repair of electrical wiring damage
3.1.13	E-1	Measure and diagnose the cause(s) of abnormal key-off battery drain; determine necessary action
3.1.14	E-1	Inspect and test power sources, fusible links, circuit breakers, and fuses; determine necessary action
3.1.15	E-1	Inspect and test switches, connections, relays, and wires of body of electrical circuits and components; perform necessary action

3.1.16	A-3	Diagnosis the cause of power sources, control equipment, and components with instructional manual
3.1.17	A-3	Complete written report (e.g., results, discuss, recommendations, conclusions and suggestions) to be guideline for improving skills in problem-solving, creativity, and decision making

Job Duty 3.2 Battery Diagnosis and Service

Task lists:

3.2.1	E-1	Describe the general safety rules pertaining to battery diagnosis and service
3.2.2	E-1	Interpret and verify environmental protect, energy conservations, public mind, and procedures
3.2.3	E-1	Inspect the procedure as follow as instructional module
3.2.4	E-1	Check and prepare tools, equipment, and materials correctly
3.2.5	E-1	Check and select battery recharges with charging equipment; determine needed service
3.2.6	E-1	Pre-caution and maintain or restore electronic memory functions
3.2.7	I-2	Inspect, clean, distillation fill, and replace battery
3.2.8	E-1	Perform slow/fast battery charge
3.2.9	I-2	Inspect and clean battery cables, connectors, clamps, and hold-downs
3.2.10	A-3	Perform jumper cables with auxiliary power supply according to manufacturers recommended specifications
3.2.11	A-3	Perform hydrometer to read specific gravity of sulphuric acid; determine needed service
3.2.12	A-3	Complete written report (e.g., results, discuss, recommendations, conclusions and suggestions) to be guideline for improving skills in problem-solving, creativity, and decision making

Job Duty 3.3 Starting System Diagnostic and Repair

Task lists:

3.3.1	E-1	Describe the general safety rules pertaining to diagnosis and repair starting system
3.3.2	E-1	Interpret and verify environmental protect, energy conservations, public mind, and procedures
3.3.3	E-1	Inspect the procedure as follow as instructional module
3.3.4	E-1	Check and prepare tools, equipment, and materials correctly
3.3.5	E-1	Verify and interpret starting system concern by duplicating instruction manual
3.3.6	E-1	Perform starter current draw tests
3.3.7	E-1	Perform starter circuit voltage tests
3.3.8	I-2	Inspect and test starter relays, solenoids, clutch, gear train; perform necessary action
3.3.9	A-3	Remove, install and clean starter
3.3.10	A-3	Perform starter bench test, furthermore, ground leak test, winding damage, armature damage, ball bearing, carbon brush, magnetic fields, thrust washer, and bench tests; determine necessary action
3.3.11	A-3	Inspect and test control equipment (e.g., ignition switch, connectors, and starter circuit; perform necessary action
3.3.12	A-3	Complete written report (e.g., results, discuss, recommendations, conclusions and suggestions) to be guideline for improving skills in problem-solving, creativity, and decision making

Job Duty 3.4 Charging System Diagnostic and Repair

Task lists:

3.4.1	E-1	Describe the general safety rules pertaining to diagnosis and repair charging system
3.4.2	E-1	Interpret and verify environmental protect, energy conservations, public mind, and procedures

3.4.3	E-1	Inspect the procedure as follow as instructional module
3.4.4	E-1	Check and prepare tools, equipment, and materials correctly
3.4.5	E-1	Verify and interpret charging system concern by duplicating instruction manual
3.4.6	E-1	Perform charging system output test by using ammeter; determine necessary action
3.4.7	E-1	Diagnose charging system for the cause of undercharge, no-charge, and overcharge conditions according to manufacturers recommended specifications
3.4.8	I-2	Inspect, adjust and replace alternator drive belts; perform necessary action
3.4.9	I-2	Inspect and test voltage regulator (manual/electronics) circuit; perform necessary action
3.4.10	I-2	Perform alternator bench test, furthermore, ground leak test, winding damage, armature damage, ball bearing, carbon brush, rotor/stator core, diodes/rectifier sets, and bench tests; determine necessary action
3.4.11	I-2	Remove, inspect, and install alternator
3.4.12	A-3	Disassembly alternator, clean, inspect and test performance; determine necessary action
3.4.13	A-3	Perform charging circuit voltage drop tests; determine necessary action according to manufacturers recommended specifications
3.4.14	A-3	Complete written report (e.g., results, discuss, recommendations, conclusions and suggestions) to be guideline for improving skills in problem-solving, creativity, and decision making

Job Duty 3.5 Lighting Systems Diagnosis and Repair

Task lists:

3.5.1	E-1	Describe the general safety rules pertaining to diagnosis and repair lighting systems
3.5.2	E-1	Interpret and verify environmental protect, energy conservations, public mind, and procedures
3.5.3	E-1	Inspect the procedure as follow as instructional module
3.5.4	E-1	Check and prepare tools, equipment, and materials correctly
3.5.5	E-1	Verify and interpret lighting systems concern by duplicating instruction manual
3.5.6	E-1	Identify the type of bulbs, illuminate capacity, and reflectors; determine necessary action
3.5.7	E-1	Explore the position of power sources, control equipments, and component of lighting systems; determine necessary action
3.5.8	I-2	Measure and diagnose the cause(s) of abnormal bright (e.g., brighter than normal, intermittent, dim, or no light operation; perform necessary action
3.5.9	I-2	Inspect, replace and aim headlights and bulbs; perform necessary action
3.5.10	A-3	Inspect and diagnose incorrect (e.g., park light, stop light, turn signal light, hazard light, room light, and etc.) operation; perform necessary action
3.5.11	A-3	Complete written report (e.g., results, discuss, recommendations, conclusions and suggestions) to be guideline for improving skills in problem-solving, creativity, and decision making

Job Duty 3.6 Instrument Cluster Systems Diagnosis and Repair

Task lists:

3.6.1	E-1	Describe the general safety rules pertaining to diagnosis and repair instrument cluster systems
3.6.2	E-1	Interpret and verify environmental protect, energy conservations, public mind, and procedures
3.6.3	E-1	Inspect the procedure as follow as instructional module
3.6.4	E-1	Check and prepare tools, equipment, and materials correctly
3.6.5	E-1	Verify and interpret instrument cluster systems concern by duplicating instruction manual

3.6.6	E-1	Inspect and test instrument cluster (e.g., gauges, gauge sending units, engine fault/MIL, and etc.) for cause of intermittent, high, low, or no gauge reading; determine necessary action
3.6.7	E-1	Diagnose the cause of incorrect horn operation; perform necessary action
3.6.8	I-2	Diagnose the cause of wiper operation; diagnose wiper speed control and park control problems; perform necessary action necessary action
3.6.9	A-3	Complete written report (e.g., results, discuss, recommendations, conclusions and suggestions) to be guideline for improving skills in problem-solving, creativity, and decision making

Job Duty 3.7 Accessories Systems diagnosis and repair

Task lists:

3.7.1	E-1	Describe the general safety rules pertaining to diagnosis and repair accessories systems
3.7.2	E-1	Interpret and verify environmental protect, energy conservations, public mind, and procedures
3.7.3	E-1	Inspect the procedure as follow as instructional module
3.7.4	E-1	Check and prepare tools, equipment, and materials correctly
3.7.5	E-1	Verify and interpret accessories systems concern by duplicating instruction manual
3.7.6	E-1	Inspect and test accessories systems (e.g., seat, power window, power door lock, power mirror, and sound) for cause of intermittent, high, low, or no operating; determine necessary action
3.7.7	I-2	Diagnose the cause of incorrect of motor-driven accessory circuits; perform necessary action
3.7.8	I-2	Diagnose the cause of heated glass, power door lock, power mirror; perform necessary action
3.7.9	I-2	Diagnose the cause of radio and sound audio static and weak, intermittent, or no radio reception; determine necessary action
3.7.10	A-3	Identify the cause of supplementary restraint system (SRS) and other passive and active tests for safety systems (theoretical discussion)
3.7.11	A-3	Complete written report (e.g., results, discuss, recommendations, conclusions and suggestions) to be guideline for improving skills in problem-solving, creativity, and decision making

A competency analysis profile on automotive body electrical technology systems describes the core competencies framework for training program on automotive technology subjects provide opportunities to develop, reinforce, and apply. It consists of 7 core competencies framework:

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 and generate ideas, solutions, reflections, and produces;
4. Problem-solving skills as they identify, describe, and analyse 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.

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 statements need all items. Also included in the task verification questionnaire was the list of competencies required for 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.

The essential guidelines to implement 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 five 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 Analyse information collected
5.3 Initiate corrective actions

DISCUSSIONS

This study focused on an automotive technology competency analysis profile for training undergraduate students of Mechanical Technology Education program at King Mongkut's University of Technology Thonburi. This result identified strategies for constructing and implementing automotive body electrical technology systems. An automotive technology competency analysis profile is identifying the tasks required of competent undergraduate students in each automotive body electrical technology system. These task lists (content standards) are continually validated by industry-based teams from 12 well-known car automobile companies in Thailand, and therefore represent state-of-the-art service procedures. The competency analysis profile was also included in 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 7 job duties, 86 tasks and 7 core competencies framework. 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 statements need all items. Also included in the task verification questionnaire was the list of competencies required for 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).

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

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 performance of the key activity.

Consequently, the tools for success on competency-based education that Oklahoma Department of Career and Technology Education (2006) can be described as three components to deliver competency-based instruction. It consists of skills standards, curriculum materials, and competency assessments. On the other hand, social and cooperative skills, leadership and career professional teacher skills, and numerical skill were rated as essential and important for MTE undergraduate programs at KMUTT.

This competency analysis profile is critical to competent performance by quality undergraduate students. This is 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 programs 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 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 comprehensively will facilitate common standards of training and professional practice which are an 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. The automotive technology competency analysis profile, which has been developed in this research, can be used to improve capability and establish training programs. It may be quicker and more effective to finish establishing the necessary competency analysis profile.
2. Each automotive technology competency analysis profile identifies the competencies needed to enter a given automotive technology area.
3. The automotive technology 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 activity 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 a resource person.
2. Assessment and evaluation should be applied by 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.

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

Duty and Task Statements	Importance Mean
1. **General Automotive Body Electrical System Diagnosis**	4.63
Tasks 3.1.1 - 3.1.17	4.37
2. **Battery Diagnosis and Service**	4.14
Tasks 3.2.1 – 3.2.12	3.87
3. **Starting System Diagnostic and Repair**	4.95
Tasks 3.3.1 – 3.3.12	4.77
4. **Charging System Diagnostic and Repair**	5.00
Tasks 3.4.1 – 3.4.14	5.00
5. **Lighting Systems Diagnosis and Repair**	4.92
Tasks 3.5.1 – 3.5.11	4.47
6. **Instrument Cluster Systems Diagnosis and Repair**	4.26
Tasks 3.6.1 – 3.6.9	4.12
7. **Accessories Systems diagnosis and repair**	4.17
Tasks 3.7.1 – 3.7.11	4.06

Note. *Important duty and tasks analysis were rated on a 3-point scale.*
Essential = 5, Important = 3, and Not Important = 1.

Appendix B: A questionnaire for task verification to core competencies ratings through DACUM process

Duty and Task Statements	Importance Mean
1. Numeracy skills:	
Calculus	4.27
Linear algebra	3.54
Diffential equations	3.51
Statistics	4.62
Precision instrumentation	4.93
2. Information skills:	
Identify	4.78
Locate	4.63
Gather	4.17
Store	4.95
Retrieve	4.78
Process	4.91
Discuss	4.73
Present information	4.88
Technical writing	4.56

Appendix B: A questionnaire for task verification to core competencies ratings through DACUM process (continued)

Duty and Task Statements	Importance Mean
3. Communication skills;	
English language and others	5.00
Learning by technology	5.00
Oral communication	4.61
Self – direct learning	3.64
Reflections	3.54
Produces	3.90
4.Problem-solving skills;	
Identify	4.85
Describe	4.76
Step for analyse problems	5.00
Multidisciplinary	5.00
Critical Thinking	4.85
Creative Thinking	4.63
System Thinking	5.00
Hands on experience	5.00
5. Social and cooperative skills;	
Interpersonal	4.87
Organizations	4.62
Self – awareness	5.00
Time management	4.79
Ethics	5.00

Team building	4.86
6. Leadership and career professional teacher skills;	
Set goals	4.23
Plan address	4.36
Challenges	4.69
Resolve conflicts	4.47
Code of conduct	4.94
7. Competencies;	
Using basic tools	5.00
Using special tools	5.00
Using equipment	5.00
Using supplementary materials	4.89
Correctly	4.81
Cleanly	5.00
Safety	5.00
Effectively	5.00
Efficiently	5.00
Integration	5.00

Note. *Important duty and tasks analysis were rated on a 3-point scale. Essential = 5, Important = 3, and Not Important = 1.*