DEVELOPMENT OF AN AUTOMOTIVE TECHNOLOGY COMPETENCY ANALYSIS PROFILE MODEL FOR TRAINING UNDERGRADUATE STUDENTS AT KMUTT: AUTOMOTIVE ENGINE SERVICE, REPAIR, AND DIAGNOSIS

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Introduction

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 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.

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. The goal of produce undergraduate students, MTE program illustrates learning outcomes that first thing. The major our students almost always appear to be vocational and technical teacher on the commissions of

vocational and education in the public/private sector. Which they were operate to auto-mechanics division more than 60%, and operate to be training instructors within mechanical engineers in any areas of career professional.

Therefore, it is necessary to develop the training process of automotive technology at KMUTT. The training will help to increase the competency of students in order to compete in the career professional because the products of the training respond to the needs and wants of the social demands. Moreover, the research results will be used as a guideline to improve learning and teaching of this student group. Thus, the purposes of this study were: 1) to develop a competency analysis profile model for training undergraduate automotive technology students of Mechanical Technology Education program at King Mongkut's University of Technology Thonburi; 2) to identify the tasks that are performed by training instructors; and 3) to propose guidelines for implementation of the model.

The research question included:

1. Do training instructors think a competency analysis profile model should be offered in MTE program to support students' competencies?
2. How to identify the effectively of a competency analysis profile model depend on social demand?
3. What are the essential guidelines to implement of a competency analysis profile model in the context of automotive engine service, repair, and diagnosis?

Literature review

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 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 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.

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 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.

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

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. Competency can be described as using 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" (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 1 Skill standards framework of america

Research methods

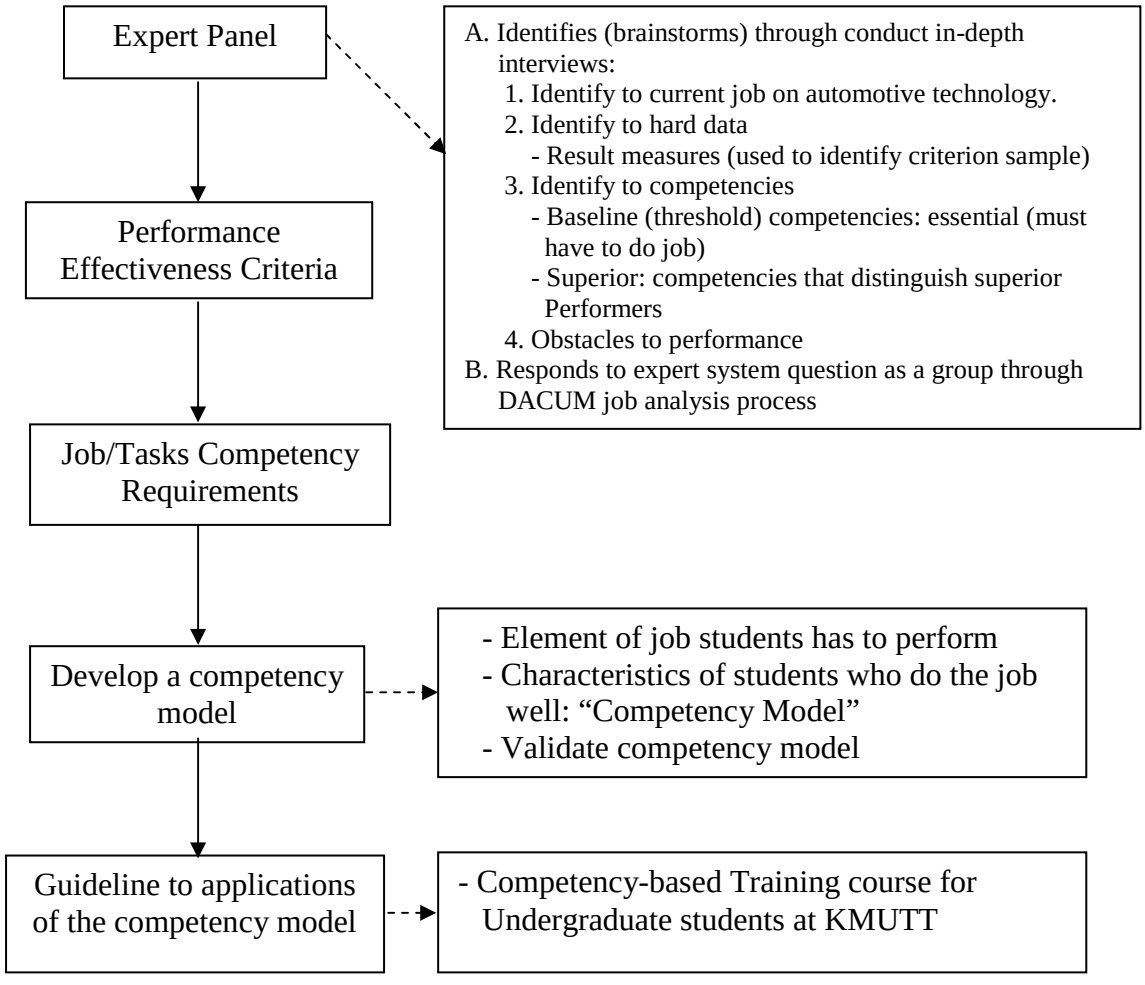

Figure 2 Designing of Competency Analysis Profile Process

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 suing criterion samples and a short study design using expert panels. See Figure 2:

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 May 2006 at Training Center of Mitsubishi Motors (Thailand) Co., Ltd. Researcher is a trained DACUM facilitator and conducted the workshop. The workshop included the following procedural steps:

1. Orient training instructors to DACUM process.
2. Review an automotive technology competency analysis profile (ATCAP) model for training undergraduate students of Mechanical Technology Education program at King Mongkut's University of Technology Thonburi.
3. Identify the general duties in automotive engine service, repair and diagnosis.
4. Identify the specific tasks performed in each duty area.
5. Refine task and duty statement.
6. Sequence task and duty statement.
7. Identify core competencies.
8. Identify the actual duties and tasks performed by entry-level training instructors in automotive engine service, repair and diagnosis.
9. Validate an automotive technology competency analysis profile (ATCAP) model.
10. Propose guidelines for implementation.

Therefore, researcher was conducted in order to construct an automotive technology competency analysis profile (ATCAP) model for training undergraduate students at KMUTT. In automotive technology education, a systematic process has evolved consisting of five steps which guide one in developing a competency analysis profile. This is also referenced to as an outcomes-based training. 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 measured or accessed. ATCAP model represented into fifth stages:

Stage 1 needs analysis: 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. Conduct needs analysis
2. Conduct job analysis

3. Conduct task verification
4. Select tasks for training
5. Conduct standard task analysis
6. Conduct literacy task analysis

Stage 2 design: 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:

1. Determine training approach
2. Develop learning objectives
3. Develop performance measures
4. Develop training plan

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

1. Perform competency profile
2. Draft learning guides/ modules
3. Construct learning aids
4. Construct curriculum guide/ lesson plan
5. Construct supportive media

6 Pilot-test/ revise materials

Stage 4 implementation: It provides into fourth components:

1. Implement training plan
2. conduct training
3. conduct formative evaluation
4. document training

Stage 5 evaluation: 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:

1. Conduct summative evaluation
2. Analyze information collected
3. Initiate corrective actions

Results

The results has shown an ATCAP model 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 ATCAP model of automotive engine service, repair and diagnosis is divided into 5 job duties, 99 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 engine service, repair, and diagnosis. This model 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 ATCAP 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 is:

1. Elementary Skills Level (E-1) items must be taught in the training program ninety-five percent (95%).

2. Intermediate Skills Level (I-2) items must be taught in the training program eighty-five percent (85%).

3. Advanced Skills Level (A-3) items must be taught in the training program seventy percent (70%).

The ATCAP model was a pilot project conducted by MTE program at KMUTT. The result revealed that: (Duffy. 2000)

Module 1 automotive engine repair

Job duty 1.1		**Perform general mechanical engine diagnosis to determine necessary action**
Tasks:		
1.1.1	E-1	Interpret and verify shop safety rules and procedures
1.1.2	E-1	Interpret and verify environmental protect, energy conservations, public mind, and procedures
1.1.3	E-1	Inspect the procedure as follow as instructional module
1.1.4	E-1	Check and prepare tools, equipment, and materials correctly
1.1.5	E-1	Verify and interpret engine concern by duplicating engine instruction manual
1.1.6	I-2	Explain why proper diagnosis methods are important to engine repair
1.1.7	E-1	List common symptoms of engine mechanical problems
1.1.8	E-1	Perform engine vacuum tests
1.1.9	E-1	Perform engine cylinder power balance tests repairs.
1.1.10	A-3	Summarize procedures for gasoline and diesel engine compression testing
1.1.11	I-2	Explain when and how to do a wet compression test

1.1.11	E-1	Perform engine cylinder compression tests
1.1.12	E-1	Perform engine cylinder leakage tests
1.1.13	I-2	Inspect engine assembly for fuel, oil, coolant, fluid contamination and other leaks
1.1.14	A-3	Diagnosis engine noise and vibrations
1.1.15	A-3	Diagnosis the cause of excessive oil consumption, unusual engine exhaust color and odor
1.1.16	E-1	Perform oil pressure tests to determine necessary action
1.1.17	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 1.2		**Removal and reinstallation (R & R) engine**
Tasks:		
1.2.1	E-1	Describe the general safety rules pertaining to engine removal, reinstallation, and parts cleaning
1.2.2	E-1	Interpret and verify environmental protect, energy conservations, public mind, and procedures
1.2.3	E-1	Inspect the procedure as follow as instructional module
1.2.4	E-1	Check and prepare tools, equipment, and materials correctly
1.2.5	E-1	Verify and interpret engine concern by duplicating engine instruction manual
1.2.6	E-1	List the preparation for engine removal
1.2.7	I-2	Explain the use of an engine lifting fixture or chain, and an engine crane
1.2.10	E-1	Describe typical inspections that should be make during engine disassembly and cleaning
1.2.11	A-3	Remove engine (front-wheel drive)
1.2.12	A-3	Reinstall engine (front-wheel drive)
1.2.13	A-3	Remove engine (rear-wheel drive)
1.2.14	A-3	Reinstall engine (rear-wheel drive)
1.2.15	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 1.3		**Inspect and repair engine cylinder head and valve train**
Tasks:		
1.3.1	E-1	Describe the general safety rules pertaining to inspect and repair engine cylinder head and valve train
1.3.2	E-1	Interpret and verify environmental protect, energy conservations, public mind, and procedures
1.3.3	E-1	Inspect the procedure as follow as instructional module
1.3.4	E-1	Check and prepare tools, equipment, and materials correctly
1.3.5	E-1	Verify and interpret engine concern by duplicating engine instruction manual
1.3.6	E-1	Adjust valves (mechanical or hydraulic lifters)

1.3.7	E-1	Inspect and replace timing belt(s), overhead camdrive sprockets, and tensioners; check belt tension; adjust as necessary
1.3.8	E-1	Verify camshaft(s) timing according to manufacturer's specifications and procedure
1.3.9	I-2	Remove cylinder head(s); visually inspect cylinder head(s) for cracks; check gasket surface areas for warp age and leakage
1.3.10	I-2	Install cylinder heads and gaskets; tighten according to manufacturer's specifications and procedures
1.3.11	I-2	Inspect valve spring retainers, locks, and valve grooves
1.3.12	I-2	Resurface valves; perform necessary action
1.3.13	I-2	Resurface valve seats; perform necessary action
1.3.14	I-2	Check valve spring assembled height and valves stem height; service valve and spring assemblies as needed
1.3.15	I-2	Inspect pushrods, rocker arms, rocker arm pivots and shafts for wear bending, crack, looseness, and blocked oil passages (orifices); perform necessary action
1.3.16	I-2	Inspect hydraulic or mechanical lifters; replace as needed
1.3.17	I-2	Inspect camshaft drives (including gear wear and backlash, sprocket and chain wear); replace as necessary
1.3.18	A-3	Inspect and test valve springs for squareness, pressure, and free height comparison; replace as needed
1.3.19	A-3	Replace valves stem seals
1.3.20	A-3	Inspect valve guides for wear; check valve guide height and stem-to-guide clearance; recondition or replace as needed
1.3.21	A-3	Check valve face-to-seat contact and valve seat concentricity (runout); service seats and valves as needed
1.3.22	A-3	Inspect camshaft for runout, journal wear, and lobe wear
1.3.23	A-3	Inspect and measure camshaft bearings for wear, damage, out-of-round, and alignment and determine necessary action
1.3.24	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 1.4		**Inspect and repair engine block assembly**
Tasks:		
1.4.1	E-1	Describe the general safety rules pertaining to inspect and repair engine block assembly
1.4.2	E-1	Interpret and verify environmental protect, energy conservations, public mind, and procedures
1.4.3	E-1	Inspect the procedure as follow as instructional module
1.4.4	E-1	Check and prepare tools, equipment, and materials correctly
1.4.5	E-1	Verify and interpret engine concern by duplicating engine instruction manual
1.4.6	E-1	Inspect internal and external threads and restore as needed
1.4.7	E-1	Prime engine lubrication system
1.4.8	I-2	Inspect and replace pans, covers, gaskets, and seals

1.4.9	E-1	Deglaze cylinder walls
1.4.10		Clean cylinder walls
1.4.11	I-2	Inspect engine block for visible cracks, passage condition, core and gallery plug condition, and surface warp age to determine necessary action
1.4.12	I-2	Inspect and measure cylinder walls for damage and wear to determine necessary action
1.4.13	I-2	Inspect and measure main and connecting rod bearings for damage, clearance, and end play to determine necessary action (includes the proper selection of bearings)
1.4.14	I-2	Inspect, measure, and service pistons and pins to determine necessary action
1.4.15	I-2	Inspect, measure, and install piston rings
1.4.16	I-2	Reassemble engine components using correct gaskets and sealants
1.4.17	A-3	Remove cylinder wall ridges
1.4.18	A-3	Inspect and measure camshaft bearings for wear, damage, out-of-round, and alignment; determine necessary action
1.4.19	A-3	Inspect crankshaft for surface cracks and journal damage; check oil pressure condition; measure journal wear; determine necessary action
1.4.20	A-3	Identify piston and bearing wear patterns that indicate connecting rod alignment and main bearing bore problems; inspect rod alignment and bearing bore condition
1.4.21	A-3	Inspect, repair or replace crankshaft vibration damper (harmonic balancer)
1.4.22	A-3	Inspect auxiliary (balance, intermediate, idler, counterbalance or silencer shaft(s); inspect shaft(s) and support bearings for damage and wear; determine necessary action; reinstall and time
1.4.23	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 1.5		**Diagnosis and repair engine lubrication and cooling systems**
Tasks:		
1.5.1	E-1	Describe the general safety rules pertaining to diagnosis and repair engine lubrication and cooling systems
1.5.2	E-1	Interpret and verify environmental protect, energy conservations, public mind, and procedures
1.5.3	E-1	Inspect the procedure as follow as instructional module
1.5.4	E-1	Check and prepare tools, equipment, and materials correctly
1.5.5	E-1	Verify and interpret engine concern by duplicating engine instruction manual
1.5.6	I-2	Perform oil pressure test; determine needed repair
1.5.7	A-3	Inspect oil pump gears or rotors, housing, pressure relief devices, and pump drive; replace as needed

1.5.8	E-1	Perform cooling system tests (pressure, combustion leakage, and temperature); determine needed repair
1.5.9	E-1	Inspect, replace, and adjust drive belts and pulleys
1.5.10	I-2	Inspect and replace engine cooling system hoses
1.5.11	I-2	Inspect, test, and replace thermostat and housing
1.5.12	I-2	Inspect coolant; drain, flush, and refill cooling system with recommended coolant and bleed air as required
1.5.13	I-2	Inspect, test, remove, and replace water pump
1.5.14	I-2	Inspect and test radiator, pressure cap, and coolant recovery system; remove and replace radiator
1.5.15	I-2	Clean, inspect, and test fan(s) (electrical or mechanical), fan clutch, fan shroud, and air drums
1.5.16	I-2	Inspect and test electrical fan control system and circuits
1.5.17	I-2	Inspect auxiliary oil cooler; replace as needed
1.5.18	I-2	Inspect, test, and oil temperature and pressure switches and sensors
1.5.19	I-1	Perform oil by using mechanical tools and automatic oil drain machine
1.5.20	I-1	Perform oil by using mechanical tools and automatic oil drain machine

The ATCAP model 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 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.

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 trough 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 (ATCAP) model**.** Of the 5 job duties, 99 tasks and 7 core competencies framework. The only 5 items received a mean rating of 4.0 to 4.8 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 model (ATCAP) on automotive technology course of MTE undergraduate program at KMUTT. Items with a mean rating of 3.0 to 3.9 were classified important. Those items receiving a mean rating of 2.5 to 2.9 were grouped as only somewhat important.

Conclusions

In conclusion, the DACUM outcomes indicate the importance of all duty and task statement. The core competencies have indicated the importance of problem-solving skills, competencies, information skills, and communication skills. 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 program at KMUTT.

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

1. The automotive technology competency analysis profile model, which has been developed in this research, 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 ATCAP identifies the competencies needed to enter a given automotive technology area.

3. The ATCAP 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.

5. The framework of the teaching and assessment strategy for educational training should be basis for competency analysis.

6. The ATCAP model of this research can provide vocational and technical institutes and car automobile training division with job duties and tasks as a reference in performance appraisal.

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.

Suggestions for future reseach

1. This research focused on the development of an automotive technology competency analysis profile model MTE program at KMUTT, although the establishment of a competency standard still needs to be researched further.

2. This research should be guideline in teaching resources, the instructional programme framework, implementation, evaluation, assessment and record the process information.

3. The reputation of the next research must be communicated to perspectives in the whole of automotive technology education (e.g., job duties and tasks placement statistics showing students accomplishment after program completion and comparisons to traditional type of training program can be available to students.

4. This research should explore to implement, cover in any area of automotive technology.

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Appendix A. A questionnaire for important duty and tasks analysis trough DACUM process

Duty and Task Statements	**Importance Mean**
1. Perform General Mechanical Engine Diagnosis to Determine Necessary Action	4.8
Tasks 1.1.1 - 1.1.17	4.5
2. Removal and Reinstallation (R & R) Engine	4.6
Tasks 1.2.1 – 1.2.15	4.3
3. Inspect and Repair Engine Cylinder Head and Valve Train	4.5
Tasks 1.3.1 – 1.3.24	4.2
4. Inspect and Repair Engine Block Assembly	4.5
Tasks 1.4.1 – 1.4.23	4.1
5. Diagnosis and Repair Engine Lubrication and Cooling Systems	4.8
Tasks 1.5.1 – 1.5.20	4.4

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	3.4
Linear algebra	2.6
Diffential equations	2.5
Statistics	4.3
Precision instrumentation	4.8
2. Information skills:	
Identify	4.5
Locate	4.7
Gather	4.4
Store	4.9
Retrieve	4.6
Process	4.7
Discuss	4.8
Present information	4.8
Technical writing	4.8

Appendix B. (continued)

Duty and Task Statements	**Importance Mean**
3. Communication skills;	
English language and others	5.0
Learning by technology	4.8
Oral communication	4.2
Self – direct learning	3.4
Reflections	2.7
Produces	2.8
4.Problem-solving skills;	
Identify	4.5
Describe	4.1
Step for analyze problems	4.8
Multidisciplinary	4.7
Critical Thinking	4.8
Creative Thinking	4.4
System Thinking	5.0
Hands on experience	5.0
5. Social and cooperative skills;	
Interpersonal	4.5
Organizations	4.8
Self – awareness	4.8
Time management	4.6
Ethics	4.8
Team building	4.3
6. Leadership and career professional teacher skills;	4.2
Set goals	4.2
Plan address	4.3
Challenges	4.6
Resolve conflicts	3.5
Code of conduct	4.2
7. Competencies;	
Using basic tools	5.0
Using special tools	4.8
Using equipment	4.8
Using supplementary materials	4.4
Correctly	4.8
Cleanly	5.0
Safety	5.0
Effectively	5.0
Efficiently	5.0
Integration	4.8

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