An Analysis of Competencies Required in Electricity and Electronics by Automotive Technicians in the Chippewa Valley

by

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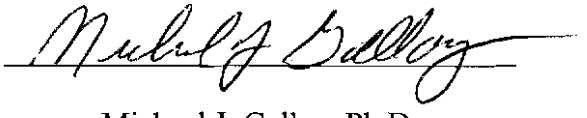

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ABSTRACT

Automobile technology changes fast. Graduates of the Automotive Maintenance Technician Program at Chippewa Valley Technical College (CVTC) may be underprepared for entry-level jobs due to curriculum that outdates quickly. There is a need for program curriculum in the area of electricity and electronics to be updated more frequently with competencies that are in alignment with industry needs.

A survey was sent to employers of graduates of the CVTC Automotive Maintenance Technician Program that listed each National Automotive Technicians Education Foundation (NATEF) competency in the area of electricity and electronics. The survey respondents were asked to rank the importance of each competency both now and in the future. Respondents were also given the opportunity to make additions, comments, and suggestions.

Results of the study indicated that the Automotive Maintenance Program at CVTC is in alignment with industry needs because it uses NATEF standards in its curriculum. The survey results also indicated that the NATEF standards for electricity and electronics correspond to that of actual industry job tasks. The study made recommendations to maintain current NATEF tasks in the program curriculum and update it at a minimum of every five years when NATEF changes its task list.

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Chapter One: Introduction

Background Information

In any technical college program, the graduates of the program are like products being sold in industry. If the product fails to perform as promised, this gives a bad impression on the seller and manufacturer. Once word spreads of a products' inferiority, the manufacturer will soon become bankrupt if changes in product design are not made.

If graduates of a technical college training program are underprepared because they lack skills, then the program is doing the graduates and their prospective employers a disservice (Paulson, 2001). The Automotive Maintenance Technician Program at Chippewa Valley Technical College (CVTC) is no exception.

CVTC is one of 16 colleges in the Wisconsin Technical College System (WCTS) CVTC serves an 11 county area in Western Wisconsin as illustrated in Figure 1. The main campus is located in Eau Claire, with major outreach campuses in Chippewa Falls, Menomonie, Neillsville, and River Falls.

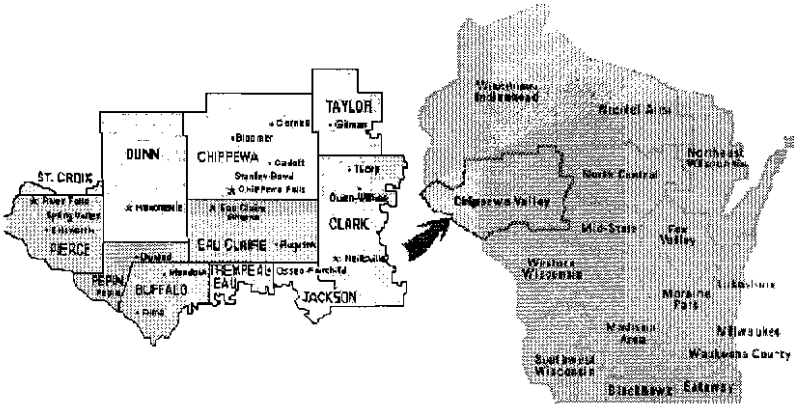

Figure 1. Chippewa Valley Technical College Region/Campuses and WTCS Colleges (CVTC, 2007a)

Student enrollment at CVTC exceeds 7,000 credit students per year. Half of CVTC students are under age 24, with student ages ranging from 16 to 68. The student population is 43% male and 57% female. Two-thirds of CVTC students work part-time. About 65% of full-time, first-time degree-seeking students receive financial aid (CVTC, 2007c).

The Automotive Maintenance Technician Program at CVTC provides training over the course of 40 weeks. This training program provides entry-level skills for a career in the automotive service industry (CVTC, 2007b).

The training that Automotive Maintenance Technician students at CVTC receive is competency-based. Competency-based education is derived from an analysis of a role that the student will take in modern society and attempts to measure demonstrated performance in some or all aspects of that role (Grant, 1979). This method of instruction has been implemented and widely employed since the 1970s as part of teaching programs for adult learners (Cos, 2004). Competencies play a vital role in training effectiveness, especially now that schools are linking them to job skills (Paulson, 2001).

The National Automotive Technicians Education Foundation (NATEF) has the responsibility of accrediting automotive technician training programs. There are eight areas of NATEF accreditation, which correspond with the eight areas of the National Institute for Automotive Service Excellence (ASE) technician certification (National Automotive Technicians Education Foundation [NATEF], 2005). Programs can be accredited in:

1. Brakes
2. Suspension and Steering
3. Heating and Air Conditioning
4. Engine Performance

5. Automatic Transmissions
6. Manual Transmissions and Drive Train
7. Electricity/Electronics
8. Engine Repair

Minimum program accreditation can be met in as few as four areas: steering and suspension, brakes, electricity and electronics, and engine performance. A status of *Master Training Program* is achieved when a program has accreditation in all eight areas (NATEF, 2005). Certified programs make it easier to ensure that students have the opportunity to learn the skills necessary to succeed on the job and meet the public's expectations (Sutphin, 1994).

NATEF has a competency list that states which competencies are to be included in the curriculum of a training program. These competencies are given a "P" ranking based upon level of difficulty; P-1 is least difficult, P-2 moderately difficult and P-3 being most difficult. A training program must include at least 95% of P-1 tasks, 80% of P-2 tasks, and 50% of P-3 tasks in their curriculum to become accredited in a given area of certification (NATEF, 2005). This competency list updated approximately every five years by a committee that represents the various areas of the automobile industry. The committee consists of individuals representing the major automobile manufacturers, automobile repair shop owners and technicians, automobile instructors and trainers, and automobile equipment and parts suppliers. The committee meets to discuss the competency list and add new skills that correlate to new technologies in the automotive repair industry and to remove tasks that are no longer relevant (NATEF, 2005).

The NATEF certification handbook states: "Theory instruction and hands-on performance of all the basic competencies will provide initial training for entry-level employment in the automotive service field or further training in any or all of the specialty areas"

(NATEF, 2005, p. 37). The Automotive Maintenance Technician Program at CVTC does comply with NATEF standards, and is currently a certified training site.

Graduates of the program are noticing the rapid changes in automobile technologies. On three occasions in graduate follow-up studies (Chippewa Valley Technical College, 2002; 2003; 2006), graduates of the program stated they found that much of their early coursework was irrelevant to their current position as an automotive technician. Skills such as rebuilding starters and alternators were being taught to the students, but no longer have relevance in the actual job setting because these skills are no longer performed due to the availability of cost-effective replacement units.

The demand for highly-skilled automotive service technicians is on the rise. According to the U.S. Department of Labor (Bureau of Labor Statistics, U.S. Department of Labor, 2006), demand for these technicians will increase 17% through the year 2014. The demand will grow as the number of vehicles in operation increases. The technician who has the necessary skills can quickly reach the top of their field (Brudereck, 1999).

According to the Virginia Department of Education (2007, n.p.), the daily tasks of an automotive technician include:

1. Talking to service advisors, other technicians, and customers to plan work and report results
2. Diagnosing the source of problems
3. Using electronic testing equipment
4. Reading and interpreting the output of diagnostic equipment
5. Figuring out how to fix problems once they're diagnosed
6. Using technical manuals, reading charts and diagrams
7. Repairing, overhauling, or replacing systems and parts

8. Doing routine maintenance like oil changes and tire rotation
9. Cleaning up the worksite and looking after their tools

An automotive technician's ability to diagnose and repair electricity and electronic problems on automobiles is becoming of great importance. With 10-15 onboard computers, a new car today has more computers than the first spacecraft (Reese, 2002). Automotive technicians must possess a good understanding of electricity and electronics, and need to be able to visualize the operation of the component they are troubleshooting (Wright, 2003). Thirty years ago, automotive technicians just needed to understand basic electrical wiring principles, such as power and ground. Today's automotive technicians need to understand complex wiring circuits with solid-state computer control, along with the basics.

Today's automobiles are using electronic controls that were once done by hydraulics and vacuum. The automatic transmission, once shifted by engine vacuum and hydraulic pressure differential, is now shifted by a computer. The computer uses inputs from various sensors to determine optimal shift points to maintain efficiency and fuel economy (Gilles, 2004). The electrical and electronic diagnostic skills required of automotive technicians will only become more important with the emergence of new technology such as hybrid vehicles, navigation systems, and active fuel management- where half of the engines cylinders are disabled when the vehicle reached highway speeds (Gilles, 2004).

Technical colleges must be concerned with the needs of industry in order for it to provide a qualified workforce (Smith, 1986). For a technical college to develop and maintain curriculum that is current to industry needs, a survey of the competencies required from entry-level employees is needed. This can be done by a task analysis using a survey (Holm, 1986).

In education, a task analysis is a process that is completed to determine which skills, tasks, or goals of an occupation should be included in curriculum (Jonassen, Hannum, & Tessmer, 1989). Task analysis is an integral part of instructional design that should happen as early as possible. Most curriculum writers agree that a poorly executed task analysis will jeopardize the entire curriculum creation process (Jonassen, Hannum, & Tessmer, 1989). From the results of the task analysis, an understanding of the required competencies for a specific occupation should be present. It is now up to the technical college to implement the findings of the task analysis into their curriculum to train potential employees.

Statement of the Problem

Automobile technology changes fast. Graduates of the Automotive Maintenance Technician Program at CVTC may be underprepared for entry-level jobs due to curriculum that outdates quickly. There is a need for program curriculum in the area of electricity and electronics to be updated more frequently with competencies that are in alignment with industry needs.

Purpose of the Study

The purpose of this study is to determine the electricity and electronics competencies required of automotive technicians in the Chippewa Valley both presently and in the future. This will be done by surveying employers of graduates of the Automotive Maintenance Program at CVTC. It would be of great value to determine these competencies so that instructors can update the curriculum before fall of 2008.

Research Objectives

The objectives for the study are to:

1. Identify the automotive electricity and electronics competencies that are needed by a currently practicing automotive technician.

2. Identify which electricity and electronics competencies are most important to employers.
3. Identify the automotive electricity and electronics competencies that are needed by automotive technicians in the future.
4. Identify emerging trends in new technology in the area of automotive electricity and electronics.

Importance of the Study

This study is important for the following reasons:

1. Because of rapidly changing technology, automotive curriculum often becomes outdated rapidly. The NATEF standards used at CVTC for curriculum are updated by NATEF every five years (NATEF, 2005). Therefore, new technology is not included in NATEF standards until the next revision, and as a result not updated at CVTC.
2. Because of changes to engineering methods, the new automobile technology is introduced faster than the old vehicles are leaving the road (Zygmont, 2006). It is important to study which competencies are still relevant and which ones can be removed from program curriculum.

Limitations of the Study

The following items may limit the results of the study:

1. The study will be limited to automotive repair facilities in the Chippewa Valley. The needs of other geographic regions will not be considered.
2. The research will use a survey that was created by the researcher. The survey may contain errors and/or emissions not intended by the researcher. Every effort was made to ensure its validity.

3. The educational background and work experience of the sample used in the survey will vary; therefore an accurate representation of job competencies may not be present.
4. The survey sample was comprised of employers that have hired CVTC Automotive Maintenance Technician graduates. Graduates of the program were not surveyed.
5. There may be certain electrical competencies that are unique to the Chippewa Valley which may not depict an actual need of automotive technicians in other areas.
6. The survey sample was composed of employers who have hired CVTC Automotive Maintenance Technician graduates in the past five years. This does not represent the entire auto repair industry in the Chippewa Valley.
7. Results are limited to that of the survey respondents.

Assumptions of the Study

The following items will be assumed by the researcher during the study:

1. The researcher assumes the all respondents will answer the survey in an honest manner.
2. The researcher assumes individuals with current knowledge of automobiles and the competency needs of automotive technicians will complete the survey.

Definition of Terms

For clarity and understanding, the following terms need to be identified:

Accreditation - to recognize (an educational institution) as maintaining standards that qualify the graduates for admission to higher or more specialized institutions or for professional practice (Merriam-Webster, 2007).

Automotive Technician - a person who specializes in the maintenance, repair, and sometimes modification of automobiles (Wikipedia, 2007).

Chippewa Valley - an area in Western Wisconsin including the communities of Eau Claire, Chippewa Falls, Durand, Menomonie, and Altoona (Wikipedia, 2007).

Competencies - knowledge, skills, attitudes, values, motivations and beliefs people need in order to be successful in a job (Gupta, 1999).

Chapter Two: Review of Literature

Introduction

This chapter will discuss the history of the National Automotive Technicians Education Foundation (NATEF); along with their process for accrediting training programs. It will also discuss competency-based education and conducting a job task analysis. The chapter will conclude with a look at related research done by other individuals and groups.

NATEF Certification

Background and History

NATEF was established in 1983 as a non-profit organization with a mission of evaluating automotive technician training programs against industry standards (Shoemaker, n.d.). The Industry Planning Council (IPC) of the American Vocational Association began the push to certify automotive technician training programs. The IPC felt that technician training programs needed to be significantly improved in order to provide the number of entry level technicians needed (Shoemaker, n.d.).

The board of the National Institute for Automotive Service Excellence (ASE) met and set standards for certifying training programs. A certified training program must meet standards and competencies set forth by the automotive industry and also must meet minimum instructional hours (Shoemaker, n.d.).

This competency list is updated approximately every five years by a committee that represents the various areas of the automobile industry. The committee consists of individuals representing the major automobile manufacturers, automobile repair shop owners and technicians, automobile instructors and trainers, and automobile equipment and parts suppliers. The committee meets to discuss the competency list and add new skills that correlate to new

technologies in the automotive repair industry and to remove tasks that are no longer relevant (NATEF, 2005).

The states with strong leadership at the state level were the first to apply for certification. The automotive technician training program at Northeast Wisconsin Technical College in Green Bay, Wisconsin was one of the first three programs in the nation that received NATEF accreditation (Shoemaker, n.d.).

Purpose

The purpose of NATEF certification is to improve the quality of training offered at the secondary and post-secondary levels (NATEF, 2005). These programs are then recommended for certification by the ASE. This process has resulted in certified training programs at the secondary and post-secondary level in all 50 states.

Standards

The NATEF standards were developed by the automotive industry based upon their needs (NATEF, 2005). The NATEF (2005, p. 4) standards are as follows:

Standard One – Purpose

The automobile technician training program should have clearly stated program goals, related to the needs of the students and employers served.

Standard Two – Administration

Program administration should ensure that instructional activities support and promote the goals of the program.

Standard Three – Learning Resources

Support material, consistent with both program goals and performance objectives, should be available to staff and students.

Standard Four – Finances

Funding should be provided to meet the program goals and performance objectives.

Standard Five – Student Services

Systematic skills assessment, interviews, counseling services, placement, and follow-up procedures should be used.

Standard Six – Instruction

Instruction must be systematic and reflect program goals. A task list and specific performance objectives with criterion referenced measures must be used.

Standard Seven – Equipment

Equipment and tools used must be of the type and quality found in the repair industry and must also be the type needed to provide training to meet the program goals and performance objectives.

Standard Eight – Facilities

The physical facilities must be adequate to permit achievement of the program goals and performance objectives.

Standard Nine – Instructional Staff

The instructional staff must have technical competency and meet all state and local requirements for certification.

Standard Ten – Cooperative Agreements

Written policies and procedures should be used for cooperative and apprenticeship training programs.

Certification Process

The NATEF certification process is quite rigorous. First, a program must begin by conducting an extensive self-evaluation. Usually, program instructors, administrators, and advisory committee members perform this evaluation (NATEF, 2005). This group compares their program to the standards set forth by NATEF. The group also has the opportunity to make improvements before submitting evaluation materials to NATEF.

Upon completion of the self-evaluation, the materials are sent to NATEF, where they are reviewed to determine if the program qualifies for an on-site team evaluation (NATEF, 2005). If approved, NATEF assigns an Evaluation Team Leader (ETL).

An ETL is a person, often an educator, who has been trained by NATEF to conduct the on-site evaluation (NATEF, 2005). ETLs must have a minimum of six years combined experience as an automotive technician and as an automotive instructor. At least three of those years must be as a working technician. ETLs must also have a B.A. or B.S. in education and be ASE Master Certified Automobile Technicians.

Once the ETL is assigned, he or she will make contact with the training program's certification coordinator (NATEF, 2005). A date will then be set for the on-site evaluation. The coordinator must provide two to three additional individuals to form the evaluation team. These additional members usually come from industry, and cannot have any ties to the program being evaluated. These additional members must not be former instructors or graduates of the program within the last ten years (NATEF, 2005).

The ETL, along with the team members from industry, will conduct the on-site evaluation. During this evaluation, the team will use information provided by the program, and match it up with the NATEF standards (NATEF, 2005). The team uses the same process as the

self-evaluation. Ratings are made on a one to five scale, and a program cannot rate below a three in any standard in order to be certified.

Once the on-site evaluation is complete, the ETL will hold a report-out session. NATEF encourages program faculty, school administrators and student representatives to be present at this session (NATEF, 2005). At this session, the ETL comments on the positive attributes of the program, as well as the items that need improvement or attention. The ETL cannot make a determination if NATEF certification will be attained; he or she is only responsible for sending the final report to NATEF. Once NATEF receives the final report, they make the decision as to whether or not the program will become certified.

Certification

Once NATEF has certified a program, the term of certification lasts for five years (NATEF, 2005). Two and a half years after certification, NATEF sends a compliance report to the school. This report is used to verify that the program is maintaining its standards (NATEF, 2005). This compliance report is filled out by program instructors; along with the advisory committee. There is no on-site visit for the compliance report.

Competency-Based Instruction

As stated in chapter one, the training that Automotive Maintenance Technician students at Chippewa Valley Technical College (CVTC) receive is competency-based. Competency-based instruction greatly increases the likelihood that students will be adequately prepared for employment (Perry, 1982). This method of instruction has been widely employed since the 1970s as part of teaching programs for adult learners (Cos, 2004). Most training programs that prepare workers for industry use the competency-based approach because the learning objectives

closely resemble that of industry. Competency-based education is becoming more prevalent in post-secondary education, as industry aligns with institutions to train their workers.

In competency-based education, it is critical that a majority of the learning activities be centered on and keyed to the development of actual job skills (Perry, 1982). The skills need to be presented in such a way that the students know the level of performance that is expected on the job. These skills are often learned in a lab setting with structured activities (Cos, 2004). The focus is on the success of the learner as an individual, and is not dependent upon the entire group attaining competency. The competency-based approach to learning acknowledges that people learn at different rates and in different ways.

These competencies are the body of knowledge that employers look for in prospective employees who hope to obtain and maintain gainful employment (Perry, 1982). When students enroll in a competency-based training program, they have presumably made an informed career selection. In each course in a competency-based training program, the students should be made aware of the skills and knowledge they should acquire in that particular course.

"While traditional, time-based approaches to education have met with varying levels of success over the years, it is an ineffective system when the goal is to train individuals to perform specific, job-related skills" (Sullivan, 1995, n.p.). In a traditional educational system, the unit of progression is time and it is teacher-centered. In competency-based education, the unit of progression is mastery of specific knowledge and skills and is learner-centered. Norton (1987) listed the five essential elements of competency-based learning:

- Competencies are to be achieved are carefully identified, verified, and made public in advance

- Criteria to be used in assessing achievement and the conditions under which achievement will be assessed are explicitly stated and made public in advance.
- The instructional program provides for the individual development and evaluation of each of the competencies specified.
- Assessment of competency takes the participant's knowledge and attitudes into account, but requires actual performance of the competency as the primary source of evidence.
- Participants progress through the instructional program at their own rate by demonstrating the attainment of the specified competencies.

Competency-based educational systems have generally been described as having three focal points, all of which must be present in order for the system to be successful. These three focal points and indicators of their quality are (Johnson, 2006, p. 72):

- Competencies – clearly defined statements of essential content that are clear, specific, and attainable.
- Assessment – Are there multiple and meaningful ways of assessing progress toward the competency?
- Accountability – Is there a well-crafted set of incentives, interventions, and rewards that apply at every level of performance for all involved, including learners, instructors, employees, and supervisors?

Advantages of Competency-Based Education

There are obvious advantages to competency-based education. Post-secondary education has become progressively responsive to the needs of business and industry, therefore an accurate depiction of job skills can be attained (Paulson, 2001). Advantages of competency-based education that were recognized by Norton (1987, n.p.) include:

- Competencies are carefully selected.
- Supporting theory is integrated with skill practice. Essential knowledge is learned to support the performance of skills.
- Detailed training materials are keyed to the competencies to be achieved and are designed to support the acquisition of knowledge and skills.
- Methods of instruction involve mastery learning, the premise that all participants can master the required knowledge or skill, provided sufficient time and appropriate training methods are used.
- Participant's knowledge and skills are assessed as they enter the program and those with satisfactory knowledge and skills may bypass training for competencies already attained.
- Learning should be self-paced.
- Flexible training approaches including large group methods, small group activities, and individual study are essential components.
- A variety of support materials including print, audiovisual, and simulations keyed to the skills being mastered are being used.
- Satisfactory completion of training is based on achievement of all specified competencies.

Downfalls of Competency-Based Education

While there are a number of advantages of competency-based training, there are some potential limitations. Norton (1987, n.p.) identified three shortcomings of competency-based education:

- Unless initial training and follow-up assistance is provided for the trainers, there is a tendency to "teach as we were taught" and instructors quickly slip back into the role of the traditional teacher.
- A competency-based course is only as effective as the process used to identify the competencies. When little or no attention is given to identification of the essential job skills, then the resulting training course is likely to be ineffective.
- A course may be classified as competency-based, but unless specific materials and training approaches that relate to competency-based training are used, it is unlikely that the resulting course will be competency-based.

Many industry training programs, such as in the automotive service industry, rely on national standards (Paulson, 2001). In the automotive service industry, these national standards are set forth by NATEF. Many states are moving towards statewide curriculum in their training programs to streamline the educational process. According to Sandra Schmit (personal communication, October 17, 2007), the Electronics, Transportation, and Automotive Education Director for the Wisconsin Technical College System (WTCS), Wisconsin is moving forward with plans to implement a statewide curriculum for automotive technician training programs at the 16 technical colleges in the state.

Competency-based education is here to stay (Paulson, 2001). As industry grapples with the task of replacing an aging workforce, it will look to competency-based education from the local technical and community colleges to provide a skilled workforce for the foreseeable future.

Job/Task Analysis

A job analysis is a process used to determine what duties a job includes. A task analysis is a process used to determine how to perform a job. Simply put, a job/task analysis tells you

what is included in a particular job and exactly how it is supposed to be done (Wolfe, Wetzel, Harris, Mazour, & Riplinger, 1991).

Job/task analyses are done for many reasons. For example, an experienced worker may be retiring after many years at the same company. A job/task analysis could be used to identify the specific skills the company will need to search for when looking for a replacement. Most often, it is used to create or update training programs for a particular job. Job/task analysis is a process that can be performed in many different ways, in a variety of situations, and with multiple purposes (Jonanssen, Hannum, & Tessmer, 1989). Jonanssen, Hannum, and Tessmer (1989, p. 4) mentioned several instances when job/task analysis could be performed:

- To determine the operational components of a job, skill, goal, or objective – that is, to describe what task performers do, how they perform a task, how they think, or how they apply a skill.
- To decide which tasks, skills, or goals ought to be taught.
- To describe the sequence in which tasks are performed and should be taught.
- To describe the psychological activities (intellectual, knowledge, physical, or attitudinal behaviors) that are involved in any task, skill, or goal.
- To describe the scope of a task, skill, or goal.

When carrying out a job/task analysis, a number of sources must be used in order to ensure that a complete picture of the job has been attained (Davies, 1973). Most important is to obtain information about a job from someone who can perform the job at the correct level of mastery, often called a *master*. If the person or persons selected to study are not performing their job at the correct level, the resulting analysis will be inaccurate, and the result will be under-training other individuals (Davies, 1973).

When collecting data about a particular job, the analyst will take careful notes of what the masters are doing, how they do it, what they do it with, what they do it to, and finally why they do it (Davies, 1973). There are many ways to collect this data. Observation, interaction, survey, and interviews are all effective ways to gather data about job tasks (Kirwan & Ainsworth, 1992).

This careful analysis examines the component parts of the entire job. This is usually a three-step process (Carlisle, 1986). The first step is to break the job down into smaller, component parts. Next, relationships are identified between the different components and compared with the correct level of performance. Lastly, the parts are restructured to represent an improved job or task, and the learning requirements are specified.

Job/task analysis is a critical step in developing competency-based curriculum (Perry, 1982). Competencies for a particular course or training program are created as a direct result of conducting a job/task analysis.

Related Research

The success of NATEF certification in improving the quality of the automobile technician training programs has been the subject of an independent research study. The results from this study have shown that students from an ASE certified program achieved higher learning outcomes and the programs had better placement of graduates than programs that were not ASE certified.

A 1995 study conducted by Morgan V. Lewis and Lawrence Gill (1995) of The Ohio State University found a positive correlation between using standards and the effects on learning. Using the NATEF standards as the variable, Lewis and Gill studied four automotive technician training programs, two secondary and two post-secondary. The schools were located in both

Florida and Pennsylvania. One of the programs at both levels was a NATEF certified program and the other was not, but had made an inquiry about becoming certified.

Students were given a standardized test created by the researchers to measure their knowledge and abilities. Their scores were compared with the students at the other schools. The Test of Cognitive Skills, Second Edition was also given to the students to adjust the scores (Lewis & Gill, 1995).

The study concluded that the standards set forth by ASE and NATEF have a positive effect on the learning that takes place in an automotive technician training programs (Lewis & Gill, 1995). Students from NATEF certified programs scored much higher on a standardized test of knowledge about automotive repair than students from similar, non-certified schools.

Summary

When looking at the process of job/task analysis and development of competency-based curriculum, one is dependent upon the success of the other. Good competency-based instruction cannot be created without a careful job/task analysis. NATEF uses job/task analysis to create and define its task list, which is a standard for automobile training programs. There was a study done that found a positive correlation between the use of these standards and the success of students in automotive technician training programs.

Chapter Three: Methodology

Introduction

This chapter will include a description of the sample, the instrument used, and the data collection procedures. In addition, the data analyses used will be reported. The chapter will conclude with the identified methodological limitations.

Sample Selection

The sample selection consisted of 83 repair facilities in the Chippewa Valley. The repair facilities were chosen because they have hired graduates of the Automotive Maintenance Program at Chippewa Valley Technical College (CVTC).

Instrumentation

A survey was created by the researcher for this study. The survey listed the National Automotive Technician Education Foundation (NATEF) tasks in the area of electricity and electronics. Survey respondents were to rate the importance of each task presently, and how important they felt the task would be in the future. Because the survey was created by the researcher for this study, reliability and validity were not documented. However, the survey was checked for content at a regular meeting of the advisory committee for the Automotive Maintenance Program at CVTC.

Data Collection

Surveys were mailed to the 83 repair facilities on October 29, 2007. Recipients were given 14 days to return the survey via a postage-paid envelope provided for easy return.

Data Analysis

The information gathered from this study was organized to answer each of the objectives of the study.

The rating of tasks on the survey as essential, important, a minor skill, or delete skill indicated whether or not the tasks were currently important, thus fulfilling objectives number one and two.

The rating of tasks on the survey as essential, important, a minor skill, or delete skill indicated whether or not the tasks were important in the future, thus fulfilling objective number three.

The write-in suggestions the survey participants offered as tasks that also should be included were listed in chapter four and not ranked in importance. This fulfilled objective number four.

Limitations

The following items may limit the results of the study:

1. The study was limited to automotive repair facilities in the Chippewa Valley. The needs of other geographic regions of CVTC's district will not be considered.
2. The research used a survey that was created by the researcher. The survey may have contained errors and/or emissions not intended by the researcher. Every effort was made to ensure its validity.
3. The educational background and work experience of the population used in the survey varied; therefore an accurate representation of job competencies may not be represented.
4. The survey participants were comprised of employers who have hired CVTC Automotive Maintenance Technician graduates. Graduates of the program were not surveyed.
5. There may be certain electrical competencies that were unique to the Chippewa Valley which may not depict an actual need of automotive technicians in other areas.

6. The survey participants were composed of employers that have hired CVTC Automotive Maintenance Technician graduates in the past five years. This does not represent the entire auto repair industry in the Chippewa Valley.

Summary

This study collected information about competencies required of automotive technicians in the Chippewa Valley in the area of electricity and electronics. A survey of repair facilities that employ graduates of the CVTC Automotive Maintenance Technician program was used to gather the data. The data collected from the survey was analyzed to discover which competencies were presently important and which competencies will be important in the future.

Chapter Four: Results

Introduction

This chapter includes an analysis of the data collected from the survey arranged by the appropriate research objective. Demographic information about the survey responses is also reported. Because of the design and content of the survey, item analysis will not be used to report the results.

Demographic Information

There were 83 surveys mailed to employers of graduates of the Automotive Maintenance Technician Program at Chippewa Valley Technical College (CVTC). The surveys were mailed in October, 2007. There were 31 completed surveys returned. This constitutes a 37% return rate. There was one survey returned marked undeliverable because that auto repair business had closed. To view the survey used in this study, see Appendix B.

Summary of Results

It is important to note that of all the competencies listed on the survey, a majority of them were ranked either "*essential*" or "*important*" by survey respondents. The competencies that were ranked as "*essential*" will be reported in this study.

Research Objectives

Research Objective #1 – Identify the automotive electricity and electronics competencies that are needed by a currently practicing automotive technician.

Research Objective # 2 – Identify which electricity and electronics competencies are most important to employers.

Because of the structure of the survey, each item on the survey dealt with these two objectives. The competencies which had a 60% or higher response of "essential" are identified. These competencies are listed in Table 1.

Table 1

Competencies Currently Needed by Automotive Technicians That Received a Rating of Essential Greater Than 60%

Competency	Frequency (n=31)	Percentage
Identify and interpret electrical electronic system concern, determine necessary action.	22	71.00%
Use wiring diagrams during diagnosis of electrical circuit problems	22	71.00%
Diagnose body electronic systems using a scan tool; determine necessary action	21	67.70%
Diagnose supplemental restraint system (SRS) concerns, determine necessary action	20	64.50%
Measure source voltage and perform voltage drop tests in electrical/electronic circuits; determine necessary action	20	64.50%

Research Objective # 3 – Identify the automotive electricity and electronics competencies that will be needed by automotive technicians in the future.

Because of the structure of the survey, each item on the survey dealt with this objective. The competencies which had a 75% or higher response of "essential" are identified. These competencies are listed in Table 2.

Table 2

Future Competencies Needed by Automotive Technicians That Received a Rating of Essential Greater Than 75%

Competency	Frequency (n=31)	Percentage
Research applicable vehicle and service information	28	90.30%
Identify and interpret electrical/electronic system concern; determine necessary action	26	83.90%
Diagnose body electronic system circuits using a scan tool, determine necessary action	25	80.60%
Use wiring diagrams during diagnosis of electrical circuit problems	24	77.40%
Identify location of hybrid vehicle high voltage circuit disconnect location and safety procedures	24	77.40%
Inspect and test sensors connectors and wires of electronic (digital) instrument circuits; determine necessary action	24	77.40%

Research Objective #4 – Identify emerging trends in new technology in the area of automotive electricity and electronics.

The last question on the survey dealt with this research objective. Survey respondents were asked to provide additions, suggestions, or comments. Six of the 31 surveys included

additions, suggestions, or comments. These written statements were used to fulfill this research objective and are listed in Table 3.

Table 3

Comments Made By Survey Respondents

Comment
Most if not all these skills are used in auto repair every day!
More time on electrical diagnosis, don't need to know how to rebuild a starter or alternator.
Basic mechanical knowledge is a plus. Understanding basic electricity is a must in the industry today.
Tire pressure monitoring systems, engine and drivetrain.
Testing any electrical circuit is easy once they learn about electricity and electronics and where and how to retrieve the information needed. Also, diagnostic procedures and troubleshooting.
A complete and working understanding of Ohm's Law is essential. It will become more important in the near future.

Chapter Five: Discussion, Conclusions, and Recommendations

Introduction

This chapter includes discussion on the survey results reported in Chapter Four. It also makes conclusions based upon the survey results. Recommendations for further research are also discussed.

Discussion

The purpose of this study was to determine the electricity and electronics competencies required of automotive technicians in the Chippewa Valley both presently and in the future. This was done by surveying employers of graduates of the Automotive Maintenance Program at Chippewa Valley Technical College (CVTC). It will be of great value to determine these competencies so that CVTC instructors can update the Automotive Maintenance Program curriculum before fall of 2008.

The review of literature in Chapter Two discussed the National Automotive Technicians Education Foundation (NATEF) task list and its importance. It is necessary to state again that the survey used in this study was comprised of the entire NATEF task list for electricity and electronics, and respondents were asked to rate each competency for importance both presently and in the future. Based upon the survey results, it is clear that NATEF is doing their job very well when it comes to maintaining and updating the task list due to the high percentages of respondents rating competencies as essential.

Research Objective Number One

Research objective number one was to identify the automotive electricity and electronics competencies that are needed by a currently practicing automotive technician. The survey listed every NATEF task in the area of electricity and electronics and respondents were asked to rank

each competency as *essential, important, minor, or delete.* According to the survey respondents, five competencies were rated as essential more than 60% of the time (Table 1). There were many competencies that scored between 50% and 60%, this represented a majority of the competencies listed.

Based upon the survey results, it is clear that NATEF is doing their job very well when it comes to maintaining and updating the task list due to the high percentages of respondents rating competencies as essential. The NATEF task list for electricity and electronics is a good foundation for a solid program curriculum

It is recommended that the Automotive Maintenance Technician Program at CVTC include the competencies listed in Table 1 in program curriculum, along with the remainder of the NATEF competencies for electricity and electronics, in order to remain NATEF accredited.

Research Objective Number Two

Research objective number two was to identify which electricity and electronics competencies are most important to employers. The survey listed every NATEF task in the area of electricity and electronics, and respondents were asked to rank each competency as *essential, important, minor, or delete.* According to the survey respondents, five competencies were rated as essential more than 60% of the time (Table 1). There were many competencies that scored between 50% and 60%, this represented a majority of the competencies listed.

Because of the number of competencies that received a rating of essential, it is clear that the NATEF competencies are in alignment with the needs of the automotive service industry.

It is recommended that the Automotive Maintenance Technician Program at continue to include the competencies listed in Table 1 in program curriculum, along with the remainder of the NATEF competencies for electricity and electronics, in order to remain NATEF accredited.

Research Objective Number Three

Research objective number three was to identify the automotive electricity and electronics competencies that will be needed by automotive technicians in the future. The survey listed every NATEF task in the area of electricity and electronics and respondents were asked to rank each competency for future importance as *essential, important, minor, or delete.* Based upon the survey results, six of the competencies were rated as essential more than 75% of the time (Table 2). There were many competencies that scored between 50% and 75%, this represented a majority of the competencies listed.

Based upon the survey results, it is clear that NATEF is doing their job very well when it comes to maintaining and updating the task list due to the high percentages of respondents rating competencies as essential. The NATEF task list for electricity and electronics will prove to be a good foundation for a solid program curriculum in the future.

It is recommended that that Automotive Maintenance Program at CVTC continue to include these six competencies in program curriculum, along with the remainder of the NATEF competencies for electricity and electronics, in order to remain NATEF accredited. It is imperative that the program continue to adhere to the NATEF task list in the future.

Research Objective Number Four

Research objective number four was to identify emerging trends in new technology in the area of automotive electricity and electronics. The survey concluded with a space for respondents to make additions, suggestions, or comments. These written statements (Table 3) included competencies that should be included in the program, but weren't necessarily in the competency list created by NATEF. The additions, suggestions, and comments provided by survey respondents did include competencies that were already on the list created by NATEF, but their

importance was stressed by the respondents. There were some competencies listed, such as tire pressure monitoring, that are competencies in other areas of NATEF accreditation.

The NATEF task list is updated every five years. It is important that NATEF continues to consult with the needs of industry when creating its task list. Based upon the written comments from survey respondents, there are some competencies that may become more important in the coming years.

It is recommended that the Automotive Maintenance Program at CVTC take these comments, suggestions, and additions and make sure they are included in program curriculum. It is also recommended that the program update its curriculum at a minimum of every five years when NATEF updates their task list.

Recommendations for Further Research

The research conducted in this study was only done on one area of NATEF accreditation. There are seven more areas that need to be explored. Each area is as important as the other seven. Without further investigating each of the remaining areas, it cannot be said that the curriculum of the Automotive Maintenance Program at CVTC is complete and up to date.

There is also a need for more research on the effectiveness of NATEF standards on technician training. The researcher only found one such study. There needs to be more research conducted on the alignment of NATEF standards with actual job tasks performed in industry.

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Appendix A: Sample Survey Letter

10/29/07

Mr. John Doe
Title
Company Name
Address
City, State ZIP

Dear Mr. Doe,

The purpose of this communication is twofold. It is an effort to gather data to strengthen the Automotive Maintenance Technician Program at Chippewa Valley Technical College, and the data that is collected will be used as part of my graduate thesis work at UW-Stout. The data collected will be used to modify existing program curriculum to meet the automotive industry needs of the Chippewa Valley.

The study that I am conducting is to compare the competency task list that has been created by the National Automotive Technicians Education Foundation (NATEF) with the job requirements of automotive technicians in the Chippewa Valley in the area of electricity and electronics. NATEF is the accrediting body for automotive technician training programs. For more information about NATEF, please visit their website at www.natef.org.

Enclosed you will find a survey that lists all of the NATEF tasks for electricity and electronics. Please read each task and darken the circle on the left side that best pertains to the current importance of each task. On the right side, darken the circle that pertains to your estimation of the future importance of the task. At the end of the survey there is a space for you to make additions to the list, suggestions, or general comments.

I would like to thank you in advance for taking the time to fill out the survey. Your help to improve the Automotive Maintenance Technician Program at Chippewa Valley Technical College is appreciated by the entire department faculty.

I kindly ask that you please return your completed survey by Friday, November 16th, 2007. For your convenience, a postage-paid envelope is included.

Thank you again,

Brian D. Gerrits
Automotive Instructor

Enclosures

Consent Information:

I understand that by returning this survey, I am giving my informed consent as a participating volunteer in this study. I understand the basic nature of the study and agree that any potential risks are exceedingly small. I also understand the potential benefits that might be realized from the successful completion of this study. I am aware that the information is being sought in a specific manner so that no identifiers are needed and so that confidentiality is guaranteed. I realize that I have the right to refuse to participate and that my right to withdraw from participation at any time during the study will be respected with no coercion or prejudice.

This study has been reviewed and approved by The University of Wisconsin-Stout's Institutional Review Board (IRB). The IRB has determined that this study meets the ethical obligations required by federal law and University policies. If you have questions or concerns regarding this study please contact the Investigator or Advisor. If you have any questions, concerns, or reports regarding your rights as a research subject, please contact the IRB Administrator.

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Appendix B: Survey Used in This Study

CVTC Automotive Maintenance Program
Electrical/Electronics Skills Survey

Directions: On the left side please darken in the circle that best pertains to current importance of each major skill listed below. Also, on the right side, please darken in the circle that best pertains to your estimation of the future importance of those same major skills listed. At the end, please include any additions, suggestions, or comments.

Current Skills — **Skills in the Future**

ELECTRICAL/ELECTRONIC SYSTEMS

Ⓔ - essential skill
Ⓘ - important
Ⓜ - minor skill
Ⓓ - delete from curriculum

Current: essential skill	Current: important	Current: a minor skill	Current: delete		Future: essential skill	Future: important	Future: a minor skill	Future: delete
				General Electrical System Diagnosis				
Ⓔ	Ⓘ	Ⓜ	Ⓓ	Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction.	Ⓔ	Ⓘ	Ⓜ	Ⓓ
Ⓔ	Ⓘ	Ⓜ	Ⓓ	Identify and interpret electrical/electronic system concern; determine necessary action.	Ⓔ	Ⓘ	Ⓜ	Ⓓ
Ⓔ	Ⓘ	Ⓜ	Ⓓ	Research applicable vehicle and service information, such as electrical/electronic system operation, vehicle service history, service precautions, and technical service bulletins.	Ⓔ	Ⓘ	Ⓜ	Ⓓ
Ⓔ	Ⓘ	Ⓜ	Ⓓ	Locate and interpret vehicle and major component identification numbers (VIN, vehicle certification labels, and calibration decals).	Ⓔ	Ⓘ	Ⓜ	Ⓓ
Ⓔ	Ⓘ	Ⓜ	Ⓓ	Diagnose electrical/electronic integrity of series, parallel and series-parallel circuits using principles of electricity (Ohm's Law).	Ⓔ	Ⓘ	Ⓜ	Ⓓ
Ⓔ	Ⓘ	Ⓜ	Ⓓ	Use wiring diagrams during diagnosis of electrical circuit problems.	Ⓔ	Ⓘ	Ⓜ	Ⓓ
Ⓔ	Ⓘ	Ⓜ	Ⓓ	Demonstrate the proper use of a digital multimeter (DMM) during diagnosis of electrical circuit problems.	Ⓔ	Ⓘ	Ⓜ	Ⓓ
Ⓔ	Ⓘ	Ⓜ	Ⓓ	Check electrical circuits with a test light; determine necessary action.	Ⓔ	Ⓘ	Ⓜ	Ⓓ
Ⓔ	Ⓘ	Ⓜ	Ⓓ	Measure source voltage and perform voltage drop tests in electrical/electronic circuits using a voltmeter; determine necessary action.	Ⓔ	Ⓘ	Ⓜ	Ⓓ
Ⓔ	Ⓘ	Ⓜ	Ⓓ	Measure current flow in electrical/electronic circuits and components using an ammeter; determine necessary action.	Ⓔ	Ⓘ	Ⓜ	Ⓓ
Ⓔ	Ⓘ	Ⓜ	Ⓓ	Check continuity and measure resistance in electrical/electronic circuits and components using an ohmmeter; determine necessary action.	Ⓔ	Ⓘ	Ⓜ	Ⓓ
Ⓔ	Ⓘ	Ⓜ	Ⓓ	Check electrical circuits using fused jumper wires; determine necessary action.	Ⓔ	Ⓘ	Ⓜ	Ⓓ
Ⓔ	Ⓘ	Ⓜ	Ⓓ	Locate shorts, grounds, opens, and resistance problems in electrical/electronic circuits; determine necessary action.	Ⓔ	Ⓘ	Ⓜ	Ⓓ
Ⓔ	Ⓘ	Ⓜ	Ⓓ	Measure and diagnose the cause(s) of excessive key-off battery drain (parasitic draw); determine necessary action.	Ⓔ	Ⓘ	Ⓜ	Ⓓ
Ⓔ	Ⓘ	Ⓜ	Ⓓ	Inspect and test fusible links, circuit breakers, and fuses; determine necessary action.	Ⓔ	Ⓘ	Ⓜ	Ⓓ
Ⓔ	Ⓘ	Ⓜ	Ⓓ	Inspect and test switches, connectors, relays, solenoid solid state devices, and wires of electrical/electronic circuits; perform necessary action.	Ⓔ	Ⓘ	Ⓜ	Ⓓ
Ⓔ	Ⓘ	Ⓜ	Ⓓ	**Remove and replace terminal end from connector**				
Ⓔ	Ⓘ	Ⓜ	Ⓓ	Repair connectors and terminal ends.	Ⓔ	Ⓘ	Ⓜ	Ⓓ
Ⓔ	Ⓘ	Ⓜ	Ⓓ	Repair wiring harness (including CAN/BUS systems).	Ⓔ	Ⓘ	Ⓜ	Ⓓ
Ⓔ	Ⓘ	Ⓜ	Ⓓ	Perform solder repair of electrical wiring.	Ⓔ	Ⓘ	Ⓜ	Ⓓ
Ⓔ	Ⓘ	Ⓜ	Ⓓ	Identify location of hybrid vehicle high voltage circuit disconnect (service plug) location and safety procedures	Ⓔ	Ⓘ	Ⓜ	Ⓓ
Ⓔ	Ⓘ	Ⓜ	Ⓓ	**Battery Diagnosis and Service**				
Ⓔ	Ⓘ	Ⓜ	Ⓓ	Perform battery state-of-charge test; determine necessary action.	Ⓔ	Ⓘ	Ⓜ	Ⓓ
Ⓔ	Ⓘ	Ⓜ	Ⓓ	Perform battery capacity test (or conductance test); confirm proper battery capacity for vehicle application; determine necessary action.	Ⓔ	Ⓘ	Ⓜ	Ⓓ
Ⓔ	Ⓘ	Ⓜ	Ⓓ	Maintain or restore electronic memory functions.	Ⓔ	Ⓘ	Ⓜ	Ⓓ
Ⓔ	Ⓘ	Ⓜ	Ⓓ	Inspect, clean, fill, and replace battery.	Ⓔ	Ⓘ	Ⓜ	Ⓓ
Ⓔ	Ⓘ	Ⓜ	Ⓓ	Perform slow/fast battery charge.	Ⓔ	Ⓘ	Ⓜ	Ⓓ
Ⓔ	Ⓘ	Ⓜ	Ⓓ	Inspect and clean battery cables, connectors, clamps, and hold-downs; repair or replace as needed.	Ⓔ	Ⓘ	Ⓜ	Ⓓ

ELECTRICAL/ELECTRONIC SYSTEMS

Current Skills | **Skills in the Future**

Ⓔ - essential skill
Ⓘ - important
Ⓜ - minor skill
Ⓓ - delete from curriculum

Current Skills: essential skill	important	a minor skill	delete		Skills in the Future: essential skill	important	a minor skill	delete
Ⓔ	Ⓘ	Ⓜ	Ⓓ	Start a vehicle using jumper cables and a battery or auxiliary power supply.	Ⓔ	Ⓘ	Ⓜ	Ⓓ
Ⓔ	Ⓘ	Ⓜ	Ⓓ	Identify high voltage circuits of electric or hybrid electric vehicle and related safety precautions.	Ⓔ	Ⓘ	Ⓜ	Ⓓ
Ⓔ	Ⓘ	Ⓜ	Ⓓ	Identify electronic modules, security systems and/or radios that require re-initialization or code entry following battery disconnect.	Ⓔ	Ⓘ	Ⓜ	Ⓓ
Ⓔ	Ⓘ	Ⓜ	Ⓓ	Identify hybrid vehicle auxiliary (12v) battery service, repair and test procedures.	Ⓔ	Ⓘ	Ⓜ	Ⓓ
				Starting System Diagnosis and Repair				
Ⓔ	Ⓘ	Ⓜ	Ⓓ	Perform starter current draw tests; determine necessary action.	Ⓔ	Ⓘ	Ⓜ	Ⓓ
Ⓔ	Ⓘ	Ⓜ	Ⓓ	Perform starter circuit voltage drop tests; determine necessary action.	Ⓔ	Ⓘ	Ⓜ	Ⓓ
Ⓔ	Ⓘ	Ⓜ	Ⓓ	Inspect and test starter relays and solenoids; determine necessary action.	Ⓔ	Ⓘ	Ⓜ	Ⓓ
Ⓔ	Ⓘ	Ⓜ	Ⓓ	Remove and install starter in a vehicle.	Ⓔ	Ⓘ	Ⓜ	Ⓓ
Ⓔ	Ⓘ	Ⓜ	Ⓓ	Inspect and test switches, connectors, and wires of starter control circuits; perform necessary action.	Ⓔ	Ⓘ	Ⓜ	Ⓓ
Ⓔ	Ⓘ	Ⓜ	Ⓓ	Differentiate between electrical and engine mechanical problems that cause a slow-crank or no-crank condition.	Ⓔ	Ⓘ	Ⓜ	Ⓓ
				Charging System Diagnosis and Repair				
Ⓔ	Ⓘ	Ⓜ	Ⓓ	Perform charging system output test; determine necessary action.	Ⓔ	Ⓘ	Ⓜ	Ⓓ
Ⓔ	Ⓘ	Ⓜ	Ⓓ	Diagnose charging system for the cause of undercharge, no-charge, and overcharge conditions.	Ⓔ	Ⓘ	Ⓜ	Ⓓ
Ⓔ	Ⓘ	Ⓜ	Ⓓ	Inspect, adjust, or replace generator (alternator) drive belts, pulleys, and tensioners; check pulley and belt alignment.	Ⓔ	Ⓘ	Ⓜ	Ⓓ
Ⓔ	Ⓘ	Ⓜ	Ⓓ	Remove, inspect, and install generator (alternator).	Ⓔ	Ⓘ	Ⓜ	Ⓓ
Ⓔ	Ⓘ	Ⓜ	Ⓓ	Perform charging circuit voltage drop tests; determine necessary action.	Ⓔ	Ⓘ	Ⓜ	Ⓓ
				Lighting Systems Diagnosis and Repair				
Ⓔ	Ⓘ	Ⓜ	Ⓓ	Diagnose the cause of brighter than normal, intermittent, dim, or no light operation; determine necessary action.	Ⓔ	Ⓘ	Ⓜ	Ⓓ
Ⓔ	Ⓘ	Ⓜ	Ⓓ	Inspect, replace, and aim headlights and bulbs.	Ⓔ	Ⓘ	Ⓜ	Ⓓ
Ⓔ	Ⓘ	Ⓜ	Ⓓ	Inspect and diagnose incorrect turn signal or hazard light operation; perform necessary action.	Ⓔ	Ⓘ	Ⓜ	Ⓓ
Ⓔ	Ⓘ	Ⓜ	Ⓓ	Identify system voltage and safety precautions associated with high intensity discharge headlights.	Ⓔ	Ⓘ	Ⓜ	Ⓓ
				Gauges, Warning Devices, and Driver Information Systems				
Ⓔ	Ⓘ	Ⓜ	Ⓓ	Inspect and test gauges and gauge sending units for cause of intermittent, high, low, or no gauge readings; determine necessary action.	Ⓔ	Ⓘ	Ⓜ	Ⓓ
Ⓔ	Ⓘ	Ⓜ	Ⓓ	Inspect and test connectors, wires, and printed circuit boards of gauge circuits; determine necessary action.	Ⓔ	Ⓘ	Ⓜ	Ⓓ
Ⓔ	Ⓘ	Ⓜ	Ⓓ	Diagnose the cause of incorrect operation of warning devices and other driver information systems; determine necessary action.	Ⓔ	Ⓘ	Ⓜ	Ⓓ
Ⓔ	Ⓘ	Ⓜ	Ⓓ	Inspect and test sensors, connectors, and wires of electronic (digital) instrument circuits; determine necessary action.	Ⓔ	Ⓘ	Ⓜ	Ⓓ
				Horn and Wiper/Washer Diagnosis and Repair				
Ⓔ	Ⓘ	Ⓜ	Ⓓ	Diagnose incorrect horn operation; perform necessary action.	Ⓔ	Ⓘ	Ⓜ	Ⓓ
Ⓔ	Ⓘ	Ⓜ	Ⓓ	Diagnose incorrect wiper operation; diagnose wiper speed control and park problems; perform necessary action.	Ⓔ	Ⓘ	Ⓜ	Ⓓ
Ⓔ	Ⓘ	Ⓜ	Ⓓ	Diagnose incorrect washer operation; perform necessary action.	Ⓔ	Ⓘ	Ⓜ	Ⓓ
				Accessories Diagnosis and Repair				
Ⓔ	Ⓘ	Ⓜ	Ⓓ	Diagnose incorrect operation of motor-driven accessory circuits; determine necessary action.	Ⓔ	Ⓘ	Ⓜ	Ⓓ
Ⓔ	Ⓘ	Ⓜ	Ⓓ	Diagnose incorrect heated glass, mirror, or seat operation; determine necessary action.	Ⓔ	Ⓘ	Ⓜ	Ⓓ
Ⓔ	Ⓘ	Ⓜ	Ⓓ	Diagnose incorrect electric lock operation; determine necessary action.	Ⓔ	Ⓘ	Ⓜ	Ⓓ
Ⓔ	Ⓘ	Ⓜ	Ⓓ	Diagnose incorrect operation of cruise control systems; determine necessary action.	Ⓔ	Ⓘ	Ⓜ	Ⓓ
Ⓔ	Ⓘ	Ⓜ	Ⓓ	Diagnose supplemental restraint system (SRS) concerns; determine necessary action. (Note: Follow manufacturer's safety procedures to prevent accidental deployment.)	Ⓔ	Ⓘ	Ⓜ	Ⓓ
Ⓔ	Ⓘ	Ⓜ	Ⓓ	Disarm and enable the airbag system for vehicle service.	Ⓔ	Ⓘ	Ⓜ	Ⓓ

ELECTRICAL/ELECTRONIC SYSTEMS

Current Skills					Skills in the Future			
essential skill	important	a minor skill	delete		essential skill	important	a minor skill	delete
				Ⓔ - essential skill Ⓘ - important Ⓜ - minor skill Ⓓ - delete from curriculum				
Ⓔ	Ⓘ	Ⓜ	Ⓓ	Diagnose radio static and weak, intermittent, or no radio reception; determine necessary action.	Ⓔ	Ⓘ	Ⓜ	Ⓓ
Ⓔ	Ⓘ	Ⓜ	Ⓓ	Remove and reinstall door panel.	Ⓔ	Ⓘ	Ⓜ	Ⓓ
Ⓔ	Ⓘ	Ⓜ	Ⓓ	Diagnose body electronic system circuits using a scan tool; determine necessary action.	Ⓔ	Ⓘ	Ⓜ	Ⓓ
Ⓔ	Ⓘ	Ⓜ	Ⓓ	Check for module communication (including CAN/BUS systems) errors using a scan tool.	Ⓔ	Ⓘ	Ⓜ	Ⓓ
Ⓔ	Ⓘ	Ⓜ	Ⓓ	Diagnose the cause of false, intermittent, or no operation of anti-theft systems.	Ⓔ	Ⓘ	Ⓜ	Ⓓ

Please use this space to make any additions, suggestions, or comments: