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Development of Model for Professional Competency Assessment (PCA) in Vocational Education: Study of the Engine Tune-Up Injection System Assessment Scheme

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Abstract: The field legality of expertise for job applicants in the field of vocational education is one of the strong considerations. This recognition can obtain through accredited professional institutions such as the Professional Certification Institute (PCI), which operates independently. The problem arises that PCI in the automotive sector consists of several providers (PCI-TO, PCI- INA, PCI- TOP, etc.), and different levels (the 1st Party PCI, 2nd Party PCI, and 3rd Party PCI) so the quality is not the same and requires the right solution. As a result, the automotive PCI requires a reference standard as a professional competency test model standard. This study aims to test and produce a professional competency test model in automotive clusters, namely engine tune-up injection system (ETU-IS), that meet the characteristics and can be applied. The development subjects consist of PCI-TOP informants, Indonesian Training Center in Bandung (BBLKI), and P4TK BOE/VEDC in Malang as automotive competency experts. Instrument validation consists of construction, validation and feasibility test of the instrument. Data analysis uses alpha coefficients and Inter-Rater statistics. The findings of the study are (1) the assessment of professional competency standard assessment on ETU-SI using a Competency-Based Assessment approach in the form of work instructions, including case studies, demonstrations, and interviews that meet the criteria; (2) the fulfillment of instruments related to competency dimensions in aspects of competency testing consisting of TS, TMS, CMS, EMS, and JRES; and (3) verification of the infrastructure and facilities as well as the competency test the ethical requirements such as impartiality and delivery of recommendations have appropriate decision. The new finding in this study is that appraiser's behavior is the key to success in the implementation of competency tests, so technical and methodological abilities require as professional competency examiners.

Keywords: Competence test model, professional competence, engine tune-up, injection system, professional certification institute, vocational education.

Introduction

Vocational education into the concept of policy in improving the economy (Abuselidze & Beridze, 2019; Becker, 2019; Mustapha & Greenan, 2002; Pavlova, 2014), in many countries, including Indonesia. The implementation of vocational education reaps several vital problems that hinder acceleration. Among them, high unemployment is sourced from

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vocational education graduates (Ulya, 2019). They have difficulty in finding work under their field of expertise. The statement contradicts the conceptual framework of vocational education and training that is preparing graduates who are ready to work (Brown et al., 2017; Rojewski, 2009) so, the analysis of the implementation of vocational education, including context, input, the process needs to be re-evaluated by looking at the output and outcome that has occurred. On the other hand, vocational education must be oriented and as close as possible to the industrial world (Retnowati et al., 2018; Rintala & Nokelainen, 2019) so that graduates are absorbed.

Similar problems arise in the implementation of vocational education globally and internationally, where UNESCO-UNEVOC (Hollander & Mar, 2009) has released several factors including access rights, facilities, numbers, planning and administration, curriculum, learning, qualifications and even teacher conditions, information and communication technology, budgets, testing and certification as well as with the work of industry partners. The statement covers the entire system approach and must be improved in all aspects involved. Narrower in the regional problems identified by SEAMEO VOCTECH in vocational education (Chinonso & M, 2017) including ICT, relevance, curriculum, assessment, research and development, access and equality, management and quality assurance, poverty reduction, lifelong learning, decent work and levels of education resistance (formal, non-formal, informal). Researchers classify problems with a systems approach into three main priority relevance, quality and equality (Logli, 2016).

Forms of efforts that have been made by the Indonesian government include four sectors, namely international, regional, national and local improvement. Various cooperation and training to improve human resources have been carried out with several countries that have successfully held vocational training. The regional level, as a form of partnership with ASEAN, has been collaborating in the ASEAN Economic Community (AEC) and the ASEAN Socio-Cultural Community (ASCC) (Indrawan, 2017; Resources, 2018) since December 2015. While, at the national level in the form of policies includes the reform process, including the relevance of the curriculum, strengthening outputs based on needs, and training in Human Resources. At the local level, the president has issued instructions contained in Presidential Instruction No.9 of 2016 concerning "Revitalization of Vocational Schools", in which the development of vocational education is left entirely to the provincial level, namely the governor. However, the focus of human resources becomes important in strategies to improve the quality of vocational education.

This concrete action were taken as a form of implementation of Presidential Instruction No. 9 of 2016, namely the strengthening of human resources of BNSP institutions through PCI with authority to conduct a national competency test. The development of competency tests refers to the Indonesian Qualifications Framework (IQF). At the vocational school level, the implementation of competency tests uses the scope of the First Party PCI. It only shows the level of implementing institution or organization, PCI 1st Party were established by the educational institution or training institution with the primary objective of certifying work competency for human resources according to certain limits. PCI The 2nd party has the authority to conduct competency testing on employees required by the supplier organization. 3rd party PCI has the power to do competency tests on institutions or associations in the national interest.

Researchers argue, even though they differ in scope and authority. However, industry players have different views on prospective workers. Competency certificates recommended by third parties have stronger legitimacy than other certifications. On the other hand, 3rd Party PCI with its authority has the right to conduct tests on 1st PCI, and vice versa that First Party PCI does not have the same power. The researcher also analyses, the number of 3rd party PCI is minimal compared to 2nd party PCI and 1st Party PCI. The indicates that the guarantees recommended are trustworthy and accountable to the user. Whereas, the number of 1st party PCI providers requires quality assurance through the holding of competency tests. As for the implementation of competency tests, silo assessments are internal assessors (competent teachers) to test assessments (independent students). This means that the impartiality of recommendations becomes ambiguous for accountability. The depth of essence and implementation techniques in meeting the competency principle based on unit tests is biased. Thus, the professional competency test model can be adopted in First Party PCI. This answers the fulfilment of work industry standards based on IQF competency standards.

The ongoing competency so far is the Skill Competency Test (SCT) (Rais, 2018) also referred to as the expertise competency test (ECT) (Hartoyo et al., 2018). The application of SCT is based on the freedom and ability of vocational education providers in the automotive sector in choosing technology-based packages and standard packages (Frovihandika et al., 2020). The implementation of the SCT process involves vocational teachers and industry representatives together to assess the SCT process in the form of an assessment score. The concept of competency test scores does not reflect the truth of one's expertise. This is what makes SCT bias and formal legality not strong in industry recognition. Some weaknesses in SCT implementation arise, including budget and routine programs. Therefore SCT can develop its process by integrating competency tests on PCI for better quality. The researchers agreed that students who receive competent recognition by PCI have the same recognition even better than the SCT. This integration process is essential in improving the quality of vocational education graduates.

Planning on developing a professional competency test model focuses on the Engine Tune-Up Injection System (ETU-IS) scheme. The main reason is the work carried out in this competency includes various systems that are complex in four-wheeled vehicles, including basic competence, engine systems and electrical systems. Under current developments, especially learning in vocational education and applying, to the world of work, that technology-based injection systems are an absolute requirement to be mastered by prospective workers. Thus, this competency is considered, necessary, especially in the use of technology, including the use of tools and data analysis of the condition

of the machine and its electrical system. The approach to the development of competency test models is based on professional standards, namely BNSP and PCI in the automotive field. The testing phase of the competency model includes setting goals, gathering evidence, comparing evidence with objectives, and decision information.

Assessment in testing the model using the Competency-Based Assessment approach (Ahmad & Rofiq, 2020; Heo et al., 2018) is carried out by means of the test phase of the case study instruction, interview and demonstration. Case studies are provided to measure the analysis of knowledge of assessments in detecting the emergence of problems in ETU-IS. This is adjusted to the problems that often occur in the field and the world of work. Demonstration tests are carried out to measure practical ability according to test competency. The level of success in resolving cases in the form of work actions and standardized references that are adjusted as well as the development of other products is done by interviewing as from the depth of information. Taking evidence at an assessment that has not been complied with will be reconfirmed. This means that this concept can be done from any competency, but it must be done as a whole. One unit of competency that is incomplete has an impact on the decision that the assessment is recommended not competent yet.

Previous research, regarding the competence of ETU-IS, was limited to the concept of competency required by 4-stroke motor learning materials (Hartanto et al., 2018), the compatibility of the certification scheme with the industrialized world (Santoso & Hassan, 2018; Woo et al., 2018) with PCI on Electronic Fuel Injection (EFI) and conventional (Frovihandika et al., 2020), and literacy capabilities in the field of engine tune-up (Arifin et al., 2020; M. Nurtanto et al., 2020; Muhammad Nurtanto et al., 2020). Thus, the renewal of this research is the development of a professional competency test model by testing experts in their fields. Therefore, analysis can refer to PCI to maintain quality standards and competency certificates obtained have full accountability.

2. Methodology

This study uses the Borg & Gall model approach that were developed (Gall et al., 2003, 2007). Development trials were carried out in Banten Province, Indonesia. The determination of place were based on (1) the availability of The 1st Party PCI as well as a place for competency testing, the 2nd Party PCI which is verified as being sufficient in the test scheme of the ETU-IS; (2) availability of The 3rd Party PCI-TOP assessors with nationally licensed technical and methodological capabilities; (3) completeness of the test infrastructure on the ETU-IS and an upgrade of the competency of the Conventional Tune-Up; (4) organizing the 3rd Party PCI Engine Tune-Up grade competency test cluster, so that the development model can be trialled; and (5) Involvement of Assessor from PCI-TOP as The 1st Party PCI, BBLKI for Bandung as The 2nd Party PCI and PCI at one of the vocational schools in Cilegon, Indonesia as The 1st Party PCI, so that assessment standards get full input. The research was carried out in 2019.

The subject of development is the competency test participant on the ETU-IS, as many as 30 respondents consisting of 5 educator respondents, 9 respondents working in automotive companies; and 6 respondents from undergraduate students with appropriate scientific fields, while, external assessors were three assessors based on The 3rd Party PCI recommendations with the following characteristics (Table 1):

Table 1 – Characteristic of Experts

Experts	Expertise Description
Expert1	Experiences from experts as BBLK Banten Province instructors who are currently active in the Ministry of Manpower team. For 16 years, he has been active in education and training programs in training work centers. Licensed competence at the senior level with 40 competency test units. He also joined with the Association of Indonesian Vocational Educators (AIVE), some PCI in its development include PCI-TO and PCI-TOP at the national level, and others are PCI in the 1st and 2nd Party.
Expert 2	Expert experience as an instructor at the Indonesian Vocational Training Center in Bandung. He was active in developing PCI management, and several Toyota, Daihatsu and other companies became partners in the education and training fields. He also has vocational training experience in the automotive sector in Germany. Development of PCI institutions includes the 3rd and 2nd party.
Expert 3	Experts experience as educators in vocational education colleges for five years. Competencies in the field of automotive experience, one of which is the Engine Tune-Up in conventional systems and injection systems. Join the Association of Indonesian Vocational Educators (AIVE), and PCI, Indonesia.

Data obtained in the development of competency test models is done in two ways, namely testing instruments and developing instruments. The assessment instrument data is in the form of work instructions and extracting interview evidence that refers to the 3rd party IQF level. Competency experts conduct test instruments that have been developed, based on understanding agreements, especially strengthening when competency tests take place so that the understanding obtained can be uniform and the instruments can be relied upon. The developed instrument implemented theoretically and also empirically. Based on the initial testing process, the development process is applied. The construct specification

were done by factor analysis. The level of reliability is calculated using alpha coefficients (Ritter, 2010) and the reliability assessment of professional competency tests using (Hallgren, 2012; Tang et al., 2015) Kappa Cohen (k̂). The following formula is applied:

$$r = \frac{k}{k-1}\left[1 - \frac{\sum S^2 i}{\sum S^2 t}\right] \quad \ldots\ldots\ldots\ldots (1)$$

$$\hat{k} = \frac{\sum f_0 - f_e}{N - \sum f_e} \quad \ldots\ldots\ldots\ldots (2)$$

r = reliability coefficient
k = item numbers
$S^2 i$ = item variant
$S^2 t$ = total variant
Sources: (Ritter, 2010) and (Hallgren, 2012)

k̂ = agreement level of assessment
f_0 = frequency of observations
f_e = expected frequency
N = the number assessed items

The lower limit of the reliability coefficient for good test indicators is 0.70. Next, a descriptive analysis of the test variables and recommendations from the results of the implementation is carried out.

3. Result and Discussion

3.1. Mapping the Test Assessment of Professional Competence

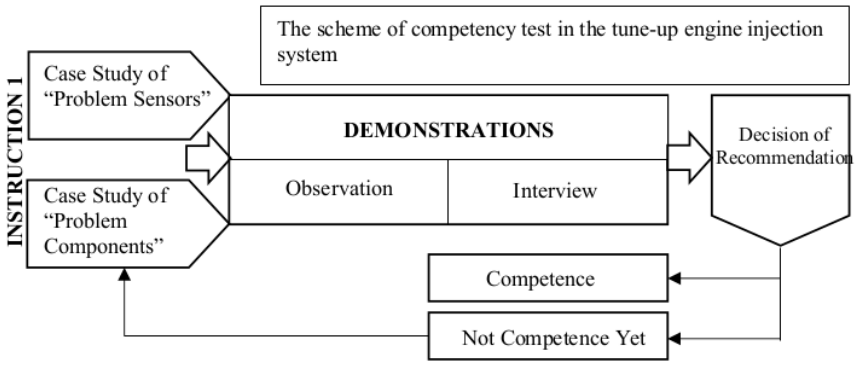


Fig.1 – The Framework for Model for Professional Competency Assessment

The competency test mapping is explained in Figure 1. It shows that the competency test were carried out with three test standards; a case study measuring HOTS-oriented knowledge or understanding, a demonstration testing the ability in the form of skills, and an interview were conducted to look deeply into the behaviour and implementation of the competency dimension. The implementation phase is offered to participants to choose which tests taken precedence. The competency test planning includes setting the engine with various cases of damage to the components and sensor functions. However, backup components and replacement sensors have been prepared if participants report information and procedures correctly. The competency test in a case study were conducted before the participants take a demonstration test. The aim is to avoid the risk of severe damage caused by participant negligence.

Demonstration tests are carried out in all competency testing units. This distinguishes between case study tests and interview tests. The following is a list of competency test units on ETU-IS referring to IQF.

Table 2 - Code and List of Competency Unit Tests

No.	Code Unit	Competency Unit
1	OTO.KR10.001.01	Maintaining components
2	OTO.KR10.009.01	Reading and Understanding Engineering Images
3	OTO.KR10.010.01	Using and maintaining the measurement tools
4	OTO.KR10.016.01	Following occupational safety and health procedures
5	OTO.KR10.017.01	Using and Maintaining Equipment and Supplies at Work
6	OTO.KR10.018.01	Communicating at Work
7	OTO.KR20.001.01	Maintaining the engine and its components

No.	Code Unit	Competency Unit
8	OTO.KR20.010.01	Maintaining the cooling system and its components
9	OTO.KR20.014.01	Maintaining the Petrol Fuel System
10	OTO.KR20.020.01	Maintaining the Emission Control System
11	OTO.KR50.001.01	Testing, Maintaining, and Replacing ACCU
12	OTO.KR50.011.01	Maintaining the Ignition System
13	OTO.KR50.012.01	Maintaining Engine Management Engine (EMS)

The automotive industry association together with the education and training center, the BBLKI in Bandung, and the assessors provided notes based on the competency, needs to be developed (Sern et al., 2019). Industry and association involvement has an impact on the needs that were adapted to conditions in the world of work. The results of the discussion obtained several concepts, as follows:

i) Indonesian National Work Competency Standards (IQF) in the automotive sector, four-wheeled vehicle sub-sector no. Kep.16/Men/VII/2004.
ii) The scope consists of routine maintenance and engine repair, which include routine maintenance of the engine, electricity, and fuel system lines periodically by performing the ETU-IS.
iii) The list of competency units compiled based on the needs of the ASBEKINDO organization and "Auto Service".

There are two acknowledgements of this competency test, namely expertise in ETU-IS and engine tune-up conventional. Strengthening of the test unit in the injection system is OTO.KR20.20 (emission control system) required; and OTO.RR50.012 (maintaining EMS). While other competency units are found in conventional systems.

i) The assessment carried out includes aspects of knowledge, skills and attitudes during the competency test carried out. The assessment is carried out in the form of a conversation consisting of case studies, demonstrations and interviews (Fig. 1.)
ii) The emphasis on testing principles, namely rejecting impartiality and conflicts of interest to maintain the credibility of the competency certificate.
iii) The extraction of evidence is carried out in general and is not limited to see the characteristics of certain producers and appraisers that are competently approved.

On the other hand, there are some findings from the implementation of competency tests that lasted the last few years, namely:

i) The application of vocational competency tests or SCT based on percentage scores and not competent recommendations.
ii) Examiners or assessors do not have the ability or technical expertise or methodological competence.
iii) Impartiality between examiners and assessments has taken place.
iv) Limited human resources on PCI at one of the vocational schools in Cilegon, Indonesia in the Engine Tune-Up assessment cluster in the Injection System, while the results of the validation of the infrastructure adequacy at the place of competency testing have been met.

A total of 13 units of competency tests must be carried out in several stages including the stages of reading, maintaining, checking, measuring, replacing, and even caring for the environment, tools, machines, results and decision making. If one unit is not fulfilled, then the "competent" recommendation is declared a failure. However, the convenience of 13 units, does not have to be implemented sequentially, but it must be integrated. The technological approach were seen from 2 additional test units of the competency test cluster in a conventional tune-up, namely emissions control and EMS (Telsey, 2020; Warju et al., 2018). Participants must be able to apply the tools as data retrieval from overcoming problems that occur. The use of test equipment in the form of a “gas analyzer” and “scan tool” is a multi-skill technology-based competency in which participants must understand how to work, set the instrument, test parameters, concentration analysis and sensor codes according to the type of vehicle. When the testing process is underway, and a fatal error has occurred, the examiner has the right to warn, that the actions of the participants are declared dangerous. At the same time, the participants are declared to stop their work and are declared not competent yet. This avoids further damage and severe risk.

3.2. Dimensions of Professional Competence on ETU-IS

Competency identification is based on IQF as a material for developing test instruments. The Assessors consider two pieces of evidence, namely, direct and indirect evidence. Direct evidence is in the form of the implementation of competency tests. The indirect evidence is based on supporting documents that refer to one's expertise in the form of certificates, that are recognized become a consideration in competency tests. Moreover, the measured dimension (Leutner et al., 2017; Norton, 2013) is also based on the adequacy of the participant's actions on five competency dimensions, including:

i) Task Skill (TS)
ii) Task Management Skill (TMS)
iii) Contingency Skill Management (CMS)
iv) Environmental Management Skills (EMS); and
v) Job and Skill Role Environment (JREs)

These dimensions are instrumental in the implementation of competency tests (Russo, 2016).

Table 3 - Competency Dimensions Applied in the Competency Test Unit

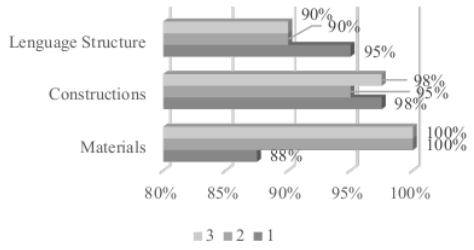
No.	Code Unit	Instruction 1	Instruction 2	Demonstration	Interview
1	OTO.KR10.001.01	/	/	X / TS	/
2	OTO.KR10.009.01	/	/	X / TS	/
3	OTO.KR10.010.01	/	/	X / TS	/
4	OTO.KR10.016.01	/	/	X / TS	/
5	OTO.KR10.017.01	/	/	X / JREs	X / EMS / JREs
6	OTO.KR10.018.01	/	/	X / TS	/
7	OTO.KR20.001.01	/	/	X / TMS	/
8	OTO.KR20.010.01	/	/	X / TMS	/
9	OTO.KR20.014.01	/	/	X / TMS	/
10	OTO.KR20.020.01	X / EMS / JREs	/	X / CMS	X / CMS / EMS
11	OTO.KR50.001.01	/	/	X / TMS	/
12	OTO.KR50.011.01	/	/	X / TMS	/
13	OTO.KR50.012.01	/	X / CMS	X / CMS	X / CMS

Noted: (X) is performed.

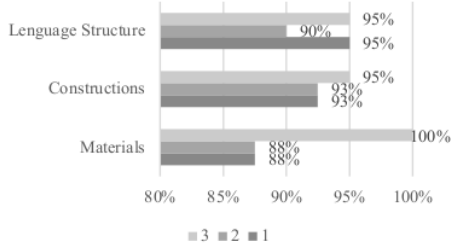
The competency adequacy requirements consist of five dimensions that are applied to the competency test unit (Table 3.). This concept is not a standard concept in instrument development. Changes possibly occur as needed. The assessor's main focus is on codification (X), but other competency elements may be asked. Generally, in the field, interviews develop according to the needs, but they must take into account time. The unit has not been answered in full, and assessors have the right to give instructions to get in-depth information, even ask more if it is deemed necessary.

3.3. Professional Competency Assessment (PCA) Instrument Test Results

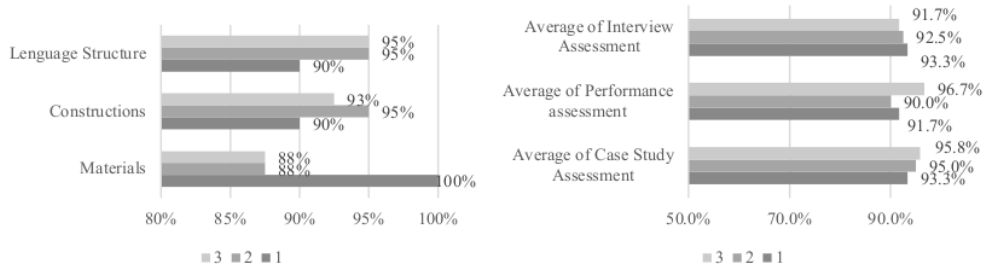
The PCA in Tune-Up Engine were carried out through constructing tests by experts. Assessments of validity, reliability, feasibility and planning are carried out to meet the analysis of model development. A score scale consisting of 1-4 has been converted to a percentage, and the final result is compared with the ranking criteria between "very bad" and "very good". Test results are stated in the following Figure 2:



(A) Assessment case study (in the instruction)



(B) Assessment Demonstration (Practice)



(C) Assessment in Interviews (D) Average test results by Experts

Fig. 2 - Results of Assessments and Average Rate Instrument of Three Experts

The instrument test results displayed indicate that the assessment of experts in the area of expertise gained was above 90.0%. This acquisition were interpreted that the results of the assessment test meet the criteria. All indicators in the category are "very good". The results of the reliability analysis using the Cohen kappa coefficient (ƙ) are shown in the following Table 4:

Table 4- Coefficient (ƙ) between Restricted Test, Performance Assessment, and Oral Assessment

Assessor	Case Study Assessment			Performance Assessment			Interview Assessment		
	1	2	3	1	2	3	1	2	3
1		0.93	0.70		0.85	0.67		0.81	0.76
2			0.86			0.82			1
3									
	Average = 0.82			**Average = 0.78**			**Average = 0.85**		

The reliability of the model developed shows that the average value obtained include (a) the coefficient (ƙ) of the test in the case study of 0.82; (b) coefficient (ƙ) performance appraisal of 0.78; and (c) coefficient (ƙ) interview assessment of 0.85. A reliability score of close to were stated as a strong relationship. The reliability coefficient value has very good reliability and meets the competency test requirements.

3.4. Results of Implementation of Professional Competency Test

The planning phase were carried out before the assessors carry out the assessment intending to equalize the understanding and critical points that must be met in the assessment. This recommendation is appropriate for all assessors to equalize their perceptions. The assessors explain the rules for carrying out the competency test and ask the participants' agreement in choosing which assessment comes first. 20 people as participants, were involved in testing competencies from various backgrounds. Background comparison is a separate finding in the development of test instruments. More details have been described as follows:

Table 5 - Results of The Implementation of the Professional Competency Test in Terms of The Codification and Identity of the Subject

A.G1	C	C	C	C	C	C	C	C	C	C	C	C	C
A.G2	C	C	C	C	C	C	C	C	C	C	C	C	C
A.G3	C	C	C	C	C	C	C	C	C	C	C	C	C
A.G4	C	C	NC	C	C	C	C	C	NC	NC	NC	C	NC
A.G5	C	C	C	C	C	C	C	C	C	C	C	C	C
A.L1	C	C	C	C	C	C	C	C	C	C	C	C	C
A.L2	C	C	C	C	C	C	C	C	C	C	NC	NC	NC
A.L3	C	C	NC	C	C	C	C	C	NC	NC	C	NC	NC
A.L4	C	C	C	C	C	C	C	C	C	NC	C	C	NC
A.L5	C	C	C	C	C	C	C	C	C	NC	C	C	NC
A.L6	C	C	C	C	C	C	C	C	C	NC	C	C	C
A.L7	C	C	C	C	C	C	C	C	NC	C	C	C	C
A.L8	C	C	C	C	C	C	C	C	C	NC	C	C	NC
A.L9	C	C	C	C	C	C	C	C	C	C	C	C	C
A.S1	C	C	C	C	C	C	C	C	C	C	C	C	C

Table 5 – (Cont.)

A.S2	C	C	C	C	C	C	C	C	C	C	C	C	C
A.S3	C	C	C	C	C	C	C	C	C	C	C	C	C
A.S4	C	C	C	C	C	C	C	C	C	C	C	C	C
A.S5	C	C	C	C	C	C	C	C	C	C	C	C	C
A.S6	C	NC	C	C	C	C	C	C	NC	NC	C	NC	NC
(%)	**100**	**92**	**90**	**100**	**100**	**100**	**100**	**100**	**80**	**65**	**90**	**85**	**65**
Codific	**01 (General Competency)**						**02 (Core Engine)**				**05 (Core Electrical)**		
ations	**01:01**	**09:01**	**10:01**	**16:01**	**17:01**	**18:01**	**01:01**	**10:01**	**14:01**	**20:01**	**01:01**	**11:01**	**12:01**

Note: AG (Ac Works / have worked); AL (acc Students); US (acc lectures)
C (competence); NC (Not competence yet)

Researchers analyzed the results of competency tests that have been conducted obtained and several findings based on job categories and competency tests. Five participants with jobs as teachers participated in the competency test with 80% success (5) were declared competent. Looking at the background of participants with recommendations that are not competent yet are teachers outside the field of expertise, but they have 2 years of the learning experience and have experienced failure in unit coding tests (OTO.KR10.010.01, OTO.KR20.014.01, OTO .KR20.020.01, OTO .KR50.012.01). The assessors made it clear that the participants were incorrect in explaining and using measuring instruments in their application of technology. The most incompetent recommendations are for participants in the student category. Most of them failed to verify the unit test code (OTO.KR10.010.01, OTO.KR20.014.01, OTO.KR20.020.01, OTO.KR50.012.01, and OTO.KR50.011.01). In understanding the participants during the testing process, the assessor stated that any work performed was less professional. The definition explains that a test participant must have strong self-assessment abilities (knowledge, skills, and attitudes) whereas, 83.3% of teachers was declared as "competent". In the preparation and readiness of the superior teacher, it is possible to be their routine habits. Based on the level of competency units consisting of general competencies, core engine and core electricity are the biggest failures in controlling emissions and EMS. Competency in this unit, there are more complex cognitive and psychomotor skills.

Some analyzes submitted by assessors related to the implementation of the test and recommendations made by participants in the future, including 11 "competent" assessments and 9 "not competent yet" assessments. In the study case assessment, 55% was declared competent, while the performance appraisal by 45% showed competence and the assessment by interview was 60%. Some competency units have the same characteristics and often appear on "not competent yet " recommendations. This means that the test material in the competency unit has an interest level that must be mastered better as follows:

i. Maintaining the Emission Control System by 35.0% is not resolved. Most test participants had difficulty in using a gas analyzer. The most important thing in this test is the level of concentration and explanation of the concentration produced by the gas analyzer. Another incident is that setting, the use of inappropriate equipment makes the results not optimal.
ii. Maintaining and improving Engine Management System (EMS) by 35.0% have not been mastered. This is related to the computer system that reads engine conditions based on control through sensors so that changes that occur must be able to be detected. Case studies provided with problems several sensor functions outside normal conditions; this makes it difficult for test participants while the primary competence of the ETU-SI is the mastery of the capabilities of the EMS. Besides the troubleshooting given with lightly damaged payloads, it is also not appropriately resolved, for example, the loss of the fuse function, jumper code according to engine characteristics.
iii. Maintaining the Gasoline Fuel System by 20.0% is not controlled. The main thing is the flow check of the gasoline fuel system. Furthermore this competency unit uses two types of understanding, namely the mechanical fuel system and the electrical fuel system.

Other competency units are still within normal limits. Judging from the background of the test participants who experienced the biggest failures were students. This indicates that the habit of doing engine tune-up work is not maximal besides the injection system is not new, but its existence is limited and there are few experts in the field.

3.5. Analysis of the Results of Professional Competence Effectiveness Assessment

Overall the instrument testing process and the implementation of a professional competency test and the subsequent stages of the model effectiveness test include aspects of Valid, Reliable, Flexible, Fair, Objective, Systematic, and Useful. Expert results were presented in the following Figure 3:

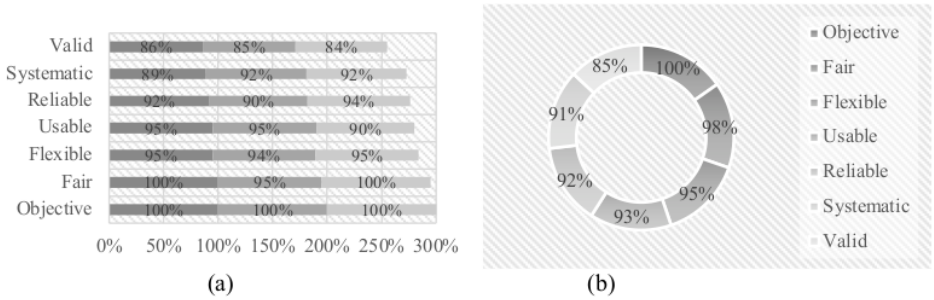


Fig. 3 - Results of the Effectiveness of the Professional Competency Test Model on the Tune-Up Engine Schema in the Injection System

Based on the results of expert evaluations presented in Figure 3, the instrument's feasibility. All instrument testing criteria have been met by a score of more than 85%. Figure 3 (a) describes the distribution by 3 experts and Figure 3 (b) describes the overall aspect. The highest test results obtained are the following aspects of an objective at 100%, fair aspects at 98%, flexible aspects at 95%, valid aspects at 93%, reliable aspects at 92%, and systematic aspects at 91%. Obtained one aspect by 85%, which is a valid aspect. All instruments meet the assessment requirements in the "very feasible or very good" category.

The objective aspect obtained by the highest percentage of all aspects is 100%. This means that the instruments assessed by experts have the same tendency. If tested on other assessments, it will be close to the same. The objective strength lies in the observer or the expert level in line with the argument (Inayah et al, 2017) the level of subjectivity and objectivity is strongly influenced by the assessor. If all assessors give a high percentage and do not have a tendency then the assessment instrument is able to measure the objectivity of the assessment. The fair aspect obtained as a percentage of 98% shows that fairly, there is no partiality in the instrument's evaluation. Lam (1995) argues that fair is equality and removes bias. Thus, the results of the fair aspect assessment show that during the assessment all experts were equal or fair. The flexible aspect is 95%, according to the principle of competency assessment. Flexibility means that during the implementation of the competency the testing phase can be carried out in accordance with the conditions in the field, in accordance with the abilities chosen by the assessment. Competency assessment refers to Australia, where there are four assessment requirements that must be met, namely valid, reliable, flexible and fair (Harris et al, 1995). Whereas systematic and usable aspects measure the extent to which the structure of conformity of the instrument is easily understood and can be used as a reinforcing aspect in the development of the PCA model. The results of the overall PCA instrument development meet the assessment requirements and can be used for the same scope (ETU-IS) in general.

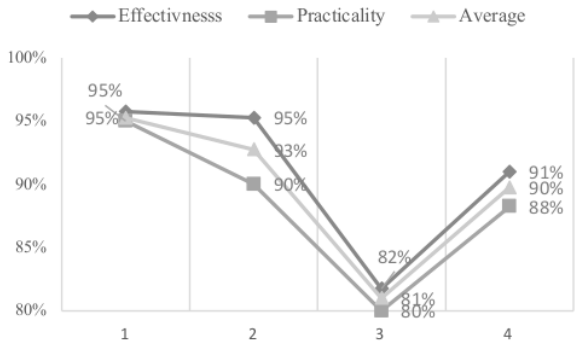


Fig. 4 - Competency Assessment Model Test Results

In terms of eligibility, the effectiveness and practicability elements were obtained on average 91% and 89%. Obtaining a score of close to 100% indicates that the relationship of eligibility is very good. The overall effectiveness and practicality of the competency test obtained are 90% with a very good category. All procedures have been carried out and met the criteria for developing a competency test model of the engine Tune-up injection system schema. The overall improvement statistics are shown in the following Table 6:

Table 6 - Competency Achievement Statistics

Statistics	Case Study Assessment Score	Performance Assessment scores	Interview Assessment scores
Subject	20	20	20
Mean	8.9	7.6	8.4
Median	8.9	8.1	8.8
Mode	9.2	8.2	8.6
Variance	3.5	0.3	2.2
Range	7.5	3.5	5.2
Minimum	7.5	6.5	4.0
Maximum	10.0	10.0	10.0

Overall review that the highest level of success lies in the case study. The scores obtained in the case study tests show the mean and median values are superior. This is due to the fact that practice tests and interviews have complex understanding and depth in meeting work instruction indicators (Treuer & Reynolds, 2017). The researcher reinforces that most of the test participants did not master the emission control work unit and EMS, though the approach of the automotive field with technology becomes the most important part, especially the development of the vocational education curriculum (Ersoy & Küçük, 2010). Automotive vocational education graduates must be able to master technology-based competencies.

The development of a professional competency test model with the CBA approach that has been applied fulfils the characteristics, including considerations from associations and industry, testing instruments by experts, making reliable evidence, making decisions and delivering the results of decisions to be important to consider. The assessor must master all aspects and elements of the competency test. Therefore, the technical and methodological requirements are the main requirements. Development of competency test models by fulfilling the criteria is relevant to industry needs and can be used in the assessment principles of PCI in various levels, especially in organizing vocational education.

4. Conclusion

The professional competency test model in the engine tune-up injection system scheme becomes a recommendation for PCI in producing quality vocational graduates who are able to meet the needs of the industrial world. Recommended results include: first, the development of the instrument has a clear framework and consists of competencies aspects of knowledge, skills and attitudes that can be done in the form of tests case studies, performance tests and interviews; second, the competency dimension is fully involved in the competency test unit consisting of TS, TMS, CMS, EMS and JREs; third, the results of the assessment instrument test conducted by automotive experts amounted to 93.3% with strong relationship reliability, implementation of competency tests fulfilling the criteria, and effectiveness analysis in the excellent category, evidenced by the aspect of the model's effectiveness by 89%, and practicality of 90%. All competency test activities have been documented and referred to in PCI in vocational education. The researchers recommend that this study produces a competency test with an excellent standardized IQF benchmark.

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Development of Model for Professional Competency Assessment (PCA) in Vocational Education: Study of the Engine Tune-Up Injection System Assessment Scheme

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