Measurement reliability inter-assessors in industrial practice activities

T Rijanto¹²*, S Soeryanto¹ and N Handayani¹

¹Department of Technology and Vocational Education, Postgraduate, Surabaya State University, Surabaya, Indonesia
²Head of Study Program S2 Technology Education and Vocational Graduate, State University of Surabaya, Indonesia

*tririjanto@unesa.ac.id

Abstract. This study aims to obtain the measurement reliability among vocational learners' assessors in industrial practice activities. The study was conducted in Indomobil Nissan Datsun workshop. There were 32 participants from various vocational schools in East Java, both from public and private schools. Assessors consists of two people, namely the mechanic chief (foreman). The performance attributes assessed are 10,000 km periodical maintenance which includes first safety, preparation for service, and periodical maintenance service. Periodical maintenance services include (1) interior inspection, (2) exterior inspection, (3) engine room inspection, (4) suspension and wheel inspection, (5) underside vehicle inspection, and (6) final inspection. The results showed that the inter-assessors reliability was equal, r_{xy} = 0.99. It means that the attribute scores obtained from the two assessors have the relatively similar position to the observed attributes.

1. Introduction

Vocational education is one of education which is designed to develop skills, work abilities, attitudes, work habits, and appreciation needed by workers to enter real work and make meaningful progress in it [1]. Vocational education and training is also designed to prepare students to work and to provide the theoretical knowledge and professional skills needed for certain types of work [2]. Thus, vocational education is one form of education and training that prepares students to enter the workforce [3-5].

Vocational education becomes meaningless if the community and students are lack of appreciation for jobs and attention off working correctly and productively as habits. Vocational education requires full cooperation, support and participation from government and business world industry, including the formation of consensus among stakeholders [3,5]. Vocational education is also demanded to be proactive and responsive to world changes occur by adopting long-term strategy throughout global economic environment changes both in the economic and political system, and finally ground the culture of the local community [6-8]. It means that vocational education must continue to improve its role in society through various revitalization policies.

Revitalization of vocational education in Indonesia is done through Presidential Instruction No. 9 of 2016. The aim of vocational education revitalization is preparing future generation who have high capability and competitiveness to face the challenges of global labor competition in the 21st century and the industrial revolution 4.0. These challenges are characterized by rapid changes occurring in the work
field, due to the huge influence of information and communication technology which causes changes in labor requirements and characteristics that are not easy to predict [9,10]. The global transformation towards a knowledge-based economy, creative industry, strong demands for the development of community quality, international and regional competition has driven changes in the pattern of vocational education in various parts of the world [11]. There has been increased openness, flexibility, complexity, and uncertainty in knowledge-based industrial societies [3,4,12,13]. In other words, revitalization of vocational education is needed.

To achieve the goal of revitalization, it can be implemented through some strategies such as: (1) curriculum development and alignment, (2) standardization of main facilities and infrastructure, (3) fulfillment of teacher and improvement of tendency professionalism, (4) learning innovation, (5) expansion of cooperation with the business and industrial world, and (6) institutional structuring and management [14]. Expansion of school cooperation with business and industrial world includes increasing the role of industry in the apprenticeship of teachers and industrial work practices for students.

Industrial work practices are patterns of organizing education and training that are jointly managed among schools, industries or professional associations as partner institutions, starting from planning, implementing, evaluating and certificating stages. So they become an integrated program using various alternative forms of implementation such as day release, block release, and so on [15]. The objectives of industrial practice are: (1) to produce workers who have professional expertise, namely workers who have suitable knowledge, skills, and work ethics that are in accordance with the demands of employment, (2) to improve and strengthen the relevance and equivalence (link and match) between vocational training education institutions and the work field, (3) to increase the efficiency of education and training process of qualified and professional workforce, and (4) to give recognition and reward for working experience as a process of education [16].

One example of implementation on vocational education revitalization, Vocational High School, the program of Light Vehicle Engineering Expertise in collaboration with PT. Indomobil Nissan Datsun in East Java through industrial work practices. The internship was conducted at the official workshop of Nissan Datsun Indomobil for six months. It conducted for detail such follows: one month of theory and five months of practice which ended by competency test. The material for competency test is 10,000 km periodic maintenance. Participants were declared passed to get a Nissan technician certificate if they have a score above 80.

The performance test is carried out by two observers, the chief mechanic or foreman. To give the score, the evaluator or observer follows certain criteria. Because of following certain criteria, there needs to be a match between the assessors. This compatibility is similar to reliability which is known as equivalent reliability measurement [17,18]. It needs to investigate how to measure the reliability of both observers in the apprenticeship competency test activities. The aim is observe the attributes obtained from the two assessors whether they have the same relative position to the observed attributes.

2. Research method

The method used is measurement through observers [18]. The procedures are: (1) carried out by observing or evaluating a 10,000 km periodical maintenance checklist and, (2) it uses two observers. The advantages of this method are not disturbing the subject and avoiding biased responses from respondents. The observer or evaluator in this study is the chief mechanic or foreman. The research was conducted in the even semester 2018/2019 (January to June 2019) at Nissan Datsun East Java Indomobil workshop. The research subjects were 32 industrial work practice participants.

Performance test material consists of (1) tool and equipment and (2) 10.000 km periodical maintenance service (PMS). Tool and equipment include the use of hand tools, measuring tools, special tools, and equipment. Periodical maintenance service of 10.000 km consisting of 10,000 km PMS preparation, interior, exterior, engine room, front wheel suspension, rear wheel suspension, and underside vehicle inspection. The number of observation items was 98. Details of the number of observation items can be seen in Table 1. Data were analyzed using Pearson correlation [19].
Table 1. Details on the number of performance items.

| No. | Tool and equipment | Number of Observation Points |
|-----|--------------------|-----------------------------|
| A   | The use of hand tools | 5                           |
|     | The use of measurement tools | 5                       |
|     | The use of special tools, | 5                          |
|     | The use of equipment | 5                          |
| B   | Periodical maintenance service of 10,000 km | 5                   |
|     | 10,000 km PMS preparation | 14                     |
|     | Interior inspection | 6                           |
|     | Exterior inspection | 21                          |
|     | Engine room inspection | 7                         |
|     | Front wheel suspension inspection | 9                     |
|     | Rear wheel suspension inspection | 9                   |
|     | Underside vehicle inspection | 16                     |
| Total |                             | 98                         |

3. Results and discussion

3.1. Results

There are two important aspects in the performance test of work practices on the routinely car maintenance industry, they are: (1) the use of tools and equipment; (2) the 10,000 km periodical maintenance service. The first aspect consisted of 20 items and the second aspect consisted of 78 items, by the total of 98 performance points. The results of analysis showed that the reliability between assessors for using tools and equipment aspects was $r_{xy} = 0.97$. It means that the attribute scores obtained from the two assessors have the similar relative position to the observed attributes. The proportion details of of inter-observer performance items can be seen in Table 2 below.

Table 2. Proportion of inter-observer assessments on tool and equipment aspects.

| Performance Items | Proportion ($p$) | Observer 1 ($p_1$) | Observer 2 ($p_2$) |
|-------------------|------------------|--------------------|--------------------|
| a. The use of Hand Tools |                   |                    |                    |
| 1 Preparing vehicle protective equipment | 1.00 | 1.00               |
| 2 Preparing hand tools | 1.00 | 1.00               |
| 3 Cleaning hand tools after finishing work | 0.97 | 0.97               |
| 4 Restoring the hand tools into place | 1.00 | 1.00               |
| 5 Discussing preparations with a mentor | 0.37 | 0.37               |
| b. The use of Measuring Tools |                   |                    |                    |
| 1 Preparing measuring instrument according to measurements | 1.00 | 1.00               |
| 2 Setting/calibrating the measuring instrument | 1.00 | 1.00               |
| 3 Performing measurements according to manual work sheet procedures | 1.00 | 1.00               |
| 4 Cleaning and positioning the measuring instrument according to place | 1.00 | 1.00               |
| 5 Discussing preparations with a mentor | 0.28 | 0.28               |
| c. The Use of Special Tools |                   |                    |                    |
| 1 Preparing special tools which are suitable with the work | 1.00 | 1.00               |
| 2 Setting/calibrating tool if it is needed | 0.97 | 0.97               |
| 3 Using special tools based on the exact procedure | 1.00 | 1.00               |
| 4 Cleaning and positioning special tools based on the suitable place | 1.00 | 1.00               |
| 5 Discussing the activities with mentor | 0.34 | 0.44               |
| d. The Use of Equipment |                   |                    |                    |
| 1 Using two post lift | 1.00 | 1.00               |
| 2 Using air compressor | 1.00 | 1.00               |
| 3 Using battery charger | 0.25 | 0.25               |
| 4 Using impact wrench and compressed air | 1.00 | 1.00               |
| 5 Discussing the activities with mentor | 0.34 | 0.34               |

Table 2 shows that the lowest performance items classified in proportion were discussing activities with mentors. It only has proportions ($p_{1.2} = 0.34$; $p_{1.2} = 0.28$; $p_1 = 0.34$ and $p_2 = 0.44$; and $p_{1.2} = 0.34$) as well as performance items using a battery charger ($p_{1.2} = 0.25$). Both observers have the similarity of the performance items observation. It shows that the performance of majority participants in industrial work practices is still weak in those two performance items. Discussing activities with mentors included in
the affective domain at work, namely communication skills. Thus, the low proportion of two observers indicates that there are weaknesses in those performance item.

The second aspect is the 10,000 km periodical maintenance service which is consisting of 78 performance points. The analysis results show that the reliability between assessors for this aspect is \( r_{xy} = 0.99 \). In other words, the attribute score obtained from the two assessors has the similar relative position to the observed attribute. Details of the proportion of items among observers can be seen in Table 3 below.

### Table 3. Proportion of inter-observer assessments of PMS 10,000 km.

| Performance Items                                         | Proportion (p) |
|----------------------------------------------------------|----------------|
| a. Preparation of PMS 10,000 km                          |                |
| 1. Setting up fender cover                               | 1.00           |
| 2. Setting up seat cover                                 | 1.00           |
| 3. Setting up steering cover                             | 0.97           |
| 4. Setting up work order                                 | 1.00           |
| 5. Taking up spare part which is needed in warehouse part | 0.37           |
| b. Interior inspection                                   |                |
| 1. Throttle pedal                                         | 1.00           |
| 2. Steering lock                                          | 0.84           |
| 3. Steering wheel free play                              | 0.75           |
| 4. Inspecting start engine                               | 1.00           |
| 5. Brake master cylinder function                         | 1.00           |
| 6. Instrument lamp (dashboard lamp)                      | 1.00           |
| 7. Air conditioner: buttons’ function of AC              | 1.00           |
| 8. Checking the out flow of refrigerant (odor)            | 1.00           |
| 9. Washer and wipers function                            | 1.00           |
| 10. Parking brake                                         | 1.00           |
| 11. Brake pedal free play                                | 1.00           |
| 12. Transmission (park and neutral switch of AT)         | 0.62           |
| 13. Select lever performance                             | 0.91           |
| 14. Head lamp, sign lamp and so on                       | 1.00           |
| c. Exterior Inspection                                   |                |
| 1. Hood (checking hood lock and other mechanism)         | 1.00           |
| 2. All doors, starting from driver position              | 1.00           |
| 3. Door lock and hinge                                   | 1.00           |
| 4. Function of all seat belt                             | 0.37           |
| 5. Trunk lid (lock and unlock) and hinge (sedan only)    | 1.00           |
| 6. Back door lock (SUV and Wagon) and hinge              | 1.00           |
| d. Equipment Usage                                       |                |
| 1. Fuel System (leakage and its indication)              | 1.00           |
| 2. Fuel Filter (non in tank type) gasoline               | 0.09           |
| 3. Diesel Fuel Filter                                    | 0.28           |
| 4. LLC Cooler System                                     | 0.75           |
| 5. Leakage of machine cooler system (pressure testing)  | 1.00           |
| 6. Radiator cap                                          | 1.00           |
| 7. Oil leakage around the machine                        | 1.00           |
| 8. Positive crank case ventilation (PVC) system          | 0.66           |
| 9. A/T oil level-A/T transmission                        | 1.00           |
| 10. Air filter                                           | 1.00           |
| 11. Spark plug                                           | 0.09           |
| 12. Distributor cap (conventional engine)                | 0.09           |
| 13. Machine Oil                                          | 1.00           |
| 14. Filter Oil                                           | 1.00           |
| 15. Battery function                                     | 1.00           |
| 16. Brake master cylinder leak and brake pipe line       | 1.00           |
| 17. Fluid brake and fluid leakage battery function       | 1.00           |
| 18. Power steering, fluid leakage                        | 0.37           |
| 19. Washer tank of front wind screen                     | 1.00           |
| 20. Belt                                                 | 1.00           |
| 21. Electrical connector                                 | 1.00           |
Table 3. Cont.

c. Front wheel suspension inspection

|   |   |   |
|---|---|---|
| 1 | Front wheel knuckle, wheel bearing | 1.00 | 1.00 |
| 2 | Wheels and their surfaces | 1.00 | 1.00 |
| 3 | Inside of wheels | 1.00 | 1.00 |
| 4 | Coil spring | 1.00 | 1.00 |
| 5 | Shock absorber | 1.00 | 1.00 |
| 6 | Brake hose and pipes | 1.00 | 1.00 |
| 7 | Caliper, rotor disc, and brake pad | 0.84 | 0.84 |

d. Back wheel suspension inspection

|   |   |   |
|---|---|---|
| 1 | Back wheel knuckle, wheel bearing | 1.00 | 1.00 |
| 2 | Wheels, their surface (loosing back wheels) | 0.56 | 0.56 |
| 3 | Inside of wheels | 0.75 | 0.75 |
| 4 | Coil spring | 1.00 | 1.00 |
| 5 | Shock absorber | 1.00 | 1.00 |
| 6 | Brake hose and pipes | 1.00 | 1.00 |
| 7 | Cylinder/rotor disc | 0.31 | 0.31 |
| 8 | Brake shoe/break pad | 0.22 | 0.22 |
| 9 | Wheel cylinder/caliper | 0.31 | 0.31 |

e. Underside vehicle inspection

|   |   |   |
|---|---|---|
| 1 | Engine and transmission (oil leakage) | 1.00 | 1.00 |
| 2 | Oil transmission (A/T) | 0.53 | 0.53 |
| 3 | Oil transmission (M/T) | 0.62 | 0.62 |
| 4 | Power steering fluid level and its condition | 0.28 | 0.37 |
| 5 | Differential oil (back wheels motor engine) | 0.16 | 0.16 |
| 6 | Transfer case oil (4x4 engine) | 0.25 | 0.25 |
| 7 | Drive shaft boot | 1.00 | 1.00 |
| 8 | Side rod bushing, arm, and joint | 1.00 | 1.00 |
| 9 | Front suspension (mounting and bolt) | 1.00 | 1.00 |
| 10 | Steering linkage | 0.66 | 0.69 |
| 11 | Brake pipe and fuel pipe | 1.00 | 1.00 |
| 12 | Parking brake cable | 1.00 | 1.00 |
| 13 | Back suspension (mounting and bolt) | 1.00 | 0.97 |
| 14 | Muffler, exhaust tube, and heat insulator | 1.00 | 1.0 |
| 15 | Brake fluid, fluid level and their condition | 1.00 | 1.0 |
| 16 | Wheels setting up, adjusting torsion and wheels’ nuts | 1.00 | 1.0 |

Table 3 shows that the performance items that were classified from the lowest to the highest proportion were (1) taking the spare parts needed in the warehouse part \((p_{1.2} = 0.37)\), (2) checking the function of all seatbelt \((p_{1.2} = 0.37)\), (3) the use of fuel filter equipment (non in tank type) gasoline \((p_{1.2} = 0.09)\), (4) the use of fuel-diesel filters \((p_{1.2} = 0.28)\), (5) the use of power steering fluid leakage \((p_{1.2} = 0.37)\), (6) drum/rotor disc examination \((p_{1.2} = 0.31)\), (7) brake pad inspection \((p_{1.2} = 0.22)\), (8) cylinder/caliper checking \((p_{1.2} = 0.31)\), (9) power steering fluid and conditions checking \((p_{1} = 0.28 \text{ and } p_{2} = 0.37)\), (10) differential oil checking of rear wheel drive vehicles \((p_{1.2} = 0.16)\), and (11) 4x4 vehicle case transfer oil checking \((p_{1.2} = 0.25)\).

After doing whole observation, the performance test of work practices on car maintenance industry routinely, it shows the results of inter-reliability \(r_{xy} = 0.99\). All aspects consist of 98 performance items. The reliability results of two assessors are relatively high. It shows that the attribute score obtained from the two assessors has the relatively same position to the observed attribute.

3.2. Discussion

The results of this study indicate that the inter-reliability of \(r_{xy} = 0.99\). Some similar studies have shown the same results [20-27]. The high reliability among assessors shows that assessors have understood and followed the specified criteria [18]. The intended criteria in this study is the periodical 10,000 km car maintenance.

The proportion of performance items \((p<0.50)\) indicates that the number of participants in industrial work practices is still largely weak on these items. In the aspect of using tools and equipments, and also for discussing activities or preparation with mentors item has a low proportion. The word discuss belongs to the affective aspect of the verb whose essence is communication. Communication and
collaboration are included in 21st century skills that must be mastered by industrial work practice participants [28].

Industrial work practices carried out for six months for students of Vocational High School grade XI odd semester of the program of Light Vehicle Engineering Expertise. During those six months, they were in the real industry life. Despite six months in the real industry life, communication skills owned by the participants are still weak. The weak communication skills of industrial work practice participants reinforce that the affective aspects cannot be grown in a short time. They need habituation, conditioning, and even through exemplary.

4. Conclusion
Based on the results of the study, it can be concluded that the inter-reliability of \( r_{yy} = 0.99 \). When it is viewed from the aspect of using tools and equipment, the reliability between assessors is \( r_{xy} = 0.97 \). Viewed from the second aspect, the periodical 10,000 km maintenance service inter-appraisal reliability is \( r_{xy} = 0.99 \). Thus, the attribute scores obtained from the two assessors have the relatively similar position to the observed attributes.

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References
[1] Adhikary P K 2005 Educational reform for linking skills development with employment in Nepal. In Meeting Basic Learning Needs in the Informal Sector (Dordrecht: Springer) 215-228
[2] Pavlova M and Munjanganja L E 2009 Changing Workplace Requirements: Implications for Education Rupert Maclean, David Wilson, Chris Chinien; International Handbook of Education for the Changing World of Work, Bridging Academic and Vocational Learning: (Germany: Springer Science+Business Media)
[3] Heinz W R 2009 Redefining the Status of Occupations (Dordrecht: Springer)
[4] Billett S 2009 Changing work, work practice: The consequences for vocational education International handbook of education for the changing world of work 175-187
[5] Hiniker L and Putnam R A 2009 Partnering to meet the needs of a changing workplace International handbook of education for the changing world of work
[6] Bailey T R, Hughes K L and Moore D T 2004 Working Knowledge: Work-based Learning and Education Reform (New York: Psychology Press)
[7] Clarke L and Winch C 2004 Apprenticeship and Applied Theoretical Knowledge in Educational Philosophy and Theory 36 5
[8] Raelin J A 2008 Work-based Learning: Bridging knowledge and action in the workplace (San Fransisco: Jossey Bass/Wiley)
[9] Rojewski J W 2009 A Conceptual Framework for Technical and Vocational Education and Training; in Rupert Maclean, David Wilson, Chris Chinien; International Handbook of Education for the Changing World of Work, Bridging Academic and Vocational Learning (Germany: Springer Science, Business Media)
[10] Boutin F, Chinien C, Moratis L and Baalen Pv 2009 Overview: Changing Economic Environment and Workplace Requirement: Implications for Re-Engineering TVET for Prosperity in Rupert Maclean, David Wilson, Chris Chinien; International Handbook of Education for the Changing World of Work, Bridging Academic and Vocational Learning (Germany: Springer Science+Business Media)
[11] Cheng Y C 2005 *New Paradigm for Re-engineering Education, Globalization, Localization and Individualization* (Netherland: Springer)

[12] Tessaring M 2009 *Anticipation of Skill Requirements: European Activities and Approaches;* In Rupert Maclean, David Wilson, Chris Chinien; *International Handbook of Education for the Changing World of Work, Bridging Academic and Vocational Learning* (Germany: Springer Science, Business Media)

[13] Wagner T 2008 *The Global Achievement Gap* (New York: Basic Books)

[14] Direktorat PSMK 2017 *Panduan Pendampingan Revitalisasi SMK Tahun 2017* (Jakarta: Direktorat Pembinaan Sekolah Menengah Kejuruan Direktorat Jenderal Pendidikan Dasar dan Menengah Kementerian Pendidikan dan Kebudayaan)

[15] Dikmenjur 2008 *Prakerin sebagai Bagian dari Pendidikan Sistem* (Jakarta: Direktorat Pembinaan Sekolah Menengah Kejuruan Direktorat Jenderal Pendidikan Dasar dan Menengah Kementerian Pendidikan dan Kebudayaan)

[16] Wena M 1996 *Pendidikan Sistem Ganda* (Bandung: Tarsito)

[17] Grounlund N E and Linn R L 1989 *Measurement and Evaluation in Teaching* (New York: MacMillan Publishing Company)

[18] Naga D S 2003 *Teori Pengukuran: Psikometrika, Teori Tes, Metoda Survei dan Pengukuran* (Jakarta: Program Pascasarjana Universitas Negeri Jakarta)

[19] Smith M J 2018 *Statistical Analysis Handbook 2018 Edition* (Edinburgh: The Winchelsea Press, Drumlin Security Ltd.)

[20] Stomfai S 2011 Intra-and inter-observer reliability in anthropometric measurements in children *International Journal of Obesity* 35 545-551

[21] Jarvis H L 2012 Inter-assessor reliability of practice based biomechanical assessment of the foot and ankle *Journal of foot and ankle research* 5 14

[22] Hannah 2012 Inter-assessor reliability of practice based biomechanical assessment of the foot and ankle *Journal of Foot and Ankle Research* 5 14

[23] Kayapinar U 2014 Measuring essay assessment: Intra-rater and inter-rater reliability *Eurasian Journal of Educational Research* 57 113-136

[24] Pereira M 2015 Inter-tester reliability of an observation-based ergonomic assessment checklist for computer workers *Proceedings 19th Triennial Congress of the IEA, Melbourne 9-14 August 2015*

[25] Leeder J E, Horsley I G and Herrington L C 2016 The Inter-rater Reliability of the Functional Movement Screen Withn an Athletic Population Using Untrained Raters *Journal of Strength and Conditioning Research* 30 2591-2599

[26] Beck 2016 Analyses of inter-rater reliability between professionals, medical students and trained school children as assessors of basic life support skills *BMC Medical Education* 16 263

[27] Juremi N 2017 Inter-rater reliability of actual tagged emotion categories validation using Cohen’s Kappa coefficient *Journal of Theoretical and Applied Information Technology* 95 259-264

[28] PPRC 2010 21st Century Skills for Students and Teachers. Research & Evaluation, August 2010, *Pacific Policy Research Center (PPRC)* (Honolulu: Kamehameha Schools, Research & Evaluation Division)