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# Development of Automotive Technology Instrument Using Rasch Analysis

Sariati Talib *, ArasinahKamis**
**( Department of Family & Consumer Science, Faculty of Technical & Vocational Education, Sultan Idris Education University, Malaysia)*
*** ( Department of Family & Consumer Science, Faculty of Technical & Vocational Education, Sultan Idris Education University, Malaysia)*
*Corresponding Author: SariatiTalib*

**ABSTRACT**
This study aims to test the validity and reliability of Automotive Technology Instrument using Rasch analysis. The objective of this study is to measure the instrument with the tests in Rasch's analysis such as fit items, item polarity, unidimensionality, item reliability and reliability of respondents. This instrument is divided into two constructs namely knowledge competence and skills competence. Knowledge competence is divided into three substructures namely administration knowledge, marketing knowledge and management knowledge that contains 58 skill items. Skills competence comprises four subconstructs: assembly skills, overhaul skills, service skills and diagnostic skills that contain 100 items. Knowledge items consist of multiple choice questions while skill items are five-point likert scale. The Automotive Technology Instruments questionnaire was administered to 240 teaching staff of the Training Skills Institute (ILK). Instructors' feedback data is included in the Statistical Package for the Social Science (SPSS) version 23.0 program before being imported into the Winstep v3.72.3 program. This study shows that the Rasch Model can help researchers build a good instrument as the items constructed offset psychometric standards.
***Keywords:***instrument, rasch, competence, reliability, knowledge, skills

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## I. INTRODUCTION

Instructors are the key drivers in the delivery of knowledge and skills to produce graduates who meet industry demands. TVET instructors will need to provide high-competence skills training that will maximize their ability to students (Klotz, Billett, &Winther, 2014).

TVET institutions need to provide skills training with high competency value, as well as providing high-competence instructors in the skills required. Teachers with high level of competence will be able to produce skilled students (Suherman, Wiyono, &Imron, 2016). Highly competent students can adapt to technological change and can contribute to quality education (MohdRidhuan, Shariza, &Mohd Ibrahim, 2015). Teachers who deliver competency-based skills training should provide students with the skills to be competent and relevant to the needs of the market and the real world (Habib &Baharuddin, 2013; Makulova et al., 2015). The competence of instructors, which includes knowledge, skills, attitudes and personality, will have a profound influence on the teaching and it will implicate human capital formation aspirated by the state (Azhari&Zaleha, 2013; Yuswono, Martubi, &Sukaswabto, 2014).

The 11th Malaysia Plan reported among TVET's challenges and issues is that there is a lack of competence among instructors that lack skills proficiency. According to studies conducted by Kamin, Ahmad, and Cartledge, (2013), automotive skills graduates in Malaysia do not meet industry needs due to the competence of instructors in knowledge and skills that are not in line with current technology in the automotive industry.

Teachers need to measure their competence so that they can identify the value of the competence of skills they have. There are several instruments that have been developed by earlier researchers such as the Automotive Mechanics Program to Increase Efficiency and Task List (Ryerson, 1976) Automotive Technology Efficiency Assessment Service (Mac Quarrie, 2005), Construction of the Framework Subject Competency-Based Automotive Technology (Sudsomboon, 2007), and Construction Competency Profile Analysis to Train Undergraduate Students for Automotive Technology Courses (Sudsomboon, 2008). But this instrument refers to technology at that time and is not relevant for use at present.

Competency gaps in the industry due to the competence of skills in education provided are not equivalent to industrial requirements (Leijen et al., 2017). An appropriate competency instrument should be developed as a reference to the competency standards of instructors to meet the needs of the work in the real automotive industry (Estriyanto, Kersten, Pardjono, &Sofyan, 2017).Thus, an automotive technology instrument is built and tested by the validity and reliability of the Rasch Model to be used as an instrument or instrument to measure the competence of knowledge and skills of instructors.

## II. PURPOSE AND OBJECTIVES OF STUDY

This study aims to test the validity and reliability of automotive technology instruments for teaching staff at the Institute of Skills Training using Rasch analysis. The objectives of this study are to:

1. Detect the suitability of item (item fit) of the instrument
2. Detect unidimensionality of instrument items
3. Detects polarity of instrument items
4. Test item reliability and item reliability.

## III. METHODOLOGY

This study is a survey study using random sampling and random sample sampling. A total of 240 teaching staff from the Skills Training Institute were selected as respondents to provide feedback on the automotive technology instrument questionnaire. The questionnaire is divided into part A, part B and part C. Table 1 shows the contents of each part of the question

**Table 1** shows the content of the questionnaire.

| **Section** | **Statement of questionnaire** |
|---|---|
| Part A | Demographic respondents |
| Part B | Skill competence |
| Part C | Knowledge competence |

**Table 2** shows the perician of the number of questions according to the construct of knowledge and skills competence.

| **No** | **Automotive Engineering Competence Construct** | **Number of items** |
|---|---|---|
| | Skill competence | |
| 1. | Installation skills | 8 |
| 2. | Repair skills | 8 |
| 3. | Overhaul skill | 25 |
| 4. | Service skills | 53 |
| 5. | Diagnostic skills | 41 |
| | **Total items of skill competence** | **135** |
| | **Knowledge competence** | |
| 1. | Competency of administration | 14 |
| 2. | Management competence | 53 |
| 3. | Competence of marketing | 13 |
| | **Total items of knowledge competence items** | **80** |

The instrumentation process involves two phases iephase 1 is a qualitative study involving the design of instruments and building instruments. and phase 2 is a quantitative study involving the validity and reliability of the instrument.

In phase 1 in the instrument design process, the researcher develops constructs and subconstructs competencies by referring to the competency model, NOSS, research spotlight, and existing instruments. In the process of building instruments, researchers identify and verify constructs and subconstructs through modified Delphi techniques. In the first round, it started with Delphi's expert interview to obtain important constructs and subconstructs. The findings of the interview, the researcher set up the Specification Table for instrument knowledge items. For Skill items, researcher develops five likert-shaped items. In the second round, Delphi specialists were given a questionnaire containing items of knowledge and items of instrument skills to obtain expert consent. The findings of the Delphi expert feedback were analyzed and the questionnaire was improved. In the third round, experts are given a questionnaire to approve. The results of the feedback are analyzed and expert consensus reaches consensus.

In phase 2 in the validity and reliability of the instrument, this instrument has been certified by experts and faculty by the Institute of Skills Training. The pilot study was conducted twice to obtain construct validity and item reliability using Rasch model which produced 58 knowledge items and 100 skill items. The actual study was conducted on 240 lecturers of the Institute of Skills Training and the results of the feedback were analyzed using the Rasch Model approach.

Feedback from the pilot study and the actual study, the researchers analyzed the data using Winstep 3.72.3 software with Rasch measurement model approach. Measurement model must have five criteria to be fulfilled to construct conclusions from observation ie; (i) generate linear measurements, (ii) overcome missing or missing items, (iii) detect misfits or outliers, (iv) provide estimates of accuracy, (v) measured objects parameters relying on measurement instruments (Wright &Mok, 2004).

The researcher observes the criteria to be followed: (i) item compatibility, (ii) unidimensionality, (iii) item polarity, (v) items reliability and reliability of respondents.

## II. FINDINGS AND DISCUSSION

Raw data has been recorded in Statistic Package for the Social Science (SPSS) software. The researcher exports data from SPSS to winstep software 3.73.3 to test the validity and reliability of denfan instruments using Rasch's approach. The researcher observes four criteria that need to be followed: item compatibility, unidimensionality, item polarity, item reliability and reliability of respondents.

**Item Compatibility (Item Fit)**

Item compatibility refers to an item measured to fit the Rasch measurement model (Siti Rahayah, 2008). The researcher set the value of item compatibility based on the determination by some researchers (Refer table 3).

Knowledge items are dichotomous while likert-shaped items. Item compatibility starts with Mean Square (MNSQ) value not exceeding Mean Infit (MNSQ) with + / (-) S.D). Misfit and Outlier can be detected by seeing ZSTD values larger or out of limit t +/- 2logit (Azrilah et al., 2015). The MNSQ range should be at the range of 0.77 logits up to 1.30 logits (Fisher, 2007) for dichotomic items (knowledge items) and 0.6 logits up to 1.4 logits (Bond & Fox, 2007) for likert-shaped items (skill items). The ZSTD value is the accepted value between -2.0 to 2.0 (Bond & Fox, 2007) and according to Linacre (2005) the ZSTD value can be ignored if MNSQ has been accepted.

**Table 3** Value Item Compatibility Value

| Reseacher | Range MNSQ | Range ZSTD |
|---|---|---|
| Azrilah et al. (2015) | MNSQ≤ MNSQ+/ (-)S.D | Between -2.00 to +2.00 |
| Fisher (2007) | Between 0.77 and 1.30 logits(item dichotomy) | Between -2.00 to +2.00 |
| Bond dan Fox (2007) | Between 0.6 and 1.4 logs(likert items) | Between -2.00 to +2.00 |

Table 4 shows a summary of the misfit of items for three subconstructs of knowledge competence. The value of MNSQ is referring to the match statistics or indicating the accuracy and competence of the data corresponding to the model. The ZSTD value indicates the match of the data whether it perfectly matches the model. The ZSTD value represents the unlikeness of the data which is significant if the data corresponds to the model. A total of 6 item of misfit from 58 knowledge competence items based on MNSQ's infit / outfit index. Subconstruct and the item is marketing = 1 item and management = 5 items.

**Table 4** Uncertainty (Misfit) Item Knowledge Competence: Actual Study

| Sub-Construk | Measure | Model SE | Infit | | Outfit | | PTMEA CORR | Item |
|---|---|---|---|---|---|---|---|---|
| | | | MNSQ | ZSTD | MNSQ | ZSTD | | |
| Marketing | -0.05 | 0.15 | 1.25 | 3.60 | 1.35 | 3.30 | 0.07 | PM15 |
| Managment | -2.83 | 0.36 | 0.87 | -0.04 | 0.46 | -1.30 | 0.40 | PU56 |
| | -2.31 | 0.29 | 0.75 | -1.10 | 0.34 | -2.40 | 0.55 | PU57 |
| | -2.71 | 0.34 | 0.82 | -0.06 | 0.44 | -1.50 | 0.44 | PU58 |
| | 1.03 | 0.14 | 1.23 | 5.20 | 1.31 | 3.80 | 0.08 | PU70 |
| | -1.24 | 0.20 | 1.03 | 0.50 | 1.68 | 2.90 | 0.22 | PU71 |

Table 5 shows a summary of the misfit of items for four subconstruct of skills competence. A total of 7 item misfit from 100 skill competency items based on MNSQ's infit / outfit index. The subconstruct and the item is install = 1 item; overhaul = 2 items; and service = 4 items.

**Table 5** Mismatches (Misfit) Skill Competency Items: Actual Study

| Sub-construk | Measure | Model SE | Infit | | Outfit | | PTMEA CORR | Item |
|---|---|---|---|---|---|---|---|---|
| | | | MNSQ | ZSTD | MNSQ | ZSTD | | |
| Install | 0.60 | 0.11 | 1.62 | 6.00 | 1.61 | 5.90 | 0.51 | KP08 |
| Overhaul | -0.05 | 0.11 | 1.44 | 4.40 | 1.41 | 4.10 | 0.66 | KR32 |
| | 0.35 | 0.11 | 1.46 | 4.60 | 1.46 | 4.60 | 0.61 | KR40 |
| Service | -3.13 | 0.16 | 1.83 | 5.60 | 2.30 | 3.90 | 0.34 | KS51 |
| | -3.19 | 0.16 | 1.42 | 3.10 | 2.06 | 3.30 | 0.41 | KS52 |
| | -3.64 | 0.18 | 1.89 | 5.20 | 2.49 | 3.40 | 0.30 | KS59 |
| | -4.50 | 0.22 | 0.22 | 1.20 | 1.43 | 1.00 | 1.00 | KS84 |

**Unidimensionality**

Unidimensionality is to measure the extent of single capacity measure items (Wright & Master, 1982). Unidimensionality is the most important consideration in the development of instruments or measuring tools to ensure the instrument is unidimensional (Linacre, 2011). Table 6 is two criteria in testing the unidimensionality of an instrument.

The researcher refers to two criteria in testing the unidimensionality of an instrument namely the value of Principal Component Analysis of Residual (PCA) and (ii) the level of distortion of items or variances that are not clear (Azrilah et al. 2015). According to Conrad, Dennis & Funk (2012) the good PCA value is at least 20% and the good level of disturbance or variance is 15% maximum (Azrilah et al., 2015). Local

independance is a value referring to the individual abilities of an item is not related to another item in the same construct. Values that meet local independance requirements are less than 0.7 (Linacre, 2007).

**Table 6** Criteria in Testing Unidimensionality of an Instrument

| **Criteria** | **Good Value** | **Reseacher** |
|---|---|---|
| Value Principal Component Analysis of Residual (PCA) | Minimun 20% | Conrad, Dennis & Funk (2012) |
| Value of disturbance or variance level is not clear | Maximum 15% | Azrilah et al. (2015) |

Table 7 shows the findings of Principal Component Analysis (PCA) based on variance explained by measure for knowledge competence. The PCA value for knowledge construction 27.0% is accepted as it exceeds 20%. Unxplained variance by 1st contrast (size) is the degree of item interruption in a contrast that is received if it is less than 15%. The value of unxplained variance by 1st contrast (size) to be in the desired specification is the knowledge construct is 4.6%.

Table 7 Unidimensi: Standardized Residual Variance for Knowledge Construct: Actual Study

TABLE 23.0 KAJIAN SEBENAR-PENGETAHUAN
INPUT: 240 PENGAJAR 58 item REPORTED: 240 PENGAJAR 51 item 2 CATS WINSTEPS 3.72.3
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Table of STANDARDIZED RESIDUAL variance (in Eigenvalue units)

-- Empirical -- Modeled
Total raw variance in observations = 72.6 100.0% 100.0%
Raw variance explained by measures = 19.6 27.0% 27.2%
Raw variance explained by persons = 7.2 9.9% 9.9%
Raw Variance explained by items = 12.4 17.1% 17.3%
Raw unexplained variance (total) = 53.0 73.0% 100.0% 72.8%
Unexplned variance in 1st contrast = 3.3 4.6% 6.3%
Unexplned variance in 2nd contrast = 3.0 4.1% 5.7%
Unexplned variance in 3rd contrast = 2.6 3.5% 4.8%
Unexplned variance in 4th contrast = 2.2 3.0% 4.1%
Unexplned variance in 5th contrast = 2.1 2.9% 4.0%

Table 8 shows an item having a residual value correlation that exceeds 0.7 logits ie PT 02, PT03, PU55 and PU59 items. All of these items go through the filter process by looking at the value of seeing MNSQ values approaching the value of 1.00 and ZSTD approaching the value of 0.00. After the filtering process, PT02 and PU59 items have been dropped.

**Table 8** Knowledge Items That Have Residual Value Correlation Exceeding 0.7 Logits

| CORREL-ATION | ENTRY NUMBER | item | ENTRY NUMBER | item |
|---|---|---|---|---|
| .88 | 2 | PT02 | 3 | PT03 |
| .82 | 37 | PU55 | 41 | PU59 |
| .70 | 32 | PU45 | 35 | PU48 |
| .68 | 1 | PT01 | 2 | PT02 |
| .62 | 47 | PU66 | 48 | PU67 |
| .55 | 34 | PU47 | 35 | PU48 |
| .53 | 1 | PT01 | 3 | PT03 |
| .36 | 11 | PM17 | 14 | PM20 |
| .36 | 12 | PM18 | 14 | PM20 |
| -.35 | 26 | PU35 | 29 | PU39 |

Table 9 shows a summary of Principal Component Analysis (PCA) based on variance explained by measure for skills competence constructs. PCA value is accepted as it exceeds 20% ie 63.2%. Unxplained variance by 1st contrast (size) is the degree of item interruption in a contrast that is received if it is less than 15%. The unxplained variance by 1st contrast (size) of the skills construct is 4.6% within the permissible value.

**Table 9** Unidimensi: Standardized Residual Variance for Skills Competency Construct: Actual Study

TABLE 23.0 KAJIAN SEBENAR-KEMAHIRAN
INPUT: 240 PENGAJAR 100 item REPORTED: 240 PENGAJAR 93 item 5 CATS WINSTEPS 3.72.3
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Table of STANDARDIZED RESIDUAL variance (in Eigenvalue units)

-- Empirical -- Modeled
Total raw variance in observations = 249.8 100.0% 100.0%
Raw variance explained by measures = 157.8 63.2% 63.5%
Raw variance explained by persons = 81.0 32.4% 32.6%
Raw Variance explained by items = 76.7 30.7% 30.9%
Raw unexplained variance (total) = 92.0 36.8% 100.0% 36.5%
Unexplned variance in 1st contrast = 11.4 4.6% 12.4%
Unexplned variance in 2nd contrast = 9.8 3.9% 10.7%
Unexplned variance in 3rd contrast = 7.1 2.8% 7.7%
Unexplned variance in 4th contrast = 4.4 1.8% 4.8%
Unexplned variance in 5th contrast = 3.6 1.5% 4.0%

Table 10 shows skill items with residual value correlation that exceeds 0.7 logits. After passing the item filter process, items KR30, KS56, KD100 and KD110 are dropped.

**Table 10** Items Removed Skill (Has Residual Value Correlation Exceeding 0.7 Logits)

| CORRELATION | ENTRY NUMBER item | ENTRY NUMBER item |
|---|---|---|
| .83 | 26 KR32 | 33 KR40 |
| .79 | 24 KR30 | 25 KR31 |
| .78 | 94 KD125 | 95 KD127 |
| .76 | 69 KS93 | 72 KD98 |
| .75 | 86 KD117 | 88 KD119 |
| .75 | 73 KD100 | 86 KD117 |
| .74 | 80 KD108 | 81 KD110 |
| .74 | 56 KS75 | 73 KD100 |
| .73 | 91 KD122 | 93 KD124 |
| .73 | 43 KS55 | 44 KS56 |

**Polarity**

Item polarity is a value that refers to items measuring the same construct as well as assuming all the items measuring a single subconstruct (Bond & Fox, 2007). According to Linacre (2005) the value of the item polarity also indicates the item or individual contradicts the variable. A high value polarity item (PTMEA) indicates that an item is more capable of distinguishing individuals, whereas the value of PTMEA is negative or zero indicates that the individual's relationship is contrary to constructed constructs (Linacre, 2011). Good PTMEA value is above 0.3 logits (Bond & Fox, 2007; Wu & Adam, 2007).

Table 11 shows a summary of the polarity of items that does not measure the same constructs for knowledge items. The value of the item's polarity, Point Measure Correlation (PTMEA) should be positive and have values above 0.3 logits. Items that conform to a set of PTMEA values confirms items that are measured in the same direction. The items dropped were PT09, PM16, PU28, PU39, PU46, PU49, PU60, PU61, PU72, PU73 and PU75 as the PTMEA values were not in the proposed specification.

**Table 11** KTeA Knowledge Competence Items Polarity: Actual Study

| No | Subconstruk | PTMEA CORR | | | | Total Item |
|---|---|---|---|---|---|---|
| | | Minimum | Item | Maximum | Item | |
| 1. | Administration | 0.21 | PT09 | 0.35 | PT07 | 8 |
| 2. | Marketing | 0.07 | PM15 | 0.45 | PM15 | 10 |
| 3. | Managment | 0.22 | PU71 | 0.54 | PU57 | 40 |

Table 12 shows a summary of the polarities of the items measuring the same constructs. The value of the item's polarity, Point Measure Correlation (PTMEA) should be positive and have values above 0.3 logits. Items that conform to a set of PTMEA values confirms items that are measured in the same direction. The dropped item is KD117 because the minimum value of PTMEA is less than 0.3 logits.

**Table 12** KTeA Skill Competence Items Polarity: Actual Study

| Bil | Subconstruk | PTMEA CORR | | | | Total Item |
|---|---|---|---|---|---|---|
| | | Minimum | Item | Maximum | Item | |
| 1. | Install | 0.57 | KP04 | 0.68 | KP10 | 6 |
| 2. | Overhaul | 0.61 | KR40 | 0.84 | KR15 | 28 |
| 3. | Service | 0.34 | KS51/KS56 | 0.84 | KS74 | 35 |
| 4. | Diagnosis | 0.25 | KD117 | 0.82 | KD110 | 31 |

Item reliability is demonstrating the adequacy of items to measure what they want to measure, while individual credibility is the ultimate repetition of individual results when the same test is done (Azrilah et al. 2015). According to Wright and Master (1982), individual reliability refers to the estimation of the score can differentiate the ability of an individual to another. The reliability of

the item refers to the extent to which items remain equally along the scale even though the items are the same but assigned to different individuals but still have the same capabilities (Bond & Fox, 2007). Table 13 shows the reliability value according to the views of some researchers.

**Table 13** Reliable Value Based on Several Research Findings

| Researcher | Reliability value |
|---|---|
| Fisher (2007) | Exceeding 0.94 is considered excellent<br>The value of 0.93 to 0.91 is very good<br>The value of 0.9 up to 0.81 is good. |
| Linacre (2012) | An individual reliability index of more than 0.8 and item reliability index exceeds 0.91 proving that the sample is sufficient |
| Sekaran and Bougie, (2011) | Individual reliability indexes and items exceeding 0.80 are considered good |
| Cohen, Manion and Morrison (2007) | Values above 0.90 are considered to be very reliable<br>Values from 0.80 to 0.90 are considered to be very reliable<br>The value of 0.70 to 0.79 is considered reliable<br>Values 0.60 to 0.69 are considered to be minus / min reliableValues less than 0.60 are considered unacceptable. |

Table 14 shows a summary of the reliability of items for knowledge constructs. Item reliability index shows a high value of 0.98. Table 15 shows a summary of the reliability of KTeA knowledge items. The high value reliability index is 0.82. Table 16 shows a summary of item reliability for the skills construct. Item reliability index shows a high value of 0.99. Table 17 shows a summary of the reliability of KTeA skills items. The reliability index of the respondents produced a high value of 0.99.

**Table 14** Reliability of KTeA Knowledge Items: Actual Study

SUMMARY OF 38 MEASURED item

| TOTAL MODEL INFIT OUTFIT |
| SCORE COUNT MEASURE ERROR MNSQ ZSTD MNSQ ZSTD |
| MEAN 155.5 240.0 .00 .17 1.00 .1 .97 -.1 |
| S.D. 48.2 .2 1.22 .05 .08 1.4 .19 1.2 |
| MAX. 231.0 240.0 2.55 .36 1.25 5.6 1.65 3.9 |
| MIN. 45.0 239.0 -2.82 .14 .79 -2.0 .42 -2.1 |
| REAL RMSE .18 TRUE SD 1.21 SEPARATION 6.69 item RELIABILITY .98 |
| MODEL RMSE .18 TRUE SD 1.21 SEPARATION 6.78 item RELIABILITY .98 |
| S.E. OF item MEAN = .18 |

Table 15 Reliability of Respondents for Measuring KTeA Knowledge Items: Actual Study

TABLE 3.1 KAJIAN SEBENAR-PENGETAHUAN

INPUT: 240 PENGAJAR 58 item REPORTED: 240 PENGAJAR 38 item 2 CATS WINSTEPS 3.72.3

SUMMARY OF 240 MEASURED PENGAJAR

| TOTAL MODEL INFIT OUTFIT |
| SCORE COUNT MEASURE ERROR MNSQ ZSTD MNSQ ZSTD |
| MEAN 29.8 46.0 .87 .37 1.00 .0 .97 .0 |
| S.D. 6.7 .1 .91 .05 .17 1.1 .31 .9 |
| MAX. 44.0 46.0 3.66 .74 1.61 3.5 2.15 3.6 |
| MIN. 3.0 45.0 -3.28 .34 .55 -3.6 .39 -3.0 |
| REAL RMSE .39 TRUE SD .82 SEPARATION 2.13 PENGAJ RELIABILITY .82 |
| MODEL RMSE .37 TRUE SD .83 SEPARATION 2.21 PENGAJ RELIABILITY .83 |
| S.E. OF PENGAJAR MEAN = .06 |

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PENGAJAR RAW SCORE-TO-MEASURE CORRELATION = .99
CRONBACH ALPHA (KR-20) PENGAJAR RAW SCORE "TEST" RELIABILITY = .82

Table 16 Reliability of KTeA Skills Items: Actual Study

SUMMARY OF 88 MEASURED item

| TOTAL SCORE | COUNT | MEASURE | ERROR | MODEL MNSQ | ZSTD | INFIT MNSQ | ZSTD | OUTFIT MNSQ | ZSTD |
|---|---|---|---|---|---|---|---|---|---|
| MEAN | 914.6 | 240.0 | .00 | .12 | 1.02 | .0 | 1.01 | -.2 | |
| S.D. | 116.9 | .2 | 1.59 | .03 | .22 | 2.1 | .31 | 2.0 | |
| MAX. | 1186.0 | 240.0 | 3.37 | .30 | 1.93 | 5.9 | 2.71 | 5.9 | |
| MIN. | 625.0 | 238.0 | -5.52 | .11 | .70 | -3.8 | .49 | -3.9 | |

REAL RMSE .13 TRUE SD 1.59 SEPARATION 12.56 item RELIABILITY .99
MODEL RMSE .12 TRUE SD 1.59 SEPARATION 13.27 item RELIABILITY .99
S.E. OF item MEAN = .17

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Table 17 Respondents' Reliability of Measuring KTeA Skill Items: Actual Study

TABLE 3.1 KAJIAN SEBENAR-KEMAHIRAN INPUT: 240 PENGAJAR 100 item REPORTED: 240 PENGAJAR 88 item 5 CATS WINSTEPS 3.72.3

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SUMMARY OF 240 MEASURED PENGAJAR

| TOTAL SCORE | COUNT | MEASURE | ERROR | MODEL MNSQ | ZSTD | INFIT MNSQ | ZSTD | OUTFIT MNSQ | ZSTD |
|---|---|---|---|---|---|---|---|---|---|
| MEAN | 348.0 | 91.0 | 2.25 | .19 | 1.00 | -.6 | 1.01 | -.2 | |
| S.D. | 52.2 | .1 | 1.70 | .02 | .57 | 3.3 | .62 | 2.9 | |
| MAX. | 436.0 | 91.0 | 5.73 | .27 | 3.88 | 9.9 | 3.86 | 9.9 | |
| MIN. | 196.0 | 90.0 | -2.33 | .17 | .30 | -6.8 | .28 | -6.2 | |

REAL RMSE .20 TRUE SD 1.68 SEPARATION 8.33 PENGAJ RELIABILITY .99
MODEL RMSE .19 TRUE SD 1.69 SEPARATION 9.06 PENGAJ RELIABILITY .99
S.E. OF PENGAJAR MEAN = .11

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PENGAJAR RAW SCORE-TO-MEASURE CORRELATION = 1.00
CRONBACH ALPHA (KR-20) PENGAJAR RAW SCORE "TEST" RELIABILITY = .99

As a result of the analysis using the Rasch Model approach, knowledge items of 19 items were aborted and 39 items were retained while for skill items of 10 items were aborted and 90 items remained.

## V1. CONCLUSION

The items of automotive technology instruments have been analyzed according to the criteria and conditions that must be followed to achieve the legality and reliability standards of the instrument with the Rasch model approach. Table 18 shows a summary of the abandoned items and items retained for knowledge items. Table 19 shows a summary of items dropped and items retained for skill items.

**Table 18** Summary Study of KTeA Knowledge Competence Items

| No | Sub-construk | Jumlah Item | Drop item | Total drop item | Retain item | Total retain item |
|---|---|---|---|---|---|---|
| 1. | Administration | 8 | PT02, PT09 | 2 | PT01, PT03, PT06, PT07 PT08, PT11 | 6 |
| 2. | Markerting | 10 | PM15, PM16 | 2 | PM17, PM18,PM19, PM20, PM21, PM26 | 8 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | PM27 | |
| 3. | Managment | 40 | PU28, PU39 PU46, PU49 PU56, PU57 PU58, PU59 PU60, PU61 PU70, PU71 PU72, PU73 PU75 | 15 | PU29, PU30, PU31, PU32, PU33, PU34 PU35, PU36, PU37, PU43, PU44, PU45 PU47, PU48, PU55, PU63, PU64, PU65 PU66, PU67,PU69, PU74, PU76, PU77 PU80 | 25 |
| Total item | | 58 | | 19 | | 39 |

**Table 19** Summary of the Essential Study of Item KTeA Skills Competency

| **No** | **Sub-construk** | **Total item** | **Drop item** | **Total drop item** | **Retain item** | **Total retain item** |
|---|---|---|---|---|---|---|
| 1. | Pemasangan | 6 | - | - | KP01, KP03, KP04, KP05, KP06, KP08 | 6 |
| 2. | Rombakrawat | 28 | KR32 KR40 | 3 | KR10, KR11, KR12, KR13, KR14, KR15 KR17, KR18, KR20, KR21, KR22, KR23 KR25, KR26, KR27, KR28, KR29, KR30 KR31, KR34,KR35, KR36,KR37, KR38, KR39, KR41 | 26 |
| 3. | Servis | 35 | KS51 KS52 KS56 KS59 KS84 | 5 | KS43, KS46, KS47, KS48, KS53, KS54 KS55, KS57, KS58, KS61, KS62, KS63 KS64, KS68, KS69, KS70, KS74, KS75 KS76, KS78, KS79, KS81, KS83, KS85 KS86, KS87, KS89, KS90, KS92, KS93 | 30 |
| 4. | Diagnosis | 31 | KD100 KD110 KD117 | 3 | KD95, KD97, KD98, KD101, KD102, KD103 KD104, KD106, KD107, KD108, KD111, KD112 KD114, KD115, KD118, KD119, KD120, KD121 KD122, KD123,KD124, KD125, KD127, KD128 KD129, KD130,KD131, KD134 | 28 |
| | Total item | 100 | | 12 | | 90 |

The findings show that automotive technology instruments have high reliability and reliability that can be used as a means of measuring the competence of knowledge and skills of teachers involved in the field of Automotive Technology. The result of the KTeA instrument analysis analysis, the instructor can improve the knowledge and skills based on the lack of competence that exists in itself with the competence of KTeA instruments. Competent instructors in knowledge and skills will produce students who can meet the needs of the industry market.

## REFERENCES

[1]. Azhari Mariani, & Zaleha Ismail (2013). Pengaruh kompetensi guru matematik ke atas amalan pengajaran kreatif. 2nd International Seminar on Quality and Affordable Education (ISQAE 2013), 2020(Isqae), 2006–2010.

[2]. Azrilah Abdul Aziz, Mohd Saidfudin Masodi & Azami Zaharim (2015). Asas model pengukuran Rasch:

[3]. Bond, T. G. & Fox, C. M. (2007). Applying the rasch model:Fundamental measurement in the human science (2nd ed.) Mahwah, N. J:Lawrance Erlbaum Assosiates

[4]. Bond, T., G., & Fox, C., M. (2007). Applying the Rasch model: Fundamental measurement in the human sciences. New Jersey: Routledge

[5]. Cohen, L., Manion, L., & Morrison K. (2007). Research methods in education (6th Ed.). Abringdon: Taylor and Francis.

[6]. Conrad, K. J., Conrad K. M., Mazza, J., Riley, B. B., Funk, R., Stein, M. A., & Dennis, M. L. (2012). Dimensionality, hierarchical structure, age generalizability, and criterion validity of the GAIN's Behaviioral Complexity Scale. Psychological Assessment, 24(4), 913-924, doi:10.1037/a0028196

[7]. Estriyanto, Y., Kersten, S., Pardjono, & Sofyan, H. (2017). The missing productive vocational high school teacher competency standard in the indonesian education system. Journal of Technical Education andTraining,9(1).Retrievedfromhttp://penerbit.uthm.edu.my/ojs/index.php/JTET/article/viewFile/1499/1110

[8]. Fisher, William P. Jr (2007). Rasch measurement transactions. http://www.rasch.org/rmt

[9]. Habib Mat Som & Baharuddin Saleh. (2013). Profil amalan guru dalam pelaksanaan kurikulum berasaskan kompetensi di sekolah menengah vokasional. Journal of Chemical Information and Modeling, 5(5), 1–16.

[10]. Kamin Yusri, Ahmad Adnan, & Cartledge, D. (2013). Science direct students' perceptions on the relevance of a diploma in an automotive curriculum to the workplace. Procedia - Social and Behavioral Sciences, 93, 90–96. https://doi.org/10.1016/j.sbspro.2013.09.

[11]. 157

[12]. Klotz, V. K., Billett, S., & Winther, E. (2014). Promoting workforce excellence: Formation and relevance of vocational identity for vocational educational training. Empirical Research in Vocational Education and Training, 6(1), 1–20.

[13]. Leijen, A., Slof, B., Malva, L., Hunt, P., Tartwijk, J. Van, & Schaaf, M. Van Der. (2017). Performance-based competency requirements for student teachers and how to assess them. International Journal of Information and Education Technology, 7(3), 190–194. https://doi.org/10.18178/ijiet.2017.7.3.864

[14]. Linacre, J. M. (2005).Winstep rasch measurement computer program. Chicago. Winstep.com.

[15]. Linacre, J. M. . (2007). A user's guide to windteps rasch-model computer programs. Chicago, Illinois: MESA Press

[16]. Linacre, J.M. (2011). Winsteps® rasch measurement computer program user's guide. Beaverton, Oregon : Winsteps.com

[17]. Linacre, J. M. (2015). Winsteps Rasch Measurement Computer Program User's Guide.

[18]. Beaverton, OR: Winsteps.com.

[19]. Mac Quarrie, D. L.(2007). Automotive service technology intersectional skill profiency assesment. Western Michigan University.

[20]. Makulova, A. T., Alimzhanova, G. M., Bekturganova, Z. M., Umirzakova, Z. A., Makulova, L. T., & Karymbayeva, K. M. (2015). Theory and practice of competency-based approach in education. International Education Studies, 8(8), 183. https://doi.org/10.5539/ies.v8n8p183

[21]. Mohd Ridhuan Mohd Jamil, Shariza Said, & Mohd Ibrahim K. Azeeez. (2015).Kompetensi guru terhadap pengurusan pengajaran dan pembelajaran: Suatu pendekatan teknik fuzzy delphi. Jurnal Kepimpinan Pendidikan, 3(1), 32–46.

[22]. Ryerson, W. (1976), Exploratory program for auto mechanics:Taks list and competency record. Minnesota: Minnesota State Department of Education.

[23]. Sekaran, U, & Bougie, R. (2011). Reseach

methods for business: Skill building approach. UK: John Wiley and Sonds LTD.
[24]. Siti Rahayah Ariffin. (2008). Inovasi dalam pengukuran dan penilaian. Penerbit Universiti Kebangsaan Malaysia: Selangor
[25]. Sudsomboon, W. (2007). Construction of a competency-based curiculum content framework for mechanical technology education program on automotive technology subject. Proceedings of the ICASE Asian Symposium.
[26]. Sudsomboon, W. (2008). Construction of an automotive technology competency analysis
[27]. profile for training undergraduate students: A case study of automotive body electrical technology systems. EDU-COM International Conference.
[28]. Suherman, J., Wiyono, B. B., & Imron, A. (2016). Competency mapping based education and training program development model at the centre of teachers and education staffs development and empowerment in Malang, East Java, Indonesia. Journal of Social Sciences, 5(3), 252–262.
[29]. Wright, B. D. dan Master, G. N. (1982). Rating scale analysis. Chicag, Il : Cesa Press.
[30]. 505
[31]. Williams & Ryerson. (1976). Exploratory program for auto mechanics task list and competency record. Minnesota: Minnesota Instructional Materials Center.
[32]. Wu, Margaret & Adams, Ray (2007). Applying the rasch model to psyho-social measurement. Melbourne: Educational Measurement Solutions.
[33]. Yuswono, L. C., Martubi, & Sukaswabto. (2014). Profil kompetensi guru sekolah menengah kejuruan. Jurnal Pendidikan Teknologi Dan Kejuruan, 22(2), 173–183.

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