Development and Validation of a Diagnostic Assessment Test in Auto-Electricity Aspect of Automobile Engineering Practice for Technical College Students in North Central-Nigeria

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Abstract

The need for a valid and reliable diagnostic assessment instrument in auto-electricity that could be used by teachers in the subject for diagnosing students' learning difficulties due to their persistent low achievement in the subject area, prompted this study. This study developed and validated a diagnostic assessment test in auto-electricity aspect of Automobile Engineering Practice for technical college students in North Central-Nigeria. Four research questions guided the study. Instrumentation research design was adopted for the study. The population of the study comprised 1914 students in 32 technical colleges in the zone, from which a sample of 1120 students in 23 technical colleges was drawn using simple random sampling technique. The Auto-electricity Diagnostic Test (ADT) developed was validated by five experts. Data collected were analysed using, X-Caliber 4.2 and IRT PRO softwares. Research questions were answered using Logic Validity method, 3-parameter logistic model of IRT. The results of the data analysed revealed among others that, the ADT is significantly valid in terms of content coverage of the curriculum of the subject area, the assumptions of item response theory investigated were satisfactorily met, which means that the items of the instrument were unidimensional and were locally independent of each other. Equally, the items of the instrument sufficiently fitted the 3-parameter logistic model. It also provided sufficient information about the testees' abilities with a well spread test information function across the ability continuum and all the remaining 69 items after item analysis. have all the qualities of a good diagnostic assessment test items in terms of discrimination, difficulty and guessing parameters. It was concluded that, the developed ADT is valid and has the potency of eliciting sufficient information about students' strengths and weaknesses in the subject area. Based on the findings, it was recommended among others that the ADT should be used by teachers of Automobile Engineering Practice to diagnose students' learning difficulties in auto-electricity so that no child is left behind in teaching and learning of the subject.

Keywords: *Diagnostic assessment, Auto-electricity, Automobile Engineering Practice*

INTRODUCTION

Automobile Engineering Practice is one of the trades offered in technical colleges. It is an aspect of technology that involves the study of basic principles of operations and skills necessary to diagnose and repair mechanical and electrical defects in automobile equipment. According to Idris (2012) Automobile Engineering Practice is the study of application of specific knowledge in the design, selection of materials, construction, operations and maintenance of automobiles. The teaching of automobile engineering practice in technical colleges is geared towards the production of craftsmen who will have skill, attitude and knowledge to meet the demand and development in the automobile industry. The craftsmen are expected to acquire the skills of testing, diagnosing faults, servicing and repairing of automobile equipment in both mechanical and electrical systems. Automobile Engineering is one aspect of technology that has continued to experience constant changes, improvement in the quality and sophistication in its equipment in 21st century. This is due to societal demands in terms of comfort, durability, fuel economy and emission problem (hybrid cars), usage (for example, Range Rover cars are good on all road Conditions even in rural areas) among other. These changes in the automobile engineering necessitate effective training of craftsmen who will meet up with the ever changing automobile technologies in the area of maintenance.

The importance of automobile to national development cannot be overstressed. It enhances mobility and contributes to economic development in various ways like creation of jobs through auto-manufacturing, supplying and parts merchandising, repair and servicing as well as improvement in revenue through taxes. Considering the place of automobile in the development of any nation, the study of automobile engineering practice becomes imperative. It is on this note that the Federal Republic of Nigeria (FRN, 2014) included automobile engineering practice in the curriculum of technical and vocational education at the technical college level with the following general goals: to provide trained manpower in the applied sciences, technology and business particularly at craft, advanced craft and technical level; provide the technical knowledge and vocational skills necessary for agricultural, commercial and economic development and to give training and impact the necessary skills to individuals who shall be self-reliant economically.

In pursuance of these goals, the curriculum of Automobile Engineering Practice comprises auto-body repair and spray painting, auto-electricity, auto-mechanics, auto-body building, parts-merchandising, general education, small business management and entrepreneurial training to ensure a comprehensive training of the craftsmen. The practical experience and entrepreneurial knowledge acquired through the training will enable a graduate to establish a motor vehicle servicing workshop and become self-employed as well as employer of labour. By so doing, the current unemployment rate of 33.3% according to National Bureau of Statistics, (2022), of the labour force in the country looking for work will be brought to the minimal level. These skills of maintenance of automobile equipment will become a veritable technical area where after graduation one could be self-employed and become employer of labour, and this will go a long way in improving vehicle conditions (repair/services) plying the roads in the country.

However, over the years, students' achievement in National Technical Certificate Examination (NTCE) in Automobile Engineering Practice has not been encouraging. An analysis of students' NTCE result from 2017 to 2022 revealed by NABTEB Chief Examiners' Reports within the period showed that there has been consistent poor achievement in the following areas; charging system, starting system, ignition system, and lighting and accessory system. These areas of weaknesses are from the Auto-electricity aspect of Automobile Engineering Practice. The Chief Examiners attributed the weakness to candidates' inadequate knowledge of motor vehicle electrical/electronic concepts, poor computation skills, poor grammatical expression, poor drawing skills and poor presentation of answers. Similarly, Adebayo and Jimoh (2015) noted that with advancement in technology, petrol engine automobiles are getting more and more complicated because of computerized systems and students especially at the technical colleges have difficulty in learning concepts in auto-electricity aspect of Automobile Engineering Practice.

Auto-electricity works which is the focus of the study is an aspect of Automobile Engineering Practices that is designed to equip students with the skills to be able to diagnose faults and carryout repairs on the electrical and electronic components (battery, distributor, starter motor, wiring, headlamps and others) of the motor vehicle (National Board for Technical Education, 2013). The usefulness of auto-electricity skills in the present age of automobile technology cannot be overemphasized as most motor vehicles now are remotely controlled, with the help of computer programmed sensors, which are components of the auto-electricity system. Currently, motor vehicle engines are controlled by microprocessors. These microprocessors also called Electronic Control Unit (ECU, or Brain Box) are electronic micro components that act as sensors for the engine demands (Fuel, speed, temperature among others.). In addition, faults in motor vehicles are now diagnosed using electronic gadget like computer exhaust analyzers. These are used in identifying the exact fault in the vehicle for effective and efficient repairs. Therefore, the skills of auto-electricity works are very important in the training of motor vehicle craft men, for them to acquire the current skills the automobile industry needs to fit in the world of everchanging automobile equipment. With this development therefore, for one to ascertain or be sure that the craftsmen are adequately prepared for the task ahead, assessment of what they have learnt in the process of training needs to be determined.

Several efforts have been made towards improving students' achievement in Automobile Engineering Practice. Studies by Kwaghgba, 2013 and Ogundola, 2014 have shown that some approaches such as the use of models, inquiry teaching method, the use of simulation, concepts mapping amongst others have been applied to improve students' achievement and develop their interest in Automobile Engineering Practice. Despite these efforts, it appears that no much appreciable improvement has been recorded in students' achievement in the trade. Therefore, the researcher felt the need to explore alternative and a holistic strategy that could identify the problem(s) associated with students' poor achievement as well as improve their outcomes in the subject and these could be done through diagnosis of their area of learning difficulties in the trade. The diagnosis is best achieved through the use of diagnostic assessment.

Diagnostic assessment is the type of assessment used to provide information about

students' strengths and weaknesses about a subject domain. Similarly, Department of Education (2013) defined diagnostic assessment as the process of gathering and careful evaluation of students' achievement using diagnostic test data to identify their strength and areas of need in a given learning area. Teachers use diagnostic information to adjust instruction by identifying which area students have and have not mastered in a given subject area, so that no child is left behind in teaching and learning process.

Furthermore, several researchers have established that diagnostic assessment is a potent tool for identifying students' learning difficulties in a given area of instruction. Marks (2012) conducted a diagnostic assessment on students' understanding of key concepts of electric circuits in physics in Malta and found that students had problems with parallel circuit, distinguishing between potential difference (p.d.) and current. In the same vein, Gani (2015) conducted a diagnostic assessment on students' achievement in quantitative Economics in Akwanga Nasarawa state. The data obtained provided useful information on students' strengths and weaknesses in the subject area. The efficacy of diagnostic assessment in identifying students' learning difficulties will help in identifying students' learning difficulties in auto-electricity. Unfortunately, studies have reported that most teachers are not familiar with diagnostic assessment and they do not use it (Eleje, Esomonu, Agu, Okoye, Obasi & Onah, 2016 & Bulus, 2018). These authors further submitted that teachers are more familiar with formative and summative assessments, which are not comprehensive enough to determine students' learning difficulties like in Auto-electricity. Corroborating, Ugodulunwa (2020) affirms that diagnostic assessment is used for identifying and remedying learning difficulties, errors and misconceptions, which formative and summative assessments could not correct. It appears that the non-usage of diagnostic assessment as affirmed by these authors has brought about dearth of diagnostic testing instruments that can be used in identifying students' learning difficulties like in Auto-electricity. Hence, students' learning assessment cannot be conducted without a test instrument, this present study is focused on developing and validating an auto-electricity diagnostic test instrument, which may be used by Automobile Engineering Practice teachers in identifying students' learning difficulties in terms of their mastery level in the subject area and errors they make.

Development in the context of this work refers to the procedures followed when constructing a test. Developing a diagnostic test involves; developing a skill map, creating test description, writing test items, reviewing of test items, trial testing of the items and testing of final draft (Bulus, 2018). In other words, it could also be referred to as test standardization, which entails test construction, administration, scoring, reporting and interpretation of results. (Emaikwu, 2011). The author asserts that a test without standardization automatically loses most of the qualities and characteristics of a good test. Based on the aforementioned, this study will observe the process of test standardization in developing an effective diagnostic test with all the qualities of a good test.

Validation on the other hand, refers to the processes that determine the fitness of a test; these involve the determination of validity, reliability as well as item difficulty, item discrimination and guessing parameter. Validity is the degree to which a test measures what it

intends to measure (Adikwu, Aduloju, & Agi, 2016). The validity evidence used in educational and psychological measurement include; content, construct and criterion-related validity. However, in this study, content validity will be used in ensuring that the content and objectives of auto-electricity are covered in the test. Reliability on the other hand, refers to the consistency of measuring instrument in measuring what is meant to measure. Methods of estimating reliability include; test re-tests equivalent, split-half, Kuder-Richardson and coefficient alpha method. In this study, test information function of item response theory will be used in estimating the reliability of the test. Item difficulty is the level to which a test item task examinee's ability in responding to the item. That is, an examinee should have probability of 0.05 in answering an item correctly (Ojerinde, Popoola, Ojo & Onyeneho, 2019). Item discrimination is a measure of how an item is able to distinguish between examinees of high and low ability while guessing parameter explains how likely the examinees are to provide the correct answer without knowledge of the trait (Bulus, 2018). Thus, this study developed and validated an Auto-electricity Diagnostic Test that passed through the process mentioned to produce a valid and reliable instrument. In order to achieve this purpose, the following research questions were raised and answered.

RESEARCH QUESTIONS

1. What is the content validity of the Auto-electricity Diagnostic Test developed?
2. What are the estimates of item discrimination of the Auto-electricity Diagnostic Test items?
3. What are the estimates of item difficulty of the Auto-electricity Diagnostic Test items?
4. What are the estimates of item guessing parameter of the Auto-electricity Diagnostic Test items?

METHODOLOGY

This study adopted instrumentation research design. This is because the study was aimed at developing an instrument. The population of the study consisted of all the 1914 students in the 32 technical colleges in the North-Central of Nigeria offering Automobile Engineering Practice. The sample size for the study comprised 1120 out of 1914 students in 23out of the 32 technical colleges in Federal Capital Territory (FCT) Abuja and two states; Benue and Niger States that are offering Automobile Engineering Practice were selected using simple random sampling technique. The instrument for data collection was Auto-electricity Diagnostic Test (ADT). The Auto-electricity Diagnostic Test consists of 102 multiple choice items. The procedure for development and validation of the Auto-electricity Diagnostic Test were: specifying skill map, outlining the instructional objectives, developing a table of specifications, writing test items, reviewing of test items, trial testing and revision. The ADT, skills are, starting system, ignition system, charging system and, lighting and accessory system. Instructional objectives are itemized. A table of specification of 102 multiple-choice and eight essay items was developed according to the six level of cognitive domain in relation to the four content areas. After

the table of specifications, the items were written in line with the specifications as well as the pattern of National Business and Technical Examination Board (NABTEB), that is, each item has four options A, B, C and D. The items were reviewed to avoid ambiguity and errors.

The content validity of Auto-electricity Diagnostic Test (ADT) was established by subjecting it to scrutiny of five experts, two each in Measurement and Evaluation, and three from Automobile Technology Education in University of Jos. The content validity took care of the relevance, clarity, simplicity and ambiguity of the ADT items. The experts rated the items using a rating scale that was developed by the researchers. Consequently, the ratings of the experts were subjected to statistical analysis to ascertain whether the test covers the content required in the curriculum, using Logical validity method (Anikweze, 2014). The content validity index stood at 0.88. The initial items of the instrument comprised 102 multiple choice items, however, after the scrutiny by the experts some of the items were modified while some were discarded based on language ambiguity, item difficulty above curriculum objectives limit and item not representative of the skill being measured. At the end, 97 were used for pilot testing. The Auto-electricity Diagnostic Test was trial tested on a sample of 521 NTCII Automobile Engineering Practice students in seven technical colleges in three states; Kogi, Nassarawa, and Plateau that were not part of the main study. The data obtained were analysed using item response theory framework for test information function. In the application of item response theory framework for calibration of test items, test information function (TIF) serves as the reliability of the test. TIF is a graphical representation of the sum of item information function in a test and provides estimates of the errors associated with (maximum likelihood) ability estimation. This implies that the more or higher information provided by a test at a particular ability level, the smaller the error associated with ability estimation. From the analysis of the data of the trial testing of ADT items, the multiple-choice TIF graph the maximum information was 1.9 at theta =0.01. At a cut point of theta =0.000, the TIF equaled 2.0. Based on these, information is well spread within the ability range of -2.5 to +2.5. This implies that high information of the test items cut across all levels of theta. This means that the instrument is reliable. At end of the trial testing process 82 items were left for the main study.

The research instrument ADT, was administered to the 1120 students with the assistance of help of the subject teachers in the sampled schools as research assistance. The data collected was dichotomously scored. Items correctly responded to were scored 1 while 0 was given to wrong responses. The data obtained fitted the 3-parameter model as well as its assumptions of unidimensionality and local independence. The data was analysed using factor loading analysis, tetrachoric correlation, and 3-parameter logistic model for items calibration for difficulty, discrimination and guessing parameters. The soft wares used for analyses include; X-Caliber 4.2, IRT PRO, and Statistical Package for Social Sciences (SPSS).

RESULTS

Research Question 1: What is the content validity of the Auto-electricity Diagnostic Test developed?

To establish the content validity of ADT, the items of the instrument were subjected to scrutiny by five experts. The experts rated the items using a 5-point rating scale developed by the researcher. Thereafter, the ratings of the experts were analysed using logical validity method to determine the content index of the raters on the coverage of the instrument on the content required in the curriculum. Content validity index of each experts ratings using logical validity method is thus:

Logical validity formula

$$\frac{\sum \mathbf{r}}{\sum \mathbf{N\ X\ R}}$$

Where:

$\sum \mathbf{r}$ = sum of expert's ratings
$\sum N$ = Sum of items of the scale
R = Rating scale

1. Expert One

3 X 5 = 15
5 X 4 = 20
2 X 3 = 6 = 41 = $\frac{41}{50}$ = **0.82**
41 10 X 5

2. Expert Two

7 X 5 = 35
3 X 4 = 12 = 47 = $\frac{47}{50}$ = **0.94**
47 10 X 5

3. Expert Three

6 X 5 = 30
1 X 4 = 4
3 X 3 = 9 = 43 = $\frac{43}{50}$ = **0.86**
43 10 X 5

4. Expert Four

4 X 5 = 20
4 X 4 = 16
2 X 3 = 6 = 42 = $\frac{42}{50}$ = **0.84**
42 10 X 5

5. Expert Five

7 X 5 = 35
2 X 4 = 8
1 X 3 = 3 = 46 = $\frac{46}{50}$ = **0.92**
46 10 X 5

Grand Mean of the Experts' Indices = 0.82 + 0.94 + 0.86 + 0.84 + 0.92 = **0.88**

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From the analysis, a content Validity Index (CVI) of 0.88 was obtained as the mean score of the ‹raters for the instrument. This CVI laid credence to the assertions of Fleiss (1981) and Anikweze (2014) that if CVI value is >.74 is considered strong agreement among raters of an instrument and the content validity of the instrument is excellent. This implies that the ADT is significantly valid in terms of content coverage of the curriculum of the subject area.

Research Question 2: What are the estimates of item discrimination of the Auto-electricity Diagnostic Test items?

Table 1: Item Parameter "a" for all Calibrated ADT Items

Items ID	a	Flag	Items ID	a	Flag	Items ID	a	Flag
1-	1.106		36-	1.595		71-	1.640	
2-	1.204		37-	1.177		72-	1.543	
3-	0.716		38-	1.575		73-	1.525	
4-	1.550		39-	1.473		74-	1.568	
5-	1.559		**40-**	-		75-	1.571	
6-	1.534		41-	1.592		76-	1.513	
7-	1.596		42-	1.204		77-	1.552	
8-	1.541		43-	0.716		**78-**	**3.504**	**Ha**
9-	1.528		44-	1.550		79-	1.595	
10-	1.538		45-	1.559		80-	0.977	
11-	1.566		46-	1.534		81-	1.575	
12-	1.582		47-	1.596		82-	**2.410**	**Ha**
13-	1.550		48-	1.541				
14-	1.571		49-	1.528				
15-	1.580		50-	1.566				
16-	1.565		51-	1.566				
17-	1.552		52-	1.582				
18-	1.579		53-	1.550				
19-	0.804		54-	1.571				
20-	1.319		**55-**	-				
21-	1.568		**56-**	-				
22-	1.552		57-	1.580				
23-	1.576		58-	1.565				
24-	1.548		59-	1.552				
25-	1.503		60-	1.579				
26-	1.573		61-	1.541				

27-	0.750	62-	1.585
28-	1.540	63-	1.579
29-	1.643	64-	1.552
30-	1.525	65-	1.576
31-	1.568	**66-**	-
32-	1.571	67-	1.548
33-	1.513	68-	1.603
34-	1.552	69-	1.503
35-	1.804	70-	1.500

Table 1 presents the item discrimination parameter "a" and flag for deviation from the threshold value of <2.0. from the table, 76 items representing 92.7% of the items are discriminating well, two items are flagged Ha indicating that the items "a" parameter is higher than the maximum acceptable value <2.0. However, four items (40, 55, 56 and 66) were not calibrated by the software, perhaps, the items were with no variance or have zero valid responses.

Research Question 3: What are the estimates of item difficulty of the Auto-electricity Diagnostic Test items?

Table 2: Item Parameter "b" for all Calibrated ADT Items

Items ID	b	Flag	Items ID	b	Flag	Items ID	b	Flag
1-	2.000		32-	2.951		63-	2.000	
2-	**4.000**	**– Hb**	33-	1.979		64-	2.594	
3-	2.392		34-	2.431		65-	1.870	
4-	1.351		35-	0.340		**66-**	-	
5-	2.228		36-	1.000		67-	1.695	
6-	1.115		37-	1.090		68-	2.041	
7-	1.210		38-	1.982		69-	2.960	
8-	**4.504**	**– Hb**	39-	0.924		70-	1.801	
9-	2.166		**40-**	-		71-	2.072	
10-	2.696		41-	2.000		72-	2.702	
11-	1.224		42-	1.000		73-	2.991	
12-	0.900		43-	2.392		74-	1.887	
13-	2.136		44-	2.351		75-	2.951	
14-	1.711		45-	2.228		76-	1.979	
15-	1.000		46-	1.115		77-	0.431	
16-	2.869		47-	2.000		78-	0.340	
17-	2.543		48-	0.504		79-	2.080	
18-	1.800		49-	2.166		80-	1.090	

19-	2.021	50-	2.696	81-	1.982
20-	1.200	51-	2.224	82-	2.410
21-	1.000	52-	1.040		
22-	1.594	53-	0.136		
23-	2.870	54-	2.711		
24-	0.695	**55-**	-		
25-	2.041	**56-**	-		
26-	**3.160 – Hb**	57-	1.912		
27-	**3.701 – Hb**	58-	2.869		
28-	2.972	59-	1.543		
29-	2.762	60-	0.900		
30-	2.991	60-	0.900		
31-	3.000	62-	2.040		

Table 2 presents the item difficulty parameter "b" for ADT items and flags for deviation from the threshold values of -3 to +3. From the table, 73 items representing 89% of the items are in the range of-3 to +3; three items are flagged Hb indicating that the "b" parameter were higher than the maximum acceptable value or are too difficult. Four items were not calibrated by the software.

Research Question 4: What are the estimates of item guessing parameter of the Auto-electricity Diagnostic Test items?

Table 3: Item Parameter "c" for all Calibrated ADT Items

Items ID	c	Flag	Items ID	c	Flag	Items ID	c	Flag
1-	0.105		32-	0.238		63-	0.236	
2-	0.123		33-	0.184		64-	0.244	
3-	**0.282**	**Hc**	34-	0.241		65-	0.233	
4-	**0.255**	**Hc**	35-	0.250		**66-**	-	
5-	0.246		36-	0.225		67-	0.250	
6-	0.250		37-	0.236		68-	**0.251**	**Hc**
7-	0.226		38-	0.238		69-	0.235	
8-	0.247		39-	**0.251**	**Hc**	70-	**0.288**	**Hc**
9-	0.247		40-	0.225		71-	0.243	
10-	0.246		**41-**	-		72-	0.242	
11-	0.238		42-	0.123		73-	0.248	
12-	0.233		43-	0.212		74-	0.238	
13-	0.242		44-	**0.255**	**Hc**	75-	0.238	
14-	0.237		45-	0.246		76-	0.248	
15-	0.236		46-	0.250		77-	0.241	
16-	0.240		47-	0.226		78-	0.250	

17-	0.242	48-	0.247	79-	0.225	
18-	0.233	49-	0.247	80-	0.236	
19-	0.244	50-	0.246	81-	0.238	
20-	0.230	51-	0.238	82-	**0.251**	**Hc**
21-	0.236	52-	0.233			
22-	0.244	53-	0.242			
23-	0.233	54-	0.237			
24-	0.250	**55-**	-			
25-	0.251	**56-**	-			
26-	0.235	57-	0.236			
27-	0.248	58-	0.240			
28-	0.243	59-	0.242			
29-	0.242	60-	0.233			
30-	0.248	61-	0.244			
31-	0.238	62-	0.230			

Table 3 presents the "c" parameter, which is guessing parameter or pseudo-chance parameter of ADT items and flags for deviation from the threshold of 0.25 chance for multiple-choice items with four alternatives. From the table, 71 items representing 86.6% of the items are ≤0.25; seven items were flagged Hc indicating that the "c" parameter index was higher than the maximum acceptable value, which means are prone to guessing. Four items were also not calibrated by the software.

DISCUSSION

The result of the research question one on the content validity of the test shows a content validity index of 0.88 of the experts' ratings. This index agrees with the assertion of Anikweze, (2014) that an instrument with a content validity index of 0.8, indicates that the instrument is valid in terms of content coverage in relation to the curriculum. The finding is in consonance with the outcome of the study of Okolo (2016) whose finding revealed a similar content validity index with the application of logical validity method of determining content validity of an instrument. Therefore, this finding has ascertained the efficacy of the instrument in terms of validity in measuring the trait (auto-electricity) it is designed to measure.

Furthermore, findings on research question two, three and four, which were on ADT items parameters (discrimination, difficulty and guessing parameters) of the multiple-choice. The findings revealed that a good percentage of items indices were within the acceptable levels of item calibration indices using 3-PML of IRT. These findings agreed with the outcomes of the studies of Bulus (2018) and Agbir (2021) who found items in their developed tests in Economics and Chemistry to possess good quality of item's facilities using 3-PLM calibration method. The findings of this study also support the outcomes of the study of Ojerinde, Popoola, Ojo and Onyeneho (2019) that compared the efficacy of CTT and IRT in the calibration of items parameters from data obtained from UTME Use of English pre-test. The study found that there was a great improvement in the total number of items rejected on the basis of discrimination

index; 33 for the CTT as against 11 for IRT. The present findings disagreed with the findings of the study of Enu and Okwilagwe (2015) that calibrated Mathematics and Geography items of Joint Command Schools Promotion Examination (JCSPE) of Nigerian army education corps. The study revealed that only one item falls within the acceptable guessing parameter value in the Mathematics items calibrated while a good number of the items were prone to guessing. Therefore, the implication of the present study's findings is that the calibrated ADT items have the potency to elicit students' learning difficulties in auto-electricity.

CONCLUSION

Based on the findings of this study, it was concluded that the developed Auto-electricity Diagnostic Test is valid, reliable and has all the qualities of a good diagnostic test that could elicit sufficient information about students' mastery level in the subject area.

RECOMMENDATIONS

In view of the findings of this study, the researcher hereby recommends that:

1. The ADT should be used to identify the areas of strengths and weaknesses of students in auto-electricity. This is because the test is valid in terms of content coverage and the items' parameters are within acceptable indices.
2. Since IRT is currently the most efficient test theory in the measurement of psychological and educational problems, test developers should ensure to employ it in calibrating test items due to its robustness in achieving objectivity in measurement of testees' ability.

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