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Effects of Poor Engine Repairs and Maintenance by Mechanics Operating in Local Garages

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Abstract
The automobile industry is growing so fast in Ghana and with its new sophisticated models on the Ghanaian market; it has become necessary to find out whether those who repair and maintain these vehicles in the local garages have the technical know-how to take up the challenges.
A research was therefore conducted to determine the level of their technical know-how and also to ascertain the various methods used in carrying out basic repair and maintenance works of automobile engines.
An assessment was carried out by means of questionnaire and interviews. One hundred questionnaires were distributed and eighty seven were received. Analysis of the results revealed that there is an urgent need for the respondents to undergo retraining in order to raise the level of their technical know-how. Even though some of their practices were right, most of them could lead to frequent break down of the engines.
Keywords: poor engine repairs and maintenance, mechanics, local garages, automobile industry.

1. Introduction

Auto maintenance describes the act of inspecting or testing the condition of car subsystems (e.g. engine) and servicing or replacing parts and fluids. The automotive maintenance and repair field offers many carrier opportunities for anyone who is mechanically inclined and educated in that field. The effective methods of performing maintenance and repairs operations require the use of tools specially designed for the purpose recommended. The transport sector performs a great role in human activities.
It helps in the moving of goods from the hinter lands to the market centers, assists in the conveyance of raw materials to their area of production, and promotes tourism and trade. Due to these underlining factors, the transport sector has to be tackled with all the seriousness needed so as to improve its efficiency as well as the life span of vehicles.
In Ghana, about 80% of vehicles used are “second-hand” (used vehicles) which are imported mainly from Europe and the United States of America. Most of these vehicles are maintained by local garages. It is of the view that most of the mechanics are not well trained. Equipment and tools used by these local garages are obsolete and most of them do not have any at all. Due to lack of technical know-how, maintenance works are carried out anyhow which leads to frequent breakdown of vehicles and even sometimes causes accidents. Wrong practices are adhered to rigorously and that normally affects the life span of engines.
This research is to find out more from these mechanics in local garages, the level of their knowledge on the maintenance they carry on various engines, the types of tools and equipments they use and how best they could be assisted. Most people find it difficult to send their vehicles to the foreign garages because of the cost of maintenance.

2. Specific Objectives

- To determine the level of their technical know-how.
- To ascertain the various methods used in carrying out the maintenance and repairs of the engines.
- To ascertain the various equipments and tools used for the maintenance and repair of the engines.

3. Methodology

The researcher adopted a quantitative research method which involves the use of self-administered structured questionnaires. The respondents were also interviewed alongside the questionnaire provided. A total number of 100 questionnaires were administered to some selected garages which are scattered randomly all over Accra and its environs but 87 were filled and returned. The results of the questionnaires were brought together and the data presented in a tabular form for easy correlation. The response to each of the research questions was analyzed using frequency counts and percentages.

4. Results and Discussions

(A) Background Information

Table 1.0 Educational Backgrounds

Institutions	Frequency	Percentages
Junior High School	41	47.1
Senior High School	17	19.5
Middle School	7	8.1
National vocational Training Institute	4	4.6
Technical institute	16	18.4
Polytechnic	2	2.3
Total	**87**	**100**

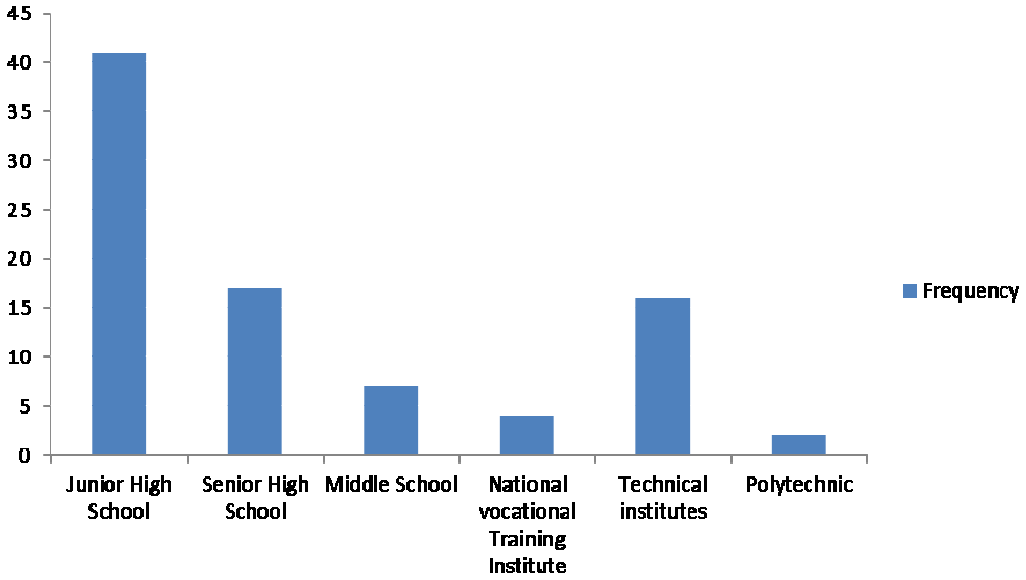

Fig. 1: Educational Background

Out of the 87 respondents questioned, 41 respondents representing 47.1% had only junior high school education. 17 respondents representing 19.5% completed senior high schools. Respondents from the technical institutes were 16 representing 18.4%. Only 2.3% of respondents had obtained higher national diploma as shown in fig. 1. Since the auto industry is advancing with the production of sophisticated vehicles, respondents need to upgrade their knowledge so as to take up the challenges confronting the industry. Respondents from the polytechnics should be encouraged to take up the challenge to own garages.

Table 1.1 Mode of Training

Mode of Training	Frequency	Percentages
Trained by an organization	16	18.4
Apprenticeship (Master)	71	81.6
Total	**87**	**100**

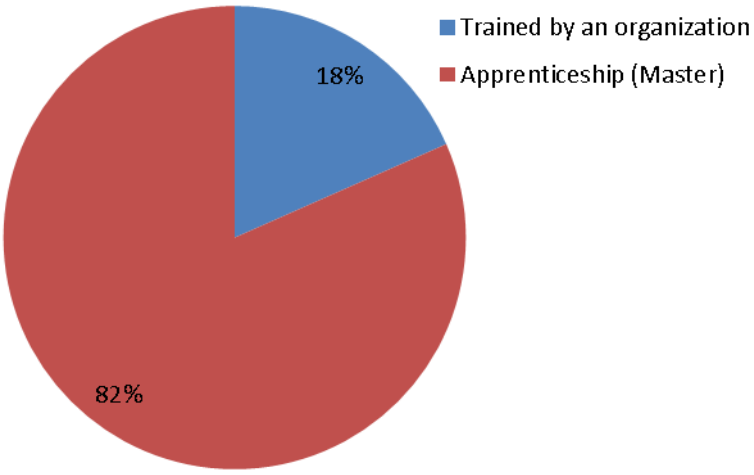

Fig. 2: Responses on Respondents Mode of Training

It was noticed that only sixteen of the respondents representing 18.4% were trained by organizations such as Toyota, Rana motors and Japan motors. The remaining 81.6% underwent apprenticeship training where they are trained by "masters'' who are chief apprentices who also lack the necessary technical know-how.

Table 1.2 Training Periods

Number of years	Frequency	Percentages
2 years	6	6.9
3 years	20	23.0
4 years and over	61	70.1
Total	**87**	**100**

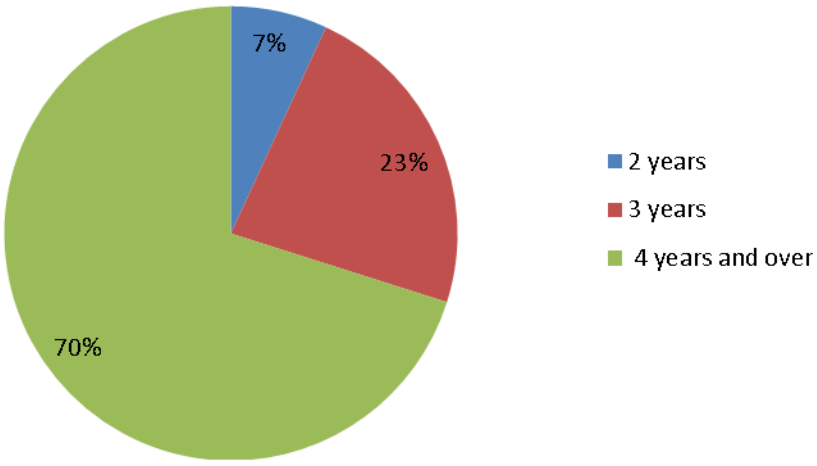

Fig 3: Number of years used in training respondents

From fig.3 it will be noticed that 70% had had training within a period of four years and more. 23% were trained within the period of three years and only 7% were trained within two year. It does not matter how long one is trained, if one does not acquire the right skills and technical know-how, much would still not be achieved.

(B) Information on Level of Technical Know-how

Table 1.3 Basic differences between petrol engine and diesel engine

		Frequency	Percentages
Petrol	Spark plugs	42	48.2
Diesel	Injectors	12	13.8
Diesel	Heater plugs	19	21.8
Abstention		25	28.7

In order to ascertain the difference between petrol engines and diesel engines, 42 respondents representing 48.2% mentioned spark plugs for petrol engines. 13.8 % respondents mentioned injectors for diesel engines. However, most petrol engines nowadays also use fuel injectors. 21.8 % mentioned heater plugs for diesel engines vehicles but when they were questioned further about how the heater plugs are used, they explained that the heater plugs ignite the diesel fuel.
During early starting, the heater plugs warm up the combustion area so that combustion will be quicker but the heater plugs are not responsible for igniting the diesel fuel. Diesel fuel has self-ignition qualities.

Table 1.4 Usage of hardening material on cylinder head gasket.

Responses	Frequency	Percentages
Yes	46	52.9
No	41	47.1
Total	**87**	**100**

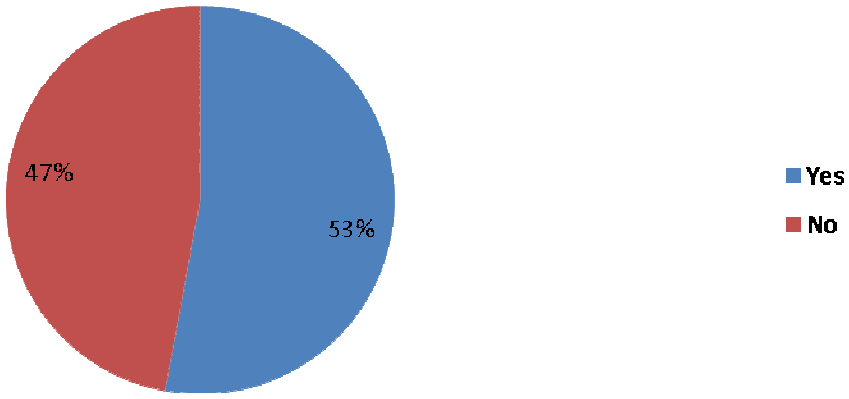

Fig.4 Reponses of respondents' knowledge on usage of hardening material on a cylinder head gasket

On respondents' knowledge on the use of hardening material on the cylinder head gasket, 76 respondents representing 52.9% answered in the affirmative as shown in table 1.4.
The surface should always be smeared with a non-hardening material like a thin film of oil or grease to allow slight gasket movement. This occurs because of unequal thermal expansion as the engine heats up and also when the cylinder head is being tightened down.

Table 1.5 Valve angle should be less than $1/2^o$ of its original value of 30^o or 45^o

Responses	Frequency	Percentages
Yes	59	67.8
No	28	32.2
Total	**87**	**100**

From table1.5 it was encouraging to know that 59 respondents representing 67.8% stated that they were aware of the fact that the valve angle should be $1/2^o$ less than its original value of 30^o or 45^o whiles 32.2% had no idea about it.
The valve is always $1/2^o$ less than the seat angle for three reasons:

- The hottest part of the valve under running conditions is the stem side of the head, and the additional expansion of this side makes the face and seat angles equal at running temperatures.
- The exhaust valve get very hot and then less strong. Under these conditions the spring load tends to cause the heads to dish slightly which can lift the inner edge of the face clear of the seating if angles are the same when cold.
- It reduces the risk of trapping carbon between face and seating. In this case, the face and seating cannot be lapped in.

Table 1.6 Difference between the sizes of the valves

Size of valves	Frequency	Percentages
Intake	58	66.7
Exhaust	25	28.7
The same	4	4.6
Total	**87**	**100**

Table 1.7 Can they be interchanged?

Responses	Frequency	Percentages
Yes	21	24.1
No	66	75.9
Total	**87**	**100**

When asked which of the valves is larger, 66.7% said it was the intake valve and 28.7% said it was the exhaust valve. 4.6% of the total respondents said they were the same size. When they were further asked whether they could be interchanged, 21 respondents representing 24.1% said yes and the remaining 66 respondents representing 75.9% said no.
The intake and the exhaust valves cannot be interchanged. Apart from the fact that the intake valve is larger than the exhaust valve so as to allow more charge into the system, the exhaust valve is normally subjected to more heat hence the material used for both valves are not the same.

Table 1.8 Difference between oil control rings and compression rings

Responses	Frequency	Percentages
Yes	72	82.8
No	15	17.2
Total	**87**	**100**

In order to find out the respondents' knowledge on the difference between oil control rings and compression rings, 82.8% answered in the affirmative whiles 17.2 % had no idea.
The compression rings seal in the air-fuel mixture as it is compressed. They also seal in the combustion pressures as the mixture burns. The oil control rings scrape excessive oil from the cylinder wall and return it to the oil pan. These two types of rings cannot be interchanged since each of them has different functions.

Table 1.9 Connecting rod bearings wear faster than main bearing.

Responses	Frequency	Percentages
Yes	59	67.8
No	8	9.2
Abstention	20	23.0
Total	**87**	**100**

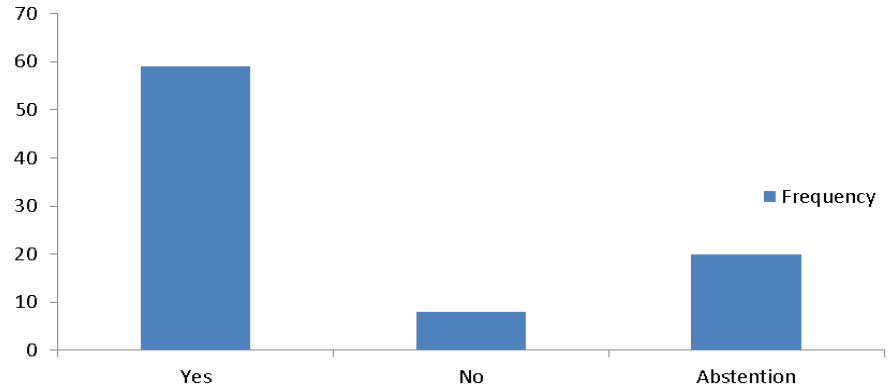

Fig.5: Responses of respondents' knowledge on the wear rate of connecting rod and main bearings

On the respondents' knowledge on the wear rate of the connecting rod bearing compared to the main bearing, it was established that 67.8% respondents were aware but 32.2% had no idea as depicted on the graph in fig.5.
The connecting rod bearing wears faster than the main bearing. During the power stroke, power is transmitted through the piston to the connecting rod, then to its bearings, hence causing the connecting rod bearings to wear faster than the main bearings.

Table 2.0 Removal of thermostat from the engine

Responses	Frequency	Percentages
Yes	69	79.3
No	18	20.7
Total	**87**	**100**

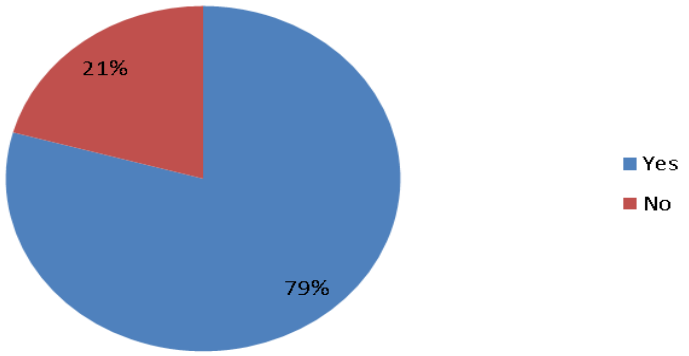

Fig.6: Responses of respondents' knowledge on the necessity not to remove the thermostat from the engine.

It is discouraging to find out that 69 respondents representing 79.3% as shown in fig. 6 were with the view that it was necessary to remove the thermostat from the engine because Ghana is in the tropics with hot weather conditions most of the time.
There is no need removing the thermostat since it is supposed to regulate the engine temperature. This allows the engine to get to its operating temperature faster and maintain that temperature necessary for the engine.

Table 2.1 Water levels in radiator can be checked by opening the radiator cap when engine is hot

Responses	Frequency	Percentages
Yes	66	75.9
No	21	24.1
Total	**87**	**100**

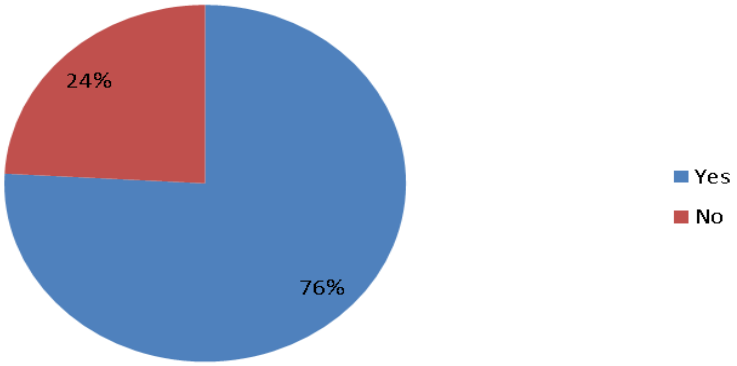

Fig.7: Responses of respondents' knowledge on how to check water level in the radiator

Most vehicles now provide an expansion tank through which it is easy to detect the level of water in the radiator tank but when respondents were asked whether it was necessary to open the radiator cap in order to check the water level, 66 respondents representing 74.9% indicated that the radiator cap needed to be opened. The remaining 25.1% of the respondents said it was not necessary as depicted on the pie chart in fig.7. Opening the radiator cap may lead to burns due to the fact that heated water under pressure may splash on the face and body.

Table 2.2 Overheating leads to distortion of the cylinder head and cracking of the cylinder head

Responses	Frequency	Percentages
Yes	70	80.5
No	17	19.5
Total	**87**	**100**

It was really encouraging to notice that 70 respondent representing 80.5% were aware of the fact that overheating leads to distortion of the cylinder head and possibly leading to a crack in the cylinder head. Causes of overheating should always be taken seriously and eliminated since its effects may be desirous to the engine.

Table 2.3 Connect the fan directly in case of faulty thermostat

Responses	Frequency	Percentages
Yes	52	59.8
No	35	40.2
Total	**87**	**100**

Connecting the fan directly incase its thermostat is faulty affects the operating temperature of the vehicle. It also leads to an increase in the volumetric efficiency of the engine which leads to increase in fuel consumption.
52 respondents representing 59.8% affirmed connecting it directly while 35 respondents representing 40.2% affirmed it negatively as shown in table 2.3.

(C) Information on methods used in carrying out engine repairs

Table 2.4 Right sequence used in tightening down of the cylinder head of an engine

Responses	Frequency	Percentages
Yes	80	92.0
No	7	8.0
Total	**87**	**100**

In order to find out the right tightening sequence of the cylinder head, 92% of respondents knew of the right sequence when tightening down the cylinder head of an engine. If the cylinder head is not tightened down properly using the right sequence it may lead to blow by. It was therefore encouraging to note that 80 respondents knew the right sequence used in tightening down of the cylinder head.

Table 2.5 Method used to determine the compression ratio of an engine.

Method	Frequency	Percentages
Compression test	50	57.5
Check the up and down movement of piston	37	42.5
Total	**87**	**100**

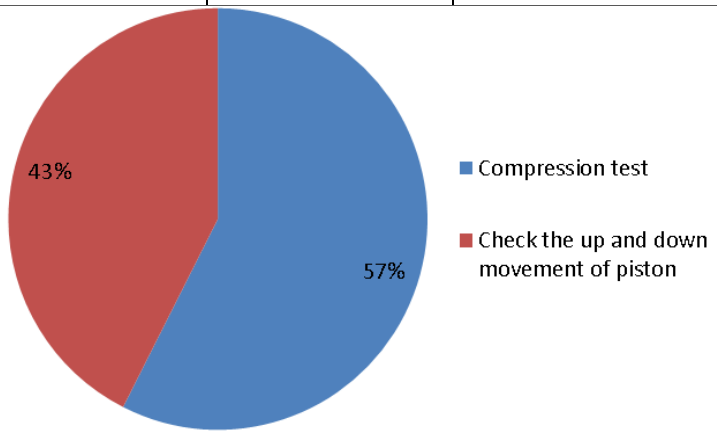

Fig.8: Responses of respondents' knowledge on how to determine the compression ratio of an engine.
The compression ratio of an engine can only be determined by a compression test and 57.5% of respondents affirmed this positively. Unfortunately 42.5% were of the view that the compression ratio could be determined by checking on the pressure developed due to the up and down movement of the piston.

(D) Information on equipments and tools used

Table 2.6 Instrument used in tightening down the cylinder head of the engine

Instruments	Frequency	Percentages
Box spanner	33	37.9
Torque wrench	54	62.1
Total	**87**	**100**

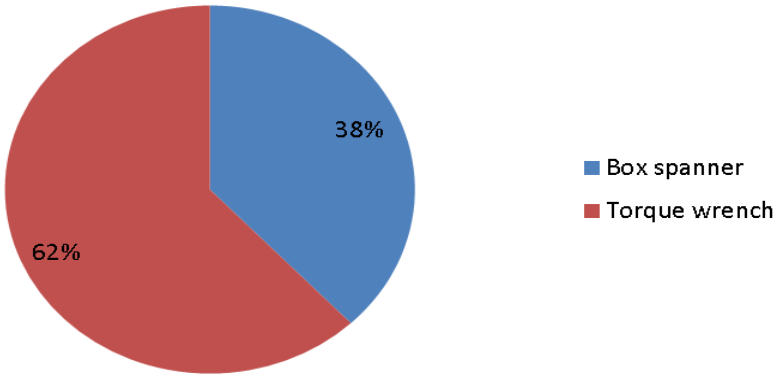

Fig.9: Instruments used in tightening down the cylinder head

On the type of instrument used in tightening down the cylinder head 33 respondents representing 37.9% use box spanners while 54 respondents representing 62.1% use torque wrenches. The torque wrench always gives equal amount of torque distribution, but when the box spanner is used it normally leads to blow by and even sometimes breaking of a nut.

Table 2.7 Instrument used in determining the compression ratio of an engine

Instruments	Frequency	Percentages
Compression Gauge	50	57.5
Check with eyes	37	42.5
Total	**87**	**100**

The compression ratio of the engine is determined by using the compression gauge. Since most of the mechanics do not have this kind of instrument, they resort to using their eyes in checking the pressure developed in the cylinders and 42.5% of respondents attested to that fact as indicated in table 2.8.

Table 2.8 Knowledge on electronic control unit (ECU)

Responses	Frequency	Percentages
Yes	55	63.2
No	32	36.8
Total	**87**	**100**

The electronic control unit (ECU) sometimes called the “brain” is now used in most vehicles, but only 63.2% of the total respondents were aware of its presence in vehicles. 36.8 % had no idea. In case a fault in the engine emanates from a faulty ECU, how can it be detected? They then sort to the use of the try an error method to solve the problems.

Table 2.9 Awareness of the diagnostic machine

Responses	Frequency	Percentages
Yes	53	60.9
No	34	39.1
Total	**87**	**100**

Nowadays, without the diagnostic machine it becomes very difficult to locate faults in the engine. It was therefore encouraging to find out that 60.9% affirmed positively their awareness of the diagnostic machine and its use and even though they have this awareness they do not have one of their own. Still 39.1% of the respondents are not aware of its use and needs to be trained accordingly.

5. Conclusion

The research has revealed that the knowledge of our mechanics needs to be upgraded if we expect them to remain in the auto industry which has become very sophisticated. Their upgrading may help prevent frequent breakdown of vehicle which sometimes lead to accidents on our roads, and also reduce the try and error methods normally employed by these mechanics which leads to excessive cost. Even though some of them have been in

the industry for years they are to be encouraged to see to the need that upgrading their skills will enable them face the numerous challenges in the auto industry. All stake holders must be involved to assist in the retraining since these mechanics are in charge of the repairs of about 80% of vehicles in the country.

6. Recommendation

Based on the findings of the study, the following recommendations have been made:

- Technical, Vocational and Polytechnic education should be encouraged by the government of Ghana.
- The apprenticeship training should be improved using the various institutions like NVTI, COTVET, TVET, Technical institutes and the Polytechnics.
- The "masters" that is the chief apprentices who train these young ones should be encouraged to undergo rigorous training so as to acquire the right knowledge that will be transferred to others.
- Competency Based Training which leads to proper skills development should be encouraged.

References

Donald, E.B., & Melvin, E. (1974), **"**Fundamentals of machine operations". Deere Company, Illinois, U.S.A.
Hillier, V.A.W. (1997), **"**Fundamentals of Motor Vehicle technology". Stanley Thornes publishers, England.
Crouse, W.H. (2004), **"**Automotive Mechanics". McGraw-Hill Book Company, London.
Duffy, F.E. (1993), "Auto Engines Technology". The Grodheart-Wilcox company, South Holland.
Ganesan, E.(1996), "Internal Combustion Engines". McGraw-Hill, Inc. U.S.A

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