Agricultural trainees' understanding of the concept of internal combustion engine in auto mechanics training

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Abstract: The purpose of this study was to determine agricultural trainees' understanding of the concept of an internal combustion engine in auto mechanics training. A structured questionnaire was administered to 105 randomly selected trainees in Faculty of Technical and Science Education, Rivers State University of Science and Technology, Port Harcourt, Nigeria. Data were analyzed with the use of frequency, percentage and mean. The findings revealed that all the respondents adequately identified sparkplug and injector nozzles (100%). It was also revealed that respondents understood the functionality of the internal combustion engine parts with average mean of 3.8. Respondents agree that they know how to remove internal combustion engine parts with average mean of 3.06. Inspecting internal combustion engine parts by the respondent recorded average mean scores of 3.21 which indicated that trainees can inspect the parts during servicing. It is suggested that trainees focus more on what they do in order to perfect and understand more in their training. [New York Science Journal 2010;3(11):71-77]. (ISSN: 1554-0200).

Key words: engines, internal combustion, trainees, understanding

1. Introduction

The content of a well structured concept on an internal combustion engine is a great tool in shaping the understanding of agricultural trainees majoring in agricultural mechanization, agricultural engineering and other related discipline. It is essential to apply the content and the concept of the topic for what it is meant to accomplish. Due to the complicated nature of the internal combustion engine parts that poses problem to the trainees the researcher then decided to investigate the trainees' understanding of the concept of internal combustion engine in auto mechanics training. Internal combustion engine is an act of burning the fuel internally. It is the heart of engine operation. An engine is a device which converts heat energy into mechanical energy to do work (John, 1980). Combustion in a petrol engine originates as the piston reaches top dead center (TDC) the fuel is ignited by the spark at the spark plug and the burning process of the mixture begins. In the case of the diesel engine combustion of the fuel is initiated by the heat of the air in the chamber. As the droplets of fuel pass through the air they absorb the heat, and if the temperature is high enough, the fuel will vaporize and ignite. Wierzba, Karim and Wierzba (1995) stressed that the combustion rate and the overall features of the diffusion flame are primarily governed by the rate at which the fuel and oxygen are brought together during the mixing process. Gupta, Bell and Tillman (1996) noted that engine operation is limited by the onset of misfire, which occurs when the flame speed is too slow or the energy release rate is insufficient to sustain combustion. Hence, the functionality of the internal combustion engine parts must be made known and understood by the trainees. The basic parts of engine like piston, piston rings, cylinder, cylinder block, crankshaft, camshaft, connecting rods, push rod and others are the parts trainees must know and also know their functionality. Burkybile, Johnson, Lee and Shelhamer (2005) noted that internal combustion engines have many parts. Hence a thorough knowledge of those parts, their functions, inspection, construction, and associated terminology is essential for success in agricultural power and technology careers. Research has shown that cylinder block is the main structural component of an engine that houses the cylinders and provides support and alignment for most of the engine components. Also cylinder head is the part of the engine that bolts to the cylinder block and seas off the tops of the combustion chambers.

The Functionality of internal combustion engine part gives the trainees an opportunity to relate better with the operation of the engine. Trainees will then be exposed on how the four-stroke and two-

stroke cycle of an engine operates. According to Burkybile, Johnson, Lee and Shelhamer (2005) a stroke is the movement of piston from top dead center to bottom dead center (BDC) or bottom dead center to top dead center. The piston is said to have completed one stroke when it travels from TDC to BDC or from BDC to TDC. In a four stroke cycle engine, the five basic operations are carried out in four strokes of the piston. These four strokes, in order of occurrence, are the intake, compression, power and exhaust. The crankshaft turns one-half revolution (1800) for each piston stroke; the crankshaft will make two complete revolutions (7200) in complete one engine operating cycle. Trainees should be able to disassemble and inspect the internal combustion engine parts.

It is important for the trainees to understand how to remove internal combustion engine parts when servicing the engine. Trainees should be able to remove and install the exhaust and intake valves, springs, and clips. The trainees must understand how to remove and install the piston/rod, crankshaft, and camshaft on the engine. Aloba, Oluleye and Akinbinu (2002) noted that physical inspection of vehicle parts during service will prevent vehicle breakdown. When disassembling internal combustion engine parts focus should be on how to identify those parts removed and the ability of the trainee to assemble them back. Research also shows that in the auto industry, preventive maintenance is generally carried out on a daily basis in order to reduce the probability of vehicle breakdown. Igboanuge, Nwachukwu and Achuenu (2002) stress that when maintenance practice is done without adequate planning and adherence to procedures in the workshop this always result in the adoption of haphazard approach to maintenance function.

According to Tharran (2002) listening for noises from the engine could help the trainee pinpoint the parts to be inspected. A ticking from the top of the engine may indicate the need for a simple valve adjustment. While a clunking or thumping sound deeper in the engine could indicate serious repairs. If a clunk becomes louder when the engine is put under a load, it may indicate problems with the crankshaft, bearings, or piston rods. Hence, a careful inspection of the internal combustion engine parts when removed from the engine will indicate if the parts are to be replaced or not. Wear and tear, carbon and dirt deposits, corrosion and distortions are things to look for in most of the part under inspection. Timely preventive maintenance and inspection will not only reduce major problems, it will also help to identify problems when they can be corrected with relative minor repairs. When inspecting internal combustion engine parts major thing to look for is worn parts because of constant rubbing of parts with each other. The complicated nature of the internal combustion engine parts poses problem to the trainees which made the researcher then decided to investigate Agricultural trainees' understanding of the concept of internal combustion engine in auto mechanics training. Hence, the specific objectives were to: 1) Determine the basic components of internal combustion engine trainees can identify physically; 2) Determine the trainees' understanding of the functionality of the internal combustion engine parts; 3) Determine how trainees rate their ability to remove basic engine parts in servicing internal combustion engine. 4) Determine how trainees are able to properly inspect internal combustion engine parts during servicing.

2. Methodology

The population for this study was all trainees in Faculty of Technical and Science Education, Rivers State University of Science and Technology, Port Harcourt, Nigeria. A structured questionnaire was administered to 105 randomly selected trainees in Faculty of Technical and Science Education. The questionnaire consisted of four sections. Section 1 elicited information on physical identification of basic components of internal combustion engine parts by the respondents. Section 2 elicited information on respondents understanding of the functionality of the internal combustion engine parts. Information on respondents' ability to remove basic engine parts in servicing internal combustion engine was collected in section three. The final section elicited information on respondents' understanding on how to properly inspect internal combustion engine parts' damage during servicing. Data were analyzed using the Statistical Package for the Social Sciences (SPSS). Descriptive statistical analysis used for this study includes frequencies, percentages and arithmetic mean.

3. Results and Discussions

The Table 1 indicated that the respondents identified all the internal combustion engine parts physically. Sparkplug and Injector nozzles recorded the highest percentages of 100 percent respectively. The reason for high percentages is because of the important function of sparkplug and injector nozzles during the ignition period in the combustion chamber. Badr, Elsayed and Karim (1996) noted that in a spark ignition engine, initiation of flame kernel comes from the passage of an electric spark from the sparkplug. Findings showed that 90.5 percent of respondents were able to identify cylinder head physically. With the high percentage recorded, the implication is that trainees must know that cylinder

head is at the top of the engine and houses the valves and intake and exhaust passages. Also, 86.7 percent of the respondents were able to identify intake and exhaust valves physically.

Table 1: Frequency and percentages of response on basic components of internal combustion engine identified physically

S/N	Internal combustion engine parts	*Frequency
1	Sparkplug	105(100)
2	Injector nozzles	105(100)
3	Cylinder head	95(90.5)
4	Intake and exhaust valves	91(86.7)
5	Gasket	89(84.8)
6	Oil sump pan	72(68.6)
7	Piston pin	71(67.6)
8	Piston	73(69.5)
9	Piston ring	75(71.4)
10	Connecting rod	73(69.5)
11	Cylinder	79(75.2)
12	Crankshaft	71(67.6)
13	Flywheel	77(73.3)
14	Main Bearing	83(79.0)
15	Rocker Arm	77(73.3)
16	Camshaft	75(71.4)
17	Timing Drives	77(73.3)
18	Push rod	83(79.0)
19	Cylinder block	85(81.0)
20	Balancer	86(81.9)

Values in parentheses are percentage.
*Multiple responses recorded

Table 2: Understanding of the functionality of the internal combustion engine parts by the trainees.

S/N	Statement	SA	A	D	SD	Mean	Remarks
21	The valve head is conical in shape so that it centers itself when it closes	49(46.7)	34(32.4)	20(19.0)	2(1.9)	3.24	Agree
22	Cylinder head is at the top of the engine and houses the valves and intake and exhaust passages.	64(61.0)	21(20.0)	20(19)	0(0)	3.42	Agree
23	Valves open and close to let fuel in and exhaust gases out of each cylinder.	81(77.1)	18(17.1)	6(5.7)	0(0)	3.71	Agree
24	Camshaft rotating in the engine block opens the valves by cam action.	62(59.0)	29(27.6)	14(13.3)	0(0)	3.46	Agree
25	Cylinder block is the main housing of the engine and supports the other main parts.	78(74.3)	24(22.9)	2(1.9)	1(1.0)	3.70	Agree
26	Cylinders are hollow tubes in which the piston works. They may be cast into the cylinder block or made of liners or sleeves.	65(61.9)	39(37.1)	1(1.0)	0(0)	3.61	Agree
27	Piston move up and down in the cylinders by the force of combustion.	78(74.3)	26(24.8)	1(1.0)	0(0)	3.73	Agree

28	Piston rings seal the compression in the combustion chamber and also help to transfer heat.	70(66.7)	27(25.7)	7(6.7)	1(1.0)	3.58	Agree
29	The piston pin is the engine part that joins the connecting rod to the piston.	81(77.1)	23(21.9)	1(1.0)	0(0)	3.76	Agree
30	Connecting rods transmit the motion of the pistons to the crankshaft.	78(74.3)	27(25.7)	0(0)	0(0)	3.74	Agree
31	Crankshaft receives the force from pistons and transmits it as rotary driving power.	71(67.6)	33(31.4)	0(0)	1(1.0)	3.66	Agree
32	Main bearings support the crankshaft in the cylinder block.	80(76.2)	23(21.9)	2(1.9)	0(0)	3.74	Agree
33	Flywheel attaches to the crankshaft and gives it momentum to return the pistons to the top of the cylinders after each downward thrust.	71(67.6)	27(25.7)	7(6.7)	0(0)	3.61	Agree
34	Balancers such as shafts or dampers, if used, balance the vibrations in the engine.	53(50.5)	36(34.3)	16(15.2)	0(0)	3.35	Agree
35	Timing drives link the crankshaft, camshaft, and other key parts together to assure that each is doing its job at the right time.	57(54.3)	31(29.5)	17(16.2)	0(0)	3.38	Agree
36	Push rod, use in valve-in-head engines, is a steel rod which transmits camshaft motion to rocker arm	57(54.3)	31(29.5)	16(15.2)	1(1.0)	3.37	Agree
37	Injection nozzle must atomize the fuel for better combustion	77(73.3)	27(25.7)	1(1.0)	0(0)	3.72	Agree
38	Injection nozzle must spread the fuel spray to fully mix it with air.	77(73.3)	27(25.7)	1(1.0)	0(0)	3.72	Agree
39	Oil pan serves as the oil reservoir	69(65.7)	19(18.1)	14(13.3)	3(2.9)	3.47	Agree

Note: SA = Strongly Agree; A = Agree; D = Disagree; SD = Strongly Disagree
Values in parentheses are percentage. Mid point is 2.50; any mean score < 2.50 suggests disagreement; any mean score ≥ 2.50 suggests agreement.

Table 2 reveals that the respondents are of the opinion that trainees understood the functionality of the internal combustion engine parts with the average mean score of 3.80. The reason for the understanding could be that the trainees paid adequate attention in the class while the training was going on. Internal combustion engine parts must be understood for one to know how to repair, remove and inspect the parts. It is revealed that the respondent knows cylinder block is the main housing of the engine and supports the other main parts which the mean of 3.70 supports. Respondents agreed that the piston pin is the engine part that joins the connecting rod to the piston. This was confirmed with the mean score of 3.76.

Table 3: Ability to remove basic engine parts during servicing of an internal combustion engine by the trainees.

S/N	Statement	SA	A	D	SD	Mean	Remarks
40	Remove sparkplug	42(40.0)	30(28.6)	29(27.6)	4(3.8)	3.05	Agree
41	Remove injector nozzles	50(47.6)	16(15.2)	29(27.6)	10(9.5)	3.01	Agree
42	Remove cylinder head	39(37.1)	25(23.8)	34(32.4)	7(6.7)	2.91	Agree
43	Remove intake and exhaust valves	55(52.4)	23(21.9)	20(19.0)	7(6.7)	3.20	Agree
44	Remove Gasket	41(39.0)	24(22.9)	37(35.2)	3(2.9)	2.98	Agree
45	Remove oil sump pan	45(42.9)	15(14.3)	37(35.2)	8(7.6)	2.92	Agree
46	Remove piston pin	36(34.3)	24(22.9)	39(37.1)	6(5.7)	2.86	Agree

47	Remove piston	49(46.7)	25(23.8)	25(23.8)	6(5.7)	3.11	Agree
48	Remove piston ring	58(55.2)	17(16.2)	23(21.9)	7(6.7)	3.20	Agree
49	Remove connecting rod	45(42.9)	28(26.7)	26(24.8)	6(5.7)	3.07	Agree
50	Remove cylinder	36(34.3)	33(31.4)	29(27.6)	7(6.7)	2.93	Agree
51	Remove crankshaft	31(29.5)	44(41.9)	24(22.9)	6(5.7)	2.95	Agree
52	Remove Flywheel	36(34.3)	34(32.4)	29(27.6)	6(5.7)	2.95	Agree
53	Remove Main Bearing	39(37.1)	46(43.8)	17(16.2)	3(2.9)	3.15	Agree
54	Remove Rocker Arm	43(41.0)	39(37.1)	20(19.0)	3(2.9)	3.16	Agree
55	Remove Camshaft	37(35.2)	41(39.0)	24(22.9)	3(2.9)	3.07	Agree
56	Remove Timing Drives	44(41.9)	33(31.4)	25(23.8)	3(2.9)	3.12	Agree
57	Remove push valve rod	40(38.1)	36(34.3)	25(23.8)	4(3.8)	3.07	Agree
58	Remove cylinder block	48(45.7)	36(34.3)	16(15.2)	5(5.8)	3.21	Agree
59	Remove Balancer	66(62.9)	17(16.2)	19(18.1)	3(2.9)	3.39	Agree
	Overall mean					3.06	

Note: SA = Strongly Agree; A = Agree; D = Disagree; SD = Strongly Disagree
Values in parentheses are percentage. Mid point is 2.50; any mean score < 2.50 suggests disagreement; any mean score ≥ 2.50 suggests agreement.

Table 3 shows that respondents agree that they know how to remove internal combustion engine parts with overall mean of 3.06. The reason of the high mean is that in the training process trainees were supervised adequately on how to remove internal combustion engine parts. Also, when you have appropriate tools to do the work, removing parts will not be difficult. Specifically, respondents can remove piston, balancer, push valve rod, camshaft, timing drives, connecting rod and piston ring.

Table 4: Understanding of how to properly inspect internal combustion engine parts' damage during servicing

S/N	Statement	SA	A	D	SD	Mean	Remarks
60	Check the sparkplug gap	47(44.8)	35(33.2)	20(19.0)	3(2.9)	3.20	Agree
61	Faulty spark plugs or spark plug heat range too high	46(43.8)	27(25.7)	28(26.7)	4(3.8)	3.10	Agree
62	Inspect the nozzle for carbon and dirt deposits	46(43.8)	38(36.2)	16(15.2)	5(4.8)	3.19	Agree
63	As soon as the engine head or heads have been removed, inspect the condition of the cylinders in the area of ring traveled	50(47.6)	31(29.5)	20(19.0)	4(3.8)	3.21	Agree
64	Inspect Worn valve guides	54(51.4)	27(25.7)	21(20.0)	3(2.9)	3.26	Agree
65	Inspect Worn pistons, pins and rings	59(56.2)	22(21.0)	15(14.3)	9(8.6)	3.25	Agree
66	Inspect camshaft journals for signs of wear or out-of-round condition	51(48.6)	31(29.5)	20(19.0)	3(2.9)	3.24	Agree
67	Inspect Carbon particles and distortion in cylinder bores	61(58.1)	21(20.0)	20(19.0)	3(2.9)	3.33	Agree
68	Inspect valves to make sure they are adequately set	63(60.0)	19(18.1)	20(19.0)	3(2.9)	3.35	Agree
69	Check gasket for damage	48(45.7)	26(24.8)	21(20.0)	10(9.5)	3.07	Agree
70	Check corrosion damage on bearing	56(53.3)	20(19.0)	26(24.8)	3(2.9)	3.26	Agree
71	Check the clutch contact face of the flywheel for scoring, overheating, or cracks	51(48.6)	24(22.9)	26(24.8)	4(3.6)	3.16	Agree
72	Examine the crankshaft for scoring, overheating, or cracks, ridging, or abnormal wear	51(48.6)	26(24.8)	24(22.9)	4(3.8)	3.18	Agree
73	Inspect push rod ends for wear or damages	54(51.4)	24(22.9)	24(22.9)	3(2.9)	3.23	Agree
74	Examine push rod for bent	53(50.5)	25(23.8)	23(21.9)	4(3.8)	3.21	Agree

	condition.						
75	Inspect the rocker arm shaft for scratches, scores, burrs, or excessive wear at points rocker arm contact	56(53.3)	25(23.8)	21(20.0)	3(2.9)	3.28	Agree
76	After cleaning and pressure testing, inspect all machined surfaces and threaded holes in the cylinder block.	51(48.6)	26(24.8)	24(22.9)	4(3.8)	3.18	Agree
77	Inspect oil pan for worn drain plug and gasket	54(51.4)	26(24.8)	21(20.0)	4(3.8)	3.14	Agree

Note: SA = Strongly Agree; A = Agree; D = Disagree; SD = Strongly Disagree
Values in parentheses are percentage. Mid point is 2.50; any mean score < 2.50 suggests disagreement; any mean score ≥ 2.50 suggests agreement.

Table 4 shows that the respondents agree that they know the process of inspecting internal combustion engine parts during servicing with the average mean scores of 3.21. The reason for this agreement is because in the process of training the trainee must know parts that are worn, crack, bent, abnormal, before making decision of parts replacement in the internal combustion engine. Trainees agree with the mean of 3.28 that they inspect the rocker arm shaft for scratches, scores, burrs, or excessive wear at points rocker arm contact before replacing it during engine servicing. The result also shows that the trainees are in agreement with a mean of 3.33 that they know how to inspect carbon particles and distortion in cylinder bores during servicing. The mean of 3.35 shows that trainees can inspect valves to make sure they are adequately set during servicing of the engine. Aloba, Oluleye and Akinbinu (2002) noted that maintenance often involves physical inspection of engine parts that can prevent engine breakdown.

4. Conclusion

Based on the finding of this study the following conclusions were made.

1. Agricultural trainees were able to identify internal combustion engine parts physically. This implies that the concept and the content of the subject matter were understood by the trainees. Engine parts indentified were sparkplug, injector nozzles, piston, piston rings, cylinder, cylinder block, crankshaft, camshaft, connecting rods etc.
2. Respondents can remove the internal combustion engine parts during servicing period.
3. It was also noted that agricultural trainees know the functionality of internal combustion engine parts.
4. As complicated as internal combustion engine is respondents can inspect the engine parts for worn, crack, bent, abnormal, before making decision of parts replacement in the internal combustion engine.

5. Recommendations

The following recommendations were based on the study's conclusion.

1. It is recommended that agricultural trainees be given modern tools to do their work in the workshop.
2. In order for trainees to understand the concept and content of what is being taught Government and NGOs should provide daily electricity to the workshop.
3. It also recommended that trainees focus more on what they do in order to perfect and understand more in their training.

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