Integration of New Technological Innovation of Automobiles into the Automotive Curriculum of Technical Education Programs at Higher Education

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Abstract - This study aimed to identify the current technological developments that are important to be integrated into the curriculum of higher education to improve its relevance. The design of this study used a survey design, which the research area is Makassar City. Respondents were taken from the automotive engineering education lecturers, and automotive technicians from 5 authorized automobile shops in Makassar. Instrument for data collection was a structured questionnaire designed by researchers from a variety of literature. Data obtained from 20 respondents were analyzed using t-test method. It was found that 36 innovations including; Electronic Fuel Injection (EFI), Variable Valve Timing Intelligence (VVT-i), Anti-lock Braking System (ABS), On-board Detection and Diagnostic System (OBD), etc, were perceived as important to be integrated into appropriate curriculum. Interventions to upgrade human resources in order to facilitate the teaching and learning of skills related to these innovations were recommended.

Index Terms – automotive, curriculum, innovation, relevance

1. Introduction

Over the last decade, vocational schools in Indonesia has become the target of criticism for the knowledge and skills of graduates inadequate and lacking in accordance with industry requirements. On the other hand complained about the inability of many graduates of vocational schools provide the skills, thus making them difficult to find a job that is satisfying the appropriate expertise. According to [1] unemployment rate is still dominated by those who are educated at the high school/vocational school. Where one in six graduates of vocational schools in the category of unemployed or about 17.26 percent of the total labor generation. This phenomenon makes vocational schools in Indonesia faces a challenge to continue to evaluate the program, the content, and implementation of the curriculum. Vocational schools are required to continually integrate the theory or practice of vocational materials with existing competencies in the industry. Vocational education should be able to prepare graduates who are competent in accordance with the needs of industry and with reality and current technological developments and the future.

The number of students who are unemployed may be due to lack of competence of students with the needs of industry. This is because the curriculum in previous years used continuously without adjustment and consolidation with the progress of the business world. So the goal of vocational schools to reduce unemployment can't be achieved effectively. Vocational education is essentially based on a curriculum that equips graduates with the skills to fill certain jobs or open their own business field. Additionally, vocational schools may also be intended to raise the local advantage as the competitiveness of the nation's capital.

In Makassar today, an increase public demand for motor vehicles, so that employment opportunities in automotive world is quite large in terms of maintenance or servicing of vehicles. This situation is ironic with unemployment still relatively not reduced. There are many vocational school graduates who have not been absorbed in the industrial world due to lack of relevance of vocational school curriculum with worker competencies required.

Revamping the curriculum is one that should be the focus for the improvement of vocational school graduates. One of the efforts in the development of vocational schools is through the development of programming skills relevant to industry needs. Competence is at the cutting edge of creating a link and match vocational school with the world of work. The substance of vocational education should display it characteristics which is reflected in the aspects linked to the curriculum planning process-oriented and outcome or graduates. The ultimate success of vocational education curriculum is not only measured by the success of the education students are in school, but also with the results of performance in the workplace. According to [2], the development of vocational education programs need clear justification. Justification for vocational education programs is that there is a real need in the employment of Field work or in business and industry. When oriented curriculum on students, then the support for the curriculum comes from the employment opportunities available to graduates.

Curriculum in vocational education can't be separated on the development of knowledge about a particular field, but must simultaneously prepare to a productive learners. According to [3] argued that the curriculum has come to be seen as a document that has been developed in written form and that is used to plan and regulating the experiences to be organized for learners, and to reviews their learning.

As measures to keep education and training in tune

with the knowledge and skills needed in the world of work, school courses and curricula must be reviewed, enriched and updated regularly in line with changes that are taking place in the industries. Thus, it was imperative to investigate the new technological innovations in automobiles with the view to identifying those that posed new challenges to the maintenance personnel for integration into the curriculum for their training program. This study was therefore designed to identify the new technological innovations used in the construction of the operative systems of modern automobiles which were not included in the curriculum for technical college motor vehicle program. Specifically, the study tried to identify the new innovations in the following sub-systems of automobiles: the engine, the transmission, suspension, steering and braking systems and the electronic system.

Three null hypotheses were tested using the student's t- test of independent population at 0.05 levels of significance.

H_1: There is no significant difference in mean responses of automotive technicians (AT) and technical lectures (TL) on the new technological innovations in automobile engines.

H_2: There is no significant difference in mean responses of AT and TL on the new technological innovations in the automobile transmission, suspension, steering and braking systems.

H_3: There is no significant difference in mean responses of AT and TL on the new technological innovations in the automobile electronics systems.

2. Methods

The design of this study used a survey design, which is a research area of Makassar. Acoording to [4], survey method is information gathering technique which is done by compiling a list of questions on the respondent. Respondents were taken from the automotive engineering education lecturers who teaches courses automotive competence by 10 respondents, and automotive technicians are also as many as 10 respondents from 5 authorized automobile shops in Makassar. Instrument for data collection was a structured questionnaire designed by researchers from a variety of literature. Instruments gather information or opinions of the respondents about the new technological innovations in automotive systems. Rating Scale uses 4 categories: very important, important, not very important and not important.

The respondents were asked to check the degree of their perceived importance of each item to be integrated into the curriculum for technical college programs. Instrument validated by three experts in the field of vocational technical education from the university. Response categories of the rating scale using numerical value of 4, 3, 2 and 1, respectively, were used to calculate the average of the responses. The actual boundaries of the numerical values are used to determine the appropriate category for each response means. At the 0.05 significance level and df of 19, the critical value of t to accept or reject the null hypothesis is 2.00

3. Result and Discussion

The results of the research hypothesis testing were presented in tables as follows:

Hypothesis 1

There is no significant difference in mean responses of AT and TL on new technological innovations in automobile engines. Table 1 show that the pooled mean responses for all the items are 2.57 to 3.31 which indicate a important and very important perception by respondents for all the new innovations to be integrated into the curriculum. The table also shows that the null hypothesis was accepted for all the items, which has the calculated t-value (t-cal) is smaller than the critical t-value of 2.00 at 0.05 levels of significance and so, was accepted.

Table 1. The t-test analysis on the innovations In automobile engine

New innovations in engines	TGP		Remark
	X	t-cal	
Electronic fuel injection	3.24	1.51	VI
Dual fuel system	2.57	1.68	I
Electronic ignition system	3.31	0.99	VI
Variable valve timing	2.93	0.38	I
Super charging	2.75	0.28	I
Turbo-inter cooling	2.78	0.21	I
Emision control systems	3.13	1.52	VI
Engine immobilizer	2.92	0.78	I
On-board diagnostic system	3.22	1.78	VI

df = 10; critical-t = 2.00; TGP = two groups pooled;
I = important ; VI = very important

Hypothesis 2

There is no significant difference in mean responses of AT and TL on the new technological innovations in automobile transmission, suspension, steering and braking systems. Table 2 shows that the pooled mean responses for all the items are 2.59 to 3.78 which indicated all the items were perceived as important and very important perception by respondents for all the new innovations to be integrated into the curriculum. It also shows that there is no statistically significant difference in mean responses of automotive technicians and technical lectures on the indicated new innovations in the transmission, suspension, steering and braking systems. The null hypothesis was therefore accepted for all the items at 0.05 levels of significance.

Table 2. The t-test analysis on the innovations in automobile transmission, suspension, steering, braking systems

New innovations in transmision, suspension, steering, braking systems	TGP		Remark
	X	t-cal	
All wheel drive system	2.71	1.74	I
Auto-active automatic transmision	2.99	1.23	I
Trans-axle transmision	2.59	1.12	I
Continuously variable transmision	3.78	1.32	VI
Cruise control system	2.88	1.76	I
Anti-lock breaking system	3.17	1.37	VI
All wheel steering system	2.95	0.55	I

df = 10; critical-t = 2.00; TGP = two groups pooled;
I = important ; VI = very important

Hypothesis 3

There is no significant difference in mean responses of automotive technicians and technical lectures on the new technological innovations in automobile electrical/ electronics systems. Table 3 shows that the pooled mean responses for all the items are 2.27 to 3.34 which indicated all the listed items were perceived as important and very important to be integrated into the curriculum. The table also shows that there are differences in the mean responses of industrial workers and technical lectures on two of the listed new innovations whose calculated t- values are more than the critical t-value of 2.00. The null hypothesis was thus rejected for these items, which include AC refrigerant recovery and recycling sistem, and global position and information system.

Table 3. The t-test analysis on the innovations In the electrical/electronic and auxiliary systems

New innovations in electrical/electronic and auxiliary systems	TGP		Rem ark
	X	t-cal	
Safety airbags	3.20	0.98	VI
Power seats, doors, and windows	2.59	1.22	I
Electronic controlled air conditioning system	2.86	1.25	I
AC refrigerant recovery and recycling system	2.56	2.11	I
Automatic front wind screen wiper	3.01	1.09	VI
Adaptive headlights	2.42	1.78	I
Active rear view mirrors	2.73	1.28	I
Automatic hazards warning lights	3.18	1.19	VI
Speed limit alarm	3.34	0.95	VI
Read mounted sensor parking assistance	2.69	1.23	I
Tire pressure monitoring system	3.12	1.89	VI
Central power locking system	2.81	0.97	I
Security alarm	3.34	0.76	VI
Global position and information system	2.36	2.10	I
Hybrid automobiles	2.27	0.55	I

df = 10; critical-t = 2.00; TGP = two groups pooled; I = important ; VI = very important

The above table shows the total of 31 new innovations comprising 9 in the engines; 7 in the transmission, suspension, steering and braking systems; and 15 in the electrical/electronics systems were rated as important to be integrated into the curriculum.

There were significant differences in the mean responses of industrial workers and technical lectures on two of the identified new technological innovations in automobiles, for which the null hypotheses were rejected. These items are AC refrigerant recovery and recycling sistem and global position and information system.

There is found that the students of Engineering Colleges of each state of this country should be given apprenticeship, and on job training opportunities. This will lead to availability of trained human resources to the industries of the region. Further, it will also widen the placement opportunities of the students in the industries, and service sector [5]. However, there is eagerly look forward to more interaction between industries and institutes which will lead to providing continuing education, expert exchange , and sharing of resources.

According to [6] interconnecting the curriculum to open systems that maintain their equilibrium by monitoring their own internal states and making adjustments to adapt to destabilizing perturbations. There must therefore be a continuous interaction and exchange of information between the schools and industries where the new innovations and changes in technology are emanating from. Further in [7] [and [8] emphasized that curriculum and instruction can be conceptualized as open systems interacting with the environment and maintaining equilibrium by transformation of information among the component sub-systems. In the same viewpoint, [9] and [10] stated the work, skills and training can be conceptualized as sub-systems of an open system; then new innovations and changes in technology demanding new work skills being the common perturbations that often destabilize the contents of school curricula and instructional activities.

The findings of this study represent the opinions of major stakeholders in the automotive technology development and education in Makassar City. It shows that all the identified new technological innovations have implications for the works of today's automobile maintenance personnel. The large number of the new innovations that were yet to be integrated into the curriculum reflects the long period the 2009 edition of the curriculum has being in use without any review. Also, the large number of these new innovations also account for the findings of the empirical studies by [11] , [12] that the products of the technical college motor vehicle mechanics work programmes lacked the relevant skills for gainful employment today's automobile industry. There has been significant private sector investment in education. However, the private sector has not successfully absorbed the graduates from training institutions and the reasons to explain this are: 1) The private sector investment targets soft investments mainly in humanities with minimum costs in science and technological equipment such as laboratories. They prefer low cost investment in Arts subjects in order to maximize profits, yet, these subjects do not emphasize skills training that are required by most private enterprises. 2) The existing corporate companies do not link with training institutions to influence curriculum and demand-driven training [13].

The areas of the new innovations in automobiles identified in this study correlates well with the areas of students' difficulties identified. The areas of difficulty for the final year students of motor vehicle mechanics work programmes include the engine, particularly the cooling and lubricating systems; the transmission system comprising the clutch, gearbox and final drive assembly as well as the suspension, steering and braking systems among others. These areas of difficulty identified most of the new innovations found in this study as shown in Tables 1, 2 and 3, which were yet to be taught to students.

4. Conclusion

The technological innovations identified in this study, which are the technologies for today and future

automobiles are so many and common on Makassar roads to be so neglected by college program that purport to train the workforce for the maintenance of all types of motor vehicles. A total of 34 new innovations comprising 10 in the engines; 11 in the transmission, suspension, steering and braking systems; and 13 in the electrical/electronics and auxiliary systems need to integration into the curriculum for the education and training program for Technical Colleges.

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