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Emerging Machining Innovations for Integration into the Mechanical Engineering Craft Practice Curriculum for Technical Colleges in Rivers State

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ABSTRACT
The present study identified emerging machining innovations in the industries perceived as important to be integrated into the existing MECP curriculum to improve its relevance and adequacy visa-a-vis industrial demand- A structural questionnaire - developed by the researcher - was used to survey the opinions of mechanical engineers and technicians, and' MECP teachers in technical colleges in Rivers State. Data obtained from 155 respondents were analysed using mean, standard deviation, and z-test statistics. It was discovered that: all the identified five groups of machine tools innovations, all the identified eight-innovations in measuring tools/instruments, and 21 out of the 23 identified innovations in cutting tools/ other accessories, were considered important to be integrated into the curriculum. Further studies to identify other innovations both in the MECP and other occupations studied in the technical colleges, updating of curricula for training and retaining of the technical teachers for effective teaching and learning of the innovative skills, among others, were recommended.
Keywords: Machining innovations, mechanical engineers, training, innovative skills

INTRODUCTION

Technical colleges, in Nigeria, according to Olayinka and Oyenuga (2010), produce craftsmen for various sectors of the economy and are regarded as the principal vocational institutions. Among their principal areas is mechanical, whose major is mechanical engineering craft practice (MECP). The programme for this trade is intended to produce competent mechanical engineering craftsmen for both self and industrial employment. Their common features are thus, the uses of machine tools, and equipment used for design, manufacturing, assembling, measuring, inspection, and quantity control techniques (Atsumbe, 2002). In order to realize these expectations, national curriculum for technical colleges as accredited by National Board for technical education (NBTE), has to be adopted.

According to the National Policy on Education (FRN, 2004), the curriculum for each trade shall consist of five components: General education, Theory and related courses: Workshop practice; Industrial training/production work, and Small business, management and entrepreneurship training. Thus, while the first component: is to avail the recipients the opportunity of acquiring general secondary education, the primary purpose of other four is to instill in the students the mechanical crafts skills/experiences required of them by the (employing) industries. These skills/ experiences border primarily on machine tools such as lathe, and other related equipment.

The development of machine tools was basically occasioned by industrial demand could be traceable to the industrial revolution that started in the 18 century in Great Britain. For ever since the Renaissance (14^{th} to- 15^{th} century), Europeans had been inventing, improving and using, ever more complex machinery, (Forger, 2010). Thus in 1769, a landmark was made by an English man, James Watt, with his large, cylinder, steam engine (Anderson, 2011). But the worrisome problem of the engine which bordered on the imprecise interior of the cylinders that permitted gas leakage between them and their pistons had to wait until the invention of precession machine.

So in 1775, a precision horizontal boring machine tool was developed by another-Englishman, John Wilkinson. This, apart from the workshop lathes used by craftsmen, was the first large machine tool used for boring the cylinders on early steam engines. Henry Maundy, within the same century, invented the first engine lathe. Having improved and applied the uniformity system of production by inter-changeable part, American Whitney, in 1798, invented the first milling machine. The planning machine, slotting machine, and shaping machines, were then developed in the first decades of the 19:h century (Wikipedia, 2011)

All these developments and innovations or improvements have today culminated in what is usually described as new technologies. Thus with similar developments in other segments of the field, such as the measuring tools, such new developments or mechanical craft innovations simply abound today in the Field of MECP occupation. These developments need to be incorporated in the MECP curriculum for technical colleges in order to make it relevant or responsive to industrial challenges. Integration of such innovations into the curriculum will, align it with the pace of industrial skills needed for today's workforce (Industrial Skills Training Centre, n.d.).

Enemali (1991) in Olayioka and Oyenuga (2010) carried out a study to investigate the quality of training and its influence on job performance of technical college graduates, in the industries in Benue State. The study was to determine the relevance and adequacy of curriculum contents for training the. right skills in technical college graduates for self and industrial employment. Population of 157 - comprising of 50 technical college teachers, 71 graduates of technical college and 36 employers of graduates from technical college and industries in Benue State - was used. The result of the study revealed that there was low rate of the degree of relevance of training in technical college curriculum contents with the industrial skills for self and industrial equipment.

Similarly, Atsumbe (2002) earned out a study to determine tire required needs improvement on the technical college mechanical engineering crafts practice curriculum in North-central States of Benue, Kaduna, Kogi, Kwara, Niger and Plateau. Population of the study comprised all mechanical engineers, technicians, and craftsmen working in the industries. The result of the study recorded that: Major areas like principles and operation of digital equipment, industrial shaping of metals, etc, were rated very high as improvement items; Topics like maintenance of tools and equipment, etc, should be-included in the new courses, etc. Of all these studies on ways of improving curriculum content for enhancing its relevance vis-à-vis industrial challenges, none has endeavoured to identify the new mechanical craft innovations such as the numerical control (NC) machine., tools, computer numerical control (CNC), machines tools, etc, to enhance its (the curriculum) adequacy and relevance in industries in Rivers State. It was against this background the present researcher conceived the idea to investigate the mechanical craft tool innovations in the industries that are important to.be integrated into the MECP curriculum to improve its relevance to industrial demands in Rivers State.

Purpose of the study

The purpose of the study was to identify emerging machining innovations in the industries that are important to be integrated into the MECP curriculum for technical colleges in Rivers State to enhance its relevance and adequacy.

Specifically, the study attempted to identify:

1) Important machine tool innovations in the industries to be integrated into the MECP curriculum for technical colleges (TC) in Rivers State.
2) Important innovations in measuring tools/instruments in the industries to be integrated into the MECP curriculum for TC in Rivers State.
3) Important innovations in cutting tools/other accessories in the industries to be integrated the MECP curriculum for TC in Rivers State.

Significance of study

The present study will be significant in many ways. The findings of the study will profit researchers and policy makers in the field of curriculum development

The ministry of Education in Rivers State in particular will find the results of this study profitable especially during teacher recruitment exercise

Scope of the Study

The present study focused on innovations in MECP occupation. Areas of the trade innovations covered included: machine tools, measuring tools/instruments, and cutting-tools/other accessories.

Research questions

The following questions were posed to guide the Study

i) What are the important machine tool innovations in the industries that need to be integrated into MECP curriculum for TC in Rivers State?
ii) What are the important innovations in measuring tools/instruments in the industries that need to be included in the MECP curriculum for TC in Rivers State?
iii) What are the important innovative cutting tools/other accessories in that need to be incorporated in the MECP curriculum for TC in Rivers State?

Hypothesis

H_0: There is no significant difference in the mean response of the mechanical engineers and mechanical teachers on the importance of machine tool innovations in industries that need to be integrated into the MECP curriculum for TC in Rivers State.

METHODOLOGY

Design of the Study

The study was carried out using survey design, Non-experimental and descriptive in nature, survey remains a very valuable tool for assessing opinions and trends (Shultleworth, 2008). Thus survey design was adopted in the study, since information were to be solicited from large sample of mechanical engineers, technicians, etc.

Population of the Study

Population for the study was 188 - comprising all mechanical engineering heads or supervisors in all the mechanical-based industries in Rivers State - 88; all the heads of mechanical engineering technician in all the mechanical based industries in Rivers State - 88, and all the MEECP teachers in the technical colleges in Rivers State - 12

Instrument for Data Collection

The instrument for gathering of data for the study was Structured- Mechanical Craft Innovation Questionnaire (SMCIQ) developed by the researcher. The instrument consisted of four sections, A,B,C and D. Section A was designed to elicit personal data from the respondents, while sections B to D focused on innovations in machine tools, cutting tools/other accessories, and measuring tools/instruments - all in MECP occupations - respectively. The items on the later sections (B-D) were responded to on a 5-point Likert scale of Very Important (VI) - 5, Important (1) -4, Fairly Important (FT) - 3, Unimportant (UI) - 2, and Very Unimportant (VUI) -1.

Validation of the Instrument

The face validation of the instrument was done by an expert in the Department of Technical Education, Ignatius Ajuru University of Education, Port Harcourt, while the content validation was accomplished by an CNC expert in the Department of Mechanical Engineering, University of Port Harcourt and an industrial expert in the Department of Quality Control, REMON oil company, Trans Amadi Industrial Layout, Port Harcourt. The validators were each served with a copy of the instrument and requested to review, comment on suitability of, and suggest modification or otherwise on, the items before the final draft was produced and used for the study.

Reliability of the Instrument

Reliability of the instrument for the study was determined through the split-half method. An oil company which was broad both in number of mechanical engineering staff and innovations in MECP occupation was purposively chosen. All the company's mechanical engineers and technicians - eight, who also did not form part of the subjects to respond to the instrument for the main study - were used for the trial test. The validated draft of the instrument was reproduced, administered to the subjects, and collected after three weeks, by the researcher.

Having been split into two equivalent halves using the odd even method, the retrieved data in their (two) halves were then correlated to| realize the coefficient at 0.74. Using the Spearman-Brown's prophecy

formula, $r_{ft} = \frac{2r_{ht}}{1+r_{rhi}}$, the reliability of the whole instrument was established at 0.81. The Spearman-Brown's prophecy formula was used because the two fractions of the single test were truly equivalent.

Method of Data Collection

Copies of the questionnaire were administered on the respondent by the researcher. After two weeks, 155 out of the 176 copies - 88% were duly filled and retrieved from the respondents by the researcher. It was these returned copies that were analysed to generate data used for the treatment of the research questions and hypothesis.

Data analysis

Data generated through the use of the questionnaire were analysed using mean, standard deviation, and z-test statistics. The mean and standard deviation were used for answering the research questions, while the z-test was used to test the hypothesis at 0.05 level of significance. With the mean established at 3 (i.e. the summation of the five - 5+4+3+2+1-15 divided by 5), any item with the mean of 3 and above was considered important, while any item with mean less than 3 was considered unimportant. At 0.05 level of significance, the null hypothesis was rejected if the calculated z-value was greater than the critical value, otherwise, the null hypothesis was accepted.

RESULTS

Research Question 1: *What are the important machine tool innovations in the industries that need to be integrated into MECP curriculum for TC in Rivers State?*

Table 1 Means responses of heads of the mechanical engineers and technicians, and technical teachers on important machine tool innovations, in the industries to be integrated into the MECP curriculum for the technical colleges.

S/N	Items	X	SD	Remark
1	Flexible shaft hand grinder	4	1	Important
2	Lathes with attachment like milling attachment, duplicating attachment, etc.	4	1	Important
3	Large multi-spindle 3-axis fixed bed milling machines	4	1	Important
4	Numerical control (NC) machine tools	5	0	Important
5	Computer numerical control (CNNC)	5	0	Important

Data presented in Table 1 show that items 1 to 3 - flexible shaft hand grinder, lathes with attachment, and large multi-spindle 3-axis fixed bed machines have means of 4 each, while items 4 and 5 were rated with higher mean of 5. This means that all the items, having attained mean values up to 3 and above, are important to be integrated into the MECP curriculum for the technical colleges.

Research Question 2: *What are the important innovations in measuring:' tools/instruments in the industries to be included in the MECP curriculum for TC in Rivers State?*

Table 2 reveals that items 9,10 and 13 have the highest means of 5, followed by items 6,7and 8 of means 4,5, and then 11 and 12 with means of 4 each. This makes it valid that all items, having means up 3 mean responses of mechanical engineers and technical teachers on the machine tool innovations in the industries to be integrated into the MEC curriculum for the technical colleges.

Table 4: z-test analysis of mean responses of ME and TT on the machine tool innovations

	-X	SD	N	Z-cal	z-crit[1]	Decision
ME	5	0	88			
TT	3.86	0.43	13	9.5	1.96	Sig.

DISCUSSION

Result of the data presented in table 1 provided answers to research question 1: The result revealed that all the items of machine tool innovations in the industries were rated important tq.be integrated in the MECP curriculum for technical colleges in Rivers State. It is often said today that we are already in the computer age - the height; technological development. Thus the high level of the acceptance of innovations especially the NC and CNC machine tools, as important innovations in the industries to be integrated into the MECP curriculum for the technical; colleges cannot be perceived as unexpected. They equally makes it vivid the direct implication of having these equipment the school - just as they feature in the industry. This is in congruent with the effort of the Industrial Training Centre (n.d.) - to

align with machine tools at the schools with those in the field in order to make the recipient craftsmen relevant to job market on graduation.

The data presented in Table2 answered the research questions:

The high level or acceptance of the items, all the more prevailed in the respondents' responses to the paeisurement items. Of course, establishment of any of the myriad of industries in the world would might have been possible without proper measurement (Walker, 1989). Those stressing on the core qualifications of- these craftsmen. Triquint (n.d) maintained that mechanical engineering technicians must be familiar with and able to use a variety of electronic and mechanical measuring tools. This simply implies stressing the need for identifying both the innovative measuring tools/instruments iii- the field of MECP occupation that are important to be integrated into the curriculum for the training these technicians.

Data presented in table 3 were in response to research question 3. It was clear from the table that the items on innovative cutting tools/other accessories also witnessed a high level of acceptance. In exception of items 15 and 18, all the-items5 ware rated important to.be integrated into the curriculum. The non-acceptance of two items may not be unconnected With-the assumption' that these: tools cannot be directly tooled without some attachment mechanisms (Walker, 1989). Since this operation - reaming - can still be readily carried out even with the conventional machine tools, the dependent weakness lowers the usefulness of the tools. Again, given- the recent technological developments, the-high acceptance of those innovations is simply ideal. Virginally (n.d.) maintains that a mechanical engineering technician should be able to adjust machine feed and speed (ie of cutting), change cutting tools, or adjust machine control (ie. with respect to cutting operation) when automatic programming is faculty? or if- the machine malfunctions. For the mechanical craftsmen to be able to accomplish these, the variety of cutting tools - including the innovated ones - needs to be identified.

Table 4 displays the testing of the hypothesis formulated on the machine tools innovations in the industries that are important to be integrated into the MECP curriculum for the technical colleges, using the z-test statistics. At 0.05 level of significance, the calculated z-value (9.5) was found to be greater than the critical z-value of 1.76 – meaning that the null hypothesis of no significance between the mean responses of the industrial engineers and technical teachers on the machine tool innovations is rejected. The mean difference in responses of the groups may not be far from the general assumption that the industries are always ahead of the technical colleges. Thus, as a measure to keep education and training in tune with 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 (Mathew & Ede, 2010).

CONCLUSION

Mechanical Engineering Craft Practice is one of the core technical college mechanical trades that produce mechanical engineering-craftsmen who are biased in production (manufacturing). Thus the common features of these technicians are the use of machine tools, and equipment for design, manufacturing, assembling, measuring, inspection, and quality control techniques (Atsumbe, 2002). These could be summarized to involve knowledge/use of machine tools, cutting tools, and measuring instruments, which as well should assume the primary or core contents of the MECP curriculum.

In the event. of recent technological developments, the mechanical crafts innovations would not only "evolve naturally abound - as it is the case today - posing additional challenges to the operational draft personnel. Such innovation? thus need.to be identified for integration into -the existing MECP curriculum (to enhance ,1 relevance). It is believed therefore that if these innovations identified in the study are utilized, the present curricular mismatch, with its concomitant self or industrial unemployment of the graduates of t technical colleges would be eliminated.

RECOMMENDATIONS

Upon the established need for updating the MECP curriculum for technical colleges in Rivers State with the innovations in the industries is recommended that:

1. Further studies be carried out in a bid to identifying other innovations, such as theoretical contents, in the occupation for development of up-to-date comprehensive MECP curriculum
2. Curriculum for the other technical college trades should as well be enriched and updated with innovations in their respective occupations.

3. A law on the attainment of 2 above, should be enacted compelling industries in Rivers State to fully turn to the state (employment) registry – where graduates of these technical colleges register – for their recruitments.
4. Curricula for the training and retraining of the technical teachers should be upgraded for effective teaching and learning of the skills associated with the innovations.

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