

Re – Training Needs of Mechanical Engineering Technologists for Improved Performance in Scientific Equipment Development Institutes in Nigeria.

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The researchers appreciate the cooperation received from Director General National Agency for Science Engineering Infrastructure (NASENI) Abuja and Directors/Chief Executives of Scientific Equipment Development Institutes (SEDI), Minna and Enugu-Nigeria respectively.

Abstract.

Following constant complains by our schools on short falls in the supply of laboratory apparatus and even when available they are sub – standard, this study was conducted to determine the re-training needs of mechanical engineering technologists who are directly involved in the production of these laboratory apparatus for improved performance in Scientific Equipment Development Institutes (SEDI) in Nigeria. Two research questions and 2 hypotheses were formulated to guide the study. The study was conducted in the two Scientific Development Institutes located at Minna and Enugu. A survey research design approach was adopted. The entire population of 82 mechanical engineers and 140 mechanical engineering technologists served as the respondents. No sampling was done. A 50 item structured questionnaire was used to collect the relevant data for the study. Data collected were analyzed using frequency counts, standard deviation, mean and t – test statistics. Results from analysis of data showed that all the 50 proposed items were accepted as retraining needs of mechanical engineering technologists. Specifically, the study revealed that the technologists were most deficient in areas of the use of automatic, NC, and CNC machines. It was recommended that as a matter of urgency government should put in place various strategies of retraining such as partnership with production industries, workshops, seminars and short term trainings outside the country.

Key words: Re-training, performance, technologists, industries, scientific equipment

1.0 Introduction

In order to achieve technological growth, a nation must invest in the development of her human capacity by re – training of all her manpower particularly those in the area of engineering. The training and re-training of all engineering base personnel cannot be over emphasized. Perhaps it is for this reason that Atsumbe (2002) stressed that survival of any industry and technological breakthrough that could be experienced by any nation is dependent on the caliber of engineering personnel paraded by that country. Re – training of engineering artisans, craftsmen, technician, technologist and engineers are not negotiable should the nation make any appreciable progress in terms of technology development. Experience of advanced nations like United Kingdom, United States of America, and Russia has shown that the standard of living, the welfare, the security, and the self esteem of such countries, rest completely on the magnitude of their productivity which is actually hinged on the available caliber of engineering manpower.

Technological advances necessitate the continuous retraining of the work force. Stine and Matthews (2009) emphasized that the challenge facing policymakers when making decisions regarding the science and technology (S&T) workforce is that science, engineering, and economic conditions are constantly changing, both in terms of workforce needs as well as the skills the science, technology, engineering and mathematics (STEM) workforce needs to be marketable relative to demand. According to Kirkpatrick (2002), the three major areas of technology that are making great impact on the labour force this time around are (1) the scope and depth of computer skills required by most jobs continue to expand; (2) advances in the design of certain production machines, (3) automation and digitalization of several manufacturing equipment which were hitherto manually or mechanically operate before this time. It is on this note that Ezeji (1988) while supporting the concept of re - training for engineering personnel's said in modern times the Nigerian technologist have had to face technology in the form of both increasing mechanization and sophisticated work processes particularly in manufacturing. The equipment and tools used in production are getting complex by the day. Technology has in no small measure affected the methods and techniques of production of goods and services in industries and factories. Those factories and industries now use

automated, semi automated production tools, equipment and utilization of skilled manpower. Deighton (2007) says technological developments only calls for increased educational level of the workers and continuous re – training, so that they can acquire the new skills necessary to fit into the industrial processes.
It is against the backdrop of the forgoing that mechanical engineering technologist working in scientific equipment development institutes in Nigeria have great need for this kind of re-training in several areas of manufacturing. Areas such as unconventional methods of machining, automatic machines, automating assembly, numerical controlled machine tools, robots and robotics, plastic technology and computer application in manufacturing. Mechanical engineering technologists are graduates of Higher National Diploma from Nigerian polytechnics. Some of the aims of polytechnic education as outlined in the National policy on Education include:

i. To provide full-time or part time courses of instruction and training in engineering, other technologies and applied science leading to the production of trained manpower.
ii. To provide the technical knowledge and skills necessary for industrial, commercial and economical development of Nigeria.
iii. To give training and impart the necessary skills for the production of technicians, technologist who shall be enterprising and self reliant.
iv. To train people who can apply scientific knowledge to solve environmental problems for the convenience of man. (FRN, 2004).

It is expected that by the aims and objectives of this programme, graduates of Higher National Diploma Mechanical Engineering should be able to conveniently work in an industrial manufacturing organizations, without much problem. Specifically, the National Board for Technical Education, NBTE (2001) clearly spelt out some of the aims of Mechanical Engineering programme to include

i. Ability to design, prepare and interpret mechanical engineering drawings of components.
ii. Production of simple and complex engineering components using tools and equipments in the laboratories
iii. Install, operate and maintenance of engineering machines etc
iv. Preparation of a comprehensive engineering report
v. Prepare a concise, accurate estimate for engineering projects and its management.

Based on the objectives of polytechnic education and specifically that of Higher National Diploma Mechanical Engineering, Wyler (2003) stressed that a higher level of knowledge and performance is expected of these set of technologists. He said under the professional direction of a trained engineer, an engineering technologist should among other things be able to analyze, solve technological problems, prepares formal reports on experiments, tests and other similar projects. His other assignments also include drafting, designing and writing of technical reports. An engineering technologist need not to have an education equivalent in type, scope, and rigor to that required of an engineer, however, he must have a more theoretical education with greater scientific and mathematical depth and experience over a broader field that is required of skilled craftsmen who work under his supervision.

Atsumbe (2007) in a similar study discovered that the mechanical technologist must have above average; knowledge of science, mathematics, industrial machinery and processes that enables him to work in all phases of production, from research and design to manufacturing, sales, and customer service. Although their jobs are more limited in scope and more practically oriented than those of engineers or scientist, technologist often do work that engineers or scientist might otherwise have to do. Mechanical technologist frequently uses complex, electronics and mechanical instruments, experimental laboratory equipment and drafting instruments. Deighton (2007) said almost all technologist particularly mechanical technologists described in this statement must be able to use engineering handbooks and compacting devices such as slide rules and calculating machines.

It is with the understanding that the mechanical technologists possess this nature of knowledge and practical experience that the federal government of Nigeria by Decree No 33 of 1992 established the National Agency for Science and Engineering infrastructure (NASENI). The mandates of (NASENI) include:

- Conduct development work in the areas of manufacturing
- Coordinate the proliferation of technologies developed either within or outside of its centers
- Development of technologies in the areas of spare parts, components and system engineering.
- Transfer these technologies to entrepreneurs for the production of goods and services.

Adewoye (2007) said the document establishing NASENI permits it to operate mainly through her development institutes. Each of the institutes has a unique mandate of engineering infrastructural development. Though there are several centers of NASENI all over the country. It is only Minna and Enugu centers that are named Scientific Equipment Development Institutes. Their mandates include the followings:

- Research into and develop systems for the mass – production of science laboratory apparatus for physics, chemistry, biology, introductory technology etc
- Scientific equipment for research, industry and higher institutions.
- Measuring and control instruments for electrical, electronics, mechanical workshop etc
- Instrument for land surveying, geophysical investigations, metrological observations etc.
- Transfer scientific equipment manufacturing technologies to private sector industries and render consultancy and extension services to organizations.

In addition to the above mandates they are to also produce, primary science kits, metal, wooden and glass wares. The provision of this science equipment for schools and industries is expected to boost technological development through research and quality teaching.

For examples Kalu (1996) observed that with quality laboratory kits the teacher and pupils are helped to actualize in practical terms the objectives of Primary Science Education. He further stressed the fact that with standard primary school kits the Nigerian child is enabled to observe and explore their environments, develop basic science process skills, scientific attitude, self confidence and reliance through problem solving activities. Further to this, in this millennium when the whole world is fast becoming a global village and science and technological advancement is spreading, the need for precision and adequate supply of scientific equipment cannot be over emphasized. When students are taught using standard scientific equipment, effective communication is guaranteed and above all it creates opportunity for independent learning. The meeting of Ministers of Education of the African Union in Cairo Egypt (2007) noted that with standard and adequate scientific equipment in the laboratories of our schools, students interest will be aroused, attitudes modified, concepts are clarified, thinking are stimulated, contents summarized. Scientific equipment helps to demonstrate and concretize knowledge that could otherwise be talked about in abstract terms. Ezekwe (1999) while emphasizing the crucial place of laboratory equipment said when these equipments are used during teaching, the mind of young students are introduced early to science and technology, it also help to inculcate scientific culture and to create a fertile environment for the students so that they can develop a positive perspective for science and make it a norm rather than exception.

Despite all the advantages in favour of the use of science equipment in laboratories of schools and the eventual set up of Scientific Equipment Development Institutes in Enugu and Minna, Nsofor (2008), in a study on the assessment of availability of science equipment in schools discovered that our primary and secondary schools, technical colleges and tertiary institutions have complained bitterly about the unavailability of science equipment and even the few available ones are sub standard, obsolete and not meeting the required precision.

In a final examination report released by West African Examination Council (WAEC) and National Examination Commission (NECO) (2004) it was observed that the mass failure of students particularly in science subjects like physics, chemistry and biology where attributed to false readings given by equipment. So as a result of this our schools and colleges have continued to graduate quack engineers, inefficient medical doctors among others.

According to Gobir (1994) the reason for the aforementioned problems are not farfetched as the mechanical engineering technologist who are at the main stream of production are ill equipped for the job of manufacturing scientific equipment. He said the current training curriculums of our polytechnics are shallow, inadequate and obsolete. It is also important to state that much mechanical engineering production equipment which were previously operated manually are now automated or computerized. Many engineering companies, especially those in industrialized nations have began to incorporate Computer Aided Engineering (CAE) into their existing design for manufacturing tools and equipment. These changes or developments are yet to be incorporated into the current curriculum of our polytechnics particularly those of engineering base courses. Abifarin (1998) and Atsumbe (2002) observed that the training in our polytechnics is no longer in consonance with current practices in industries. As a result of all these negative factors against the training received by the mechanical engineering technologist; it becomes imminent that if no further re – training is given to these cream of technologist, the future of our nation will remain bleak in terms of technological development, hence the need for this study.

1.1 Research Questions

The following research questions were formulated to guide the study;

1. What are the re-training needs of mechanical engineering technologists in the area of production engineering?
2. What are the re-training needs of mechanical engineering technologists in the areas of general and related knowledge?

1.2 Hypotheses

The following hypotheses were formulated to guide the study and were tested at 0.05 level of confidence:

$Ho_{1:}$ There is no significant difference between the mean response of mechanical engineers and technologists on the re –training needs of mechanical engineering technologists in the area of production engineering.

$Ho_{2:}$ There is no significant difference in the mean responses of mechanical engineers and technologists on the re – training needs of mechanical engineering technologists in the areas of general and related knowledge.

2.0 Methodology

The design for the study was a survey research design. The study was carried out in the two (2) scientific equipment development institutes (Minna and Enugu) and National Agency for Science Engineering Infrastructure (NASENI) Abuja. The total population for this study was eighty-two (82) mechanical engineers and one hundred and forty (140) mechanical engineering technologists all working in scientific equipment development institutes in Minna, Enugu and Abuja. The entire population for the study totaled two hundred and twenty-two respondents was not too large, the researchers decided to use all, and therefore no sampling was done. Fifty (50) item structured questionnaire was used to collect the necessary data for the study. Section "A" addressed the bio data of the respondents, section "B" dealt with items that addressed the retraining needs of the technologists in the area of production engineering and section "C" addressed their retraining needs in the area of general and related knowledge. The items were subjected to both face and content validation by experts in mechanical engineering. To establish the reliability of the instrument, a pilot test was conducted using fifteen (15) mechanical engineers and twenty (20) mechanical engineering technologists. This set of respondents did not form part of the respondents for the main study. Cronback alpha was used to compute the reliability coefficient and it gave a value of 0.75 which is an indication that the instrument is reliable. All the analyses were carried out with the aid of statistical package for social sciences (SPSS version 16). The two research questions were analyzed using mean and standard deviation, while the two hypotheses were analyzed using t – test. In deciding the acceptance level for the research questions a mean of 3.00 (mid of 5 point scale) was chosen as decision point. Therefore, any item that has a mean of 3.00 and above was considered required while items whose mean falls below 3.00 were considered not required. For testing the hypotheses the value of the calculated t – test was compared with t-critical (t-table value) and null hypotheses was accepted if the value of t - calculated is less or equal to t – critical, otherwise the null hypothesis is rejected. Table value of t was 1.96 at $P < 0.05$.

3.0 Results

3.1 Research Question 1

What are the re-training needs of Mechanical Engineering Technologists in the area of Production Engineering?

Table 1

Mean Responses on the Re-training Needs of Mechanical Engineering Technologists in the Area of Production Engineering?

S/NO	ITEMS	$\bar{X}_1$	SD_1	$\bar{X}_2$	SD_2	$\bar{X}_t$	SD_t	REMARK
	Manufacturing							
1.	Knowledge of classification processes in manufacturing system	3.19	0.29	2.94	0.36	3.07	0.33	Required
2.	Knowledge of production resources such as natural, human and energy resources	3.52	0.40	2.92	0.35	3.22	0.38	Required
3.	Knowledge of functions of industry e.g product engineering, production planning manufacturing and marketing	3.88	0.31	2.95	0.36	3.42	0.34	Required
4.	Basic principles and process of marketing, packaging, advertising and distributions	3.55	0.28	3.06	0.23	3.31	0.26	Required
	Materials							
5	Production of different grades of cast iron and their physical properties	3.43	0.28	2.92	0.33	3.18	0.31	Required
6	Production of special processed iron such as Nickel, Chromium, Molybdenum, Vanadium etc	3.44	0.29	2.90	0.45	3.17	0.37	Required

7	Special heat treatment processes of steels, such as annealing, and case hardening	3.40	0.44	3.23	0.42	3.32	0.43	Required
8	Understanding the constitution and behavior of steels when heated.	3.26	0.27	2.93	0.20	3.10	0.24	Required
	Casting							
9	Selection of appropriate method of casting for a scientific equipment	3.51	0.44	3.20	0.35	3.36	0.40	Required
10	Identification, selection, processing and classification of moulding sands	3.57	0.39	3.03	0.23	3.30	0.31	Required
11	Carry out accurate sand testing, design patterns and correct casting defects	3.47	0.62	3.19	0.45	3.33	0.54	Required
	Plastics							
12	Identification, classification and processing of plastics for manufacturing of scientific equipment	3.00	0.52	3.03	0.39	3.02	0.46	Required
13	Do simple and complex calculations of shear stress in forging of scientific components	3.24	0.48	2.80	0.39	3.02	0.44	Required
14	Application of cold/hot working processes in the manufacture of scientific equipment	3.22	0.39	3.26	0.47	3.24	0.43	Required
15	Surface finishing, coating and modification on already manufactured plastic products	3.34	0.32	2.97	0.37	3.16	0.35	Required
	Conventional Machining Methods							
16	Use turret, capstan and automatic lathe machines for producing precision scientific equipment	3.19	0.48	3.08	0.32	3.14	0.40	Required
17	Cut precision tapers using taper turning with attachment	3.19	0.52	3.18	0.47	3.19	0.50	Required
18	Calculate and arrange gears on the lathe (simple and compound) for screw cutting	3.30	0.37	3.29	0.29	3.30	0.33	Required
19	Ability to use complex work holding devices like angle plate and collect chuck for turning on the lathe	2.84	0.65	3.27	0.59	3.06	0.62	Required
20	Cutting vee, square, acme, buttress and multi start threads on the lathe	3.42	0.45	3.31	0.39	3.37	0.42	Required

21	Grinding hand tools, cutting tools with correct angle value for all available machines in the laboratory	3.36	0.47	3.16	0.46	3.26	0.47	Required
22	Cut simple, compound, angular and helical fluted gears on the milling machines.	3.43	0.49	3.34	0.67	3.39	0.58	Required
23	Use complex drilling machines such as gang, multi spindle, automatic turret drill machines	3.02	0.52	3.43	0.29	3.23	0.41	Required
24	Use appropriate cutting fluid for turning, drilling and milling all categories of materials	3.34	0.54	3.14	0.47	3.24	0.51	Required
25	Use different types of grinding machines for precision scientific equipment	3.14	0.38	3.19	0.49	3.17	0.44	Required
26	Perform operations like grinding, micro finish, super-finishing, buffing and polishing	3.21	0.49	3.32	0.54	3.23	0.52	Required
27	Knowledge of dangerous fumes, explosives, dusts, gas and poisonous chemicals	3.29	0.53	3.21	0.42	3.25	0.48	Required
28	Knowledge of tool design, analysis and material handling	3.31	0.49	3.38	0.53	3.35	0.51	Required
29	Design of jigs, fixtures, press working tools, and forging dies	3.30	0.49	3.38	0.53	3.34	0.51	Required
30	Identification and use of injection moulding, extruding and powder metallurgy method	3.64	0.53	3.29	0.45	3.47	0.49	Required
31	Application of Numerical machines with analogue and digital, controls in the production of science equipment	3.55	0.53	3.26	0.50	3.41	0.52	Required
32	Use of computer numerical control (CNC) machines	3.33	0.62	3.16	0.58	3.25	0.60	Required

in manufacturing				
AVERAGE	**3.34**	**0.45**	**3.15**	**0.42**

3.2 Research Question 2:
What is the re –training needs of mechanical engineering technologists in the areas of general and related knowledge?
Table 2
Mean responses on Re – training needs of Mechanical Technologists in the area of General and related knowledge

S/NO	ITEMS	X_1	SD_1	X_2	SD_2	X_t	SD_t	REMARK
	Basic Engineering Knowledge							
33	Drawing of bearings, journals, thrust rollers shaft etc	3.43	0.49	3.17	0.52	3.30	0.51	Required
34	Design of cams and cam followers	3.50	0.57	3.23	0.49	3.37	0.53	Required
35	Calculations and constructions of involutes bevel gears	3.42	0.54	3.20	0.39	3.31	0.47	Required
36	Preparing and assembling working drawings, balloon, referencing and part lists.	3.65	0.52	3.14	0.48	3.40	0.50	Required
37	Development of interpenetrations of cones and cylinders using triangulation	3.15	0.67	3.28	0.45	3.22	0.56	Required
38	Graphical resolution of forces, loaded beams and wind loads on frame works	3.38	0.53	3.28	0.48	3.33	0.51	Required
39	Graphical integration of areas, first and second derivatives and its application	3.07	0.56	3.27	0.50	3.17	0.53	Required
	Computer Application in Production							
40	Computer aided design and numerical control programming	3.33	0.62	3.16	0.58	3.25	0.60	Required
41	Robotic task programming and automations	3.07	0.56	3.27	0.50	3.17	0.53	Required
42	Computer aided production, planning and control	3.40	0.60	3.15	0.46	3.28	0.53	Required
43	Computer aided total quality management system and interactive computer graphics	3.30	0.56	3.27	0.48	3.29	0.52	Required
44	Writing basic programmes for machining precision components.	3.47	0.51	3.21	0.37	3.34	0.44	Required
	Mathematics							
45	Calculation and evaluation of formulae errors approximation and exponential function	3.65	0.57	3.22	0.42	3.44	0.50	Required
46	Mathematical modeling for production of basic components	3.95	0.46	3.40	0.39	3.68	0.43	Required
47	Application of trigonometric identities and equations in manufacturing	3.55	0.59	3.19	0.48	3.37	0.54	Required
48	Calculations for machine spindle speeds, feed, cutting speed and depths of cut	3.63	0.45	2.88	0.40	3.26	0.43	Required
49	Calculations for gear change and indexing for gear cutting on the milling machine	3.76	0.50	2.82	0.46	3.29	0.48	Required
50	Calculations for dies, jigs and fixture design	3.67	0.56	3.09	0.39	3.38	0.48	Required
	AVERAGE	**3.47**	**0.55**	**3.18**	**0.46**			

Analysis shows that the respondents agreed with the 32 production retraining items on table 1 and the 18 items on table 2 that deals with general and related knowledge. The mean range is between 3.00 – 3.68. This is an indication that all the proposed 50 items are relevant and could be packaged as relevant areas of retraining.

3.3 Hypothesis One
There is no significant difference between the mean responses of Mechanical Engineers and Technologists on the re-training needs of mechanical engineering technologists in the area of production engineering.
Table 3
t-test on the Re-Training Needs of Mechanical Engineering Technologists in the area of Production Engineering

Respondents	*N*	*Mean*	*SD*	*df*	*t-cal*	*t-table value*
Mechanical	82	3.34	0.45	220	3.11	1.96

Engineers			
Mechanical Engineering Technologists	140	3.15	0.42

Table 3 revealed that t-calculated (3.11) is greater than the t-table value (1.96), the result of this test suggest that the difference between the scores of mechanical engineers and mechanical engineering technologists are statistically different. It is therefore concluded that there is significant different between the mean scores of mechanical engineers and mechanical engineering technologists in the area of production engineering, null hypothesis was then rejected.

3.4 Hypothesis Two

There is no significant difference between the mean responses of mechanical engineers and technologists on the re-training needs of mechanical engineering technologists in the areas of general and related knowledge.

Table 4

t-test on the Re-Training Needs of Mechanical Engineering Technologists in the Area of General and Related Knowledge

Respondents	*N*	*Mean*	*SD*	*df*	*t-cal*	*t-table value*
Mechanical Engineers	82	3.47	0.55	220	4.02	1.96
Mechanical Engineering Technologists	140	3.18	0.46			

Table 4 revealed that t-calculated (4.02) is greater than the t-table value (1.96), the result of this test suggest that the difference between the scores of mechanical engineers and mechanical engineering technologists are statistically different. It is therefore concluded that there is significant different between the mean scores of mechanical engineers and mechanical engineering technologists in the area of general and related knowledge, null hypothesis was then rejected.

4.0 Discussion

The acceptance of the fifty (50) items proposed as areas of re-training of the mechanical engineering technologist is not coming as a surprise. This is because of the great importance attached to the scientific laboratory equipment. According to Jain (2006) laboratory equipment in schools offers students opportunities to learn about science through hands on experience that enrich their learning and improve their thinking skills. He said the only means by which countries and students can stay competitive, and improve student higher order thinking is by provision of quality scientific laboratory equipment. Another strong reason for the total acceptance of the all items boarder on the fact that good quality science teaching resource are essential to support teaching science at schools, colleges or university. This is because of the rapidly changing nature of the subject. It is often a challenge for us to keep our teaching up to date. For example ten (10) years ago it might have made sense to teach science student how to prepare a glass histology slide for viewing with a microscope. Today, slides are often prepared automatically by large scale laboratory equipment. Perhaps another strong reason for the complete acceptance of the whole items stems from the fact that science is based on gathering, observable, empirical, measurable evidence, subject to specific principles of reasoning and this can only be achieved with the help of quality scientific kits or apparatus used for experiments.

The first set of items deals with basic rudiments, principles and processes of manufacturing. The respondents rated the items under manufacturing high because according to Sharma (2006) due to the rapid developments taking place in the field of manufacturing processes, the exotic and complicated machinery and new products appearing in the markets, It is better to keep abreast with the modern technological advances been made in the world. The engineering technologist has to face a gigantic task of mastering the fundamentals and also gaining insight into the new innovations. The mechanical engineering technologists have to garble with new emerging trends in production technology. According to Sharma (2006) the mechanical engineering technologist should have a very sound knowledge of industrial or manufacturing processes. For example in the area of manufacturing task he should be able to re-design a product by using different input materials so that better or newer production techniques could be utilized and provide better integration and flow among processing steps. He should demonstrate a high knowledge of product engineering, production planning, production control, quality control and manufacturing. Atsumbe (2012) further stressed that under professional direction, an engineering technologist analyzes and solves technological problems, prepares formal reports on experiments, test, and other similar projects or carries out functions such as drafting, designing, technical writing, teaching or training. A mechanical technologist need not to have an education equivalent in type, scope, and rigor to that required of an engineer; however he must have a more theoretical education with greater scientific and mathematical depth and experience over a broader field that is required of skilled craftsmen who often work under his supervision.

Next in order of acceptance of the re-training package is engineering materials. Higgins (2005) noted that it is the duty of a mechanical technologist to bring the ideas and designs into reality by proper selection of materials, machines and manufacturing processes. Jain (2006) further stressed that to meet the challenges imposed on manufacturing technologist; it is desirable for him to have through knowledge of material science. This is because in the manufacture of precision scientific equipments a vast range of materials are available today at the disposal of the technologist. A proper selection has to be made to suit the requirement of a particular apparatus or kits. For example plastics that can resist acid attack and can be capable of been fabricated into variety of shapes, ceramics to withstand high temperatures, metals to stand up to the environment in a nuclear reactor. Effective design and production of correct scientific equipment call for our ability in selecting the right materials for a given job. Since scientific laboratory equipment can be put into various types of use, the production technologist should have an understanding of how these materials behave under different conditions e.g. under high temperature (heat), load and reaction to various chemicals etc. Therefore a mechanical engineering technologist must have thorough knowledge of physical metallurgy, metallic bond, space lattices, heat treatment and constituents of steels generally.

The over whelming acceptance of items that deals with casting and plastic is not coming as a surprise, Nee (1998) explained that most laboratory kits or apparatus are manufactured through casting. He said casting is one of the most versatile forms of mechanical processes for producing components. This is because there is no limit to the size, shape and intricacy of the articles that can be produced by casting. Casting offers one of the cheapest methods and gives high strength and rigidity even to intricate parts, which are difficult to produce by other methods of manufacturing. It is often possible to produce accurate castings in metals and plastics which are difficult to machine to size. Most beakers, burettes are manufactured by casting. Casting permits large quantity of apparatus or laboratory kits to be mass-produced.

Part of the items accepted as crucial areas of retraining are automatic, numerical and computer numerical controlled machines (NC & CNC). The respondents agreed with these items because automatic machines, NC and CNC have played an important role in increasing the production rate. According to Fitzpatrick (2005) automation, digitization and computerization of production machines have greatly improved the accuracy of products produced, a lot of time that will hitherto be wasted on the manual machine have been saved using these new machines that are software based. He further posited that scientific equipment and kits are precision in nature and most of the time have to be mass produced. These CNC machines are automated and have less interference from operators are better off for the production of laboratory equipment, kits and apparatus, because they are expected to give accurate measurement and readings during experiment.

The result of the study on the hypotheses revealed that null hypotheses were rejected, this indicate that mechanical engineers and technologists differ significantly on the re-training needs of mechanical engineering technologists in the areas of production engineering, general and related knowledge. This highlighted the critical links between the roles of mechanical engineering technologists in the manufacturing of laboratory equipment and need to attain global standard in the quality of such laboratory apparatus. This therefore calls for means of ensuring that standards are met and quality of the apparatus are efficiently produced.

In conclusion the acceptance of almost all the items is a strong indication that the curriculum of Higher National Diploma mechanical engineering syllabus is outdated, obsolete and actually shallow. The current curriculum particularly those of engineering based programmes are completely void of new production technologies such as Robots and Robotics, automating assembling, CNC machine tools, flexible manufacturing system (FMS) use of IT in manufacturing, CAD/CAM (Atsumbe, 2002).

Conclusion

The aim of establishing Scientific Equipment Development institutes in Minna and Enugu will only be achieved, when the manpower (Mechanical engineering technologists) who are employed to produce standard laboratory kits, equipment or apparatus have the requisite theoretical and practical skills. This study found out that the present crops of mechanical engineering technologists are seriously deficient in major production technology processes.

Findings further showed that these technologists lack knowledge of advanced production processes. This processes includes use of automated machines, Computer Numerical controlled machines, industrial casting and plastic processing method. Therefore based on the findings of this study the entire technologists need to be properly re-trained in all the areas identified as their major weakness point. The implications of this study is that National Agency for Science and Engineering Infrastructure (NASENI) who is the co-coordinating organization for the two Scientific Equipment Development Institutes (SEDI) should as a matter of urgency mount up various re-training programmes for these technologists, this could be done through appropriate collaborating programmes like Built Operate and Transfer (BOT) or through Built Operate Own and Transfer (BOOT). Another strong and obvious implication is that National Board for Technical Education (NBTE) that coordinates the activities of polytechnics in Nigeria need to urgently review the existing curriculum for all engineering base courses in order to incorporate emerging new technologies into the existing curriculum.

Recommendations

The following recommendations are deemed necessary for effective service by mechanical engineering technologists in Science Equipment Development institutes:

1. National Agency for Science and Engineering Infrastructure (NASENI) should as a matter of urgency mount various re-training programmes for all technologists.
2. The re-training programmes should take the form of workshops, seminars, short time training programmes, both within and outside the country.
3. Government should immediately purchase some of these machines for the centre.
4. Partnership with several production industries will hasten the trainings required.
5. Curriculum of Higher National Diploma (HND) should be reviewed by NBTE to incorporate new Technologies.

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