

COLLABORATION BETWEEN SCIENCE TECHNICAL COLLEGES AND INDUSTRIES FOR EFFECTIVE SKILL DEVELOPMENT IN MECHANICAL ENGINEERING TRADES (METs) IN BAUCHI STATE, NIGERIA

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ABSTRACT

The study focused on the method of enhancing school-industry collaboration for effective skill development of Mechanical Engineering Trades (METs) students in Science Technical Colleges in Bauchi State. Descriptive survey research design was adopted. The study was guided by two research questions and two null hypotheses tested at .05 level of significance. The population for the study was 20, comprising 13 METs teachers and seven industrial based supervisors in Bauchi State. There was no sampling used as the population was manageable. The instrument for data collection was 30 item structured questionnaire. The instrument was validated by three experts and reliability coefficient of 0.89 was obtained using Cronbach Alpha reliability method. Data collected were analyzed using Mean and Standard Deviation to answer the research questions, while t-test was used to test the null hypotheses at .05 levels of significance. The findings of the study show a gap in the preparation of METs students for skill acquisition, in terms of curriculum, low competence of technical teachers and lack of cooperation between and schools. Based on the findings, the study recommended for a review of Science Technical College curriculum to include industry-based job skills. Furthermore, it recommended that technical teachers should be provided the opportunity to upgrade their skills in industries with the current technologies. It also recommended that Industries should share facilities with Science Technical Colleges. Finally, it recommended for total retooling of Science Technical College workshops and laboratories with new training equipment and machine tools in line with modern practices. .

Key Words: Collaboration, technical colleges, industries, mechanical engineering trades.

INTRODUCTION

The 21st century is noted by the high volume of production of that is highly advanced and technologically driven. This has enabled the world to enjoy a level of development that has never been witnessed before. The driver of this modern society is Information and Communication Technology (ICT), as virtually every aspect of living is now affected by ICT. Modern metal manufacturing is not an exception to this development. There is no doubt that a strong workforce in metal working skills could be the key economic development. For Nigeria to be able to realize its vision of becoming one of the top 20 economies of the world, it must focus on massive training in metal craft skill. This will involve adopting a training model that is more aligned with an on the job training than currently practiced in the training of personal in metalcraft trades.

The universally recognized method of producing skilled technical manpower is through formal training of students in technical schools. In Nigeria, technical skill training falls under Technical Vocational Education and Training (TVET). The primary purpose of TVET, is to develop abilities, understanding, work skills and any information needed by a worker to enter and make progress in employment and be productive. Science Technical Colleges (STCs) are the institutions established with the aims of training and producing craftsmen who in turn serve the industry (FGN, 2014). Technical skills training therefore remains the fastest way of accelerating economic development. Developed economies of the world place great emphasis on giving effective manpower training in

technical schools with models that emphasize in exposing learners to the practices in industry Guimon, (2013) Oviewe, Uwameiye & Uddin, (2019) have indeed asserted on the impact of TVET in promoting national development.. This is particularly important for metal manufacturing and service trades.

Technical education in Nigeria at all levels and especially at craftsmanship stage in STCs is facing a number of challenges. These challenges include poor organization, deficiencies in modern teaching and learning facilities, lack of competent technical teachers, poor staff training programs, outdated training machines and equipment, poor infrastructure and learning conditions and lack of ICT facilities (Okoli, Igwe & Elam, 2019). Particularly worrying are issues ranging from policy implementation, curriculum, and teacher quality which do not reflect the problems of the society. For instance, TVET curriculum has little or no relationship with workplace (Okwelle & Ojotola, 2018). This situation could be responsible for the low quality of graduates of STCs in Nigeria (Rufai, Umar & Idris, 2013). Mbah, Obi and Ohimen (2018) reported that students lack the requisite training skills to function effectively in the world of work. This problem is most felt in the metal production industry, which is responsible for making mechanical components. There is particularly worrying because societies with strong metal craft skills, tend to develop strong economy because it is the foundation of any kind of production. Science Technical Colleges are therefore considered as pivotal to industrial development, hence its programs include craft engineering courses that include Mechanical Engineering Trades (METs).

METs is a general term that defines trades that have common bearing metal welding/ forming, and or services/repairs of machines or machine related equipment and appliances. The occupations MET comprise of agricultural implements and equipment, motor vehicle works, air conditioning and refrigeration mechanics mechanic and mechanical engineering craft practice, foundry craft practice, instrument mechanics works and marine engineering craft are the main occupations (Ogumbe, 2015). Students' practical activities involves various tasks on machine tools and bench work. Skill in METs is the knowledge, procedures, and methods of carrying out specialized tasks to operate tools and equipment that are related to the tasks. demonstration of dexterity or the ability to carry out the processes of metal work operations such as cutting, drilling, forging, casting, fitting, welding and assembling with little or no wastage of necessary resources.

The prevailing conditions in STCs, means that METs graduates cannot meet the requirement for transiting to the modern world of industry hence the need to address the problem. One of such an approach could be through joint training between industry and STCs. Such collaboration could strengthen the quality of METs programs and prepare student for smooth transition from school to industry (Nungse, Ugwoke, Ogbuanya, and Shettima, 2020). Therefore, for STCs to improve student's competency, there is the need to integrate school based instruction with workplace based apprenticeship training as obtained in the German dual training system. Collaborative training is necessary against the backdrop of fast changing practices in the industry. The global competition in technology and the growing demand to produce quality products demands high quality workforce than currently obtained in STCs. Alie and Hassan (2012), identified some advantages of collaboration to include promoting knowledge transfer between schools between school and industry, reducing demand and supply mismatch, improving technical skills and enhancing employability skills.

A compelling reason for addressing the skill gap is that the skill needs of the workplace are continuously changing. While technical colleges in Nigeria are still left with old training machines and equipment, the industries have advanced in their methods of production. Therefore, for students to meet up with current changes in the industry, there is a need to adopt a curriculum that blends instruction in school and exposure to real working environment in the industry. This suggestion goes in line with the assertion of Billet (2013), who advocated that the focus of vocational education should be on work and workplace, and for emphasis on outcomes that move beyond the acquisition of school based skills to work-centered learning. Although work placement is the central focus of TVET as originally envisaged by the Nigerian government, the training obtained in such schools fall short of the standard of the industry. Therefore, for TVET

programs to be relevant to industry demands, it should be designed to increase industry involvement. This can go a long way as a step to reshape TVET as a more work centered system (Chappell & Hawke, 2013)

Science Technical College programs are designed to provide three stages in skill acquisition that comprise of theoretical, practical and the exposure to challenges (Nwanaka & Amaechule, 2011). Though Science Technical Colleges may seem to provide the theoretical and practical stages through the school-based learning, they lack the exposure to challenge commonly called the "work-based learning", which can only be achieved outside the colleges. Work-based learning is therefore where students are exposed to practical experience in an industrial setting through the school-industry collaboration. Work-based learning is a planned work experience where students are kept under the supervision of industrial-based supervisors to receive mentorship for a specified period in order to acquire industrial experience. It recognizes that even good performance in school without industrial exposure is unlikely to lead to smooth transition on the job.

The concept of school-based learning is used to describe the training carried out within the school while the work-based learning is the exposure of students to practical experience in an industrial setting. When school-based learning and the work-based learning are made to complement each other through an effective school-industry collaboration could meet the skills needs of the industry. School-industry collaboration is described as the partnership between formal education and the industrial sector to create enabling training environment for students to acquire on-the-job experiences, knowledge, skills, and appropriate attitude to work (Nungse, Ugwoke, Ogbuanya & Shettima, 2020). Comparative studies have shown that developed countries of the world show how such collaboration help students in skill acquisition and school to industry transition. For instance, in Germany training involves dual systems whereby 80% of instruction is done in the industries and 20% instruction in schools so as to equip learners with relevant employable skills (Anindo, Mugambi & Matula, 2016).

Work-based skill training is not yet part of STCs curriculum in Nigeria, hence this could be the cause for the gap in the training of METs student, and a justification of this study. Indeed. Patrinos, Barrera-Osorio & Guáqueta (2009) have highlighted the function of industries to include: assessment of training resources of institution to find out if the institutions are capable of giving the students adequate training and background on those occupations required in the industries. Furthermore, industries are expected to examine the curriculum of the training programmes to ensure that their occupational interests are covered and provide funds to assist institutions. Industries can also assist teachers /instructors in research work by allowing them to use laboratories and industrial machinery to upgrade their knowledge and skills to keep abreast with new technologies. Industries are also expected to make special provision of occupational placement for the graduates of technical colleges. Unfortunately, it appears that most graduates of METs in Nigeria, especially Bauchi State lack adequate practical skills to work in the industry or become self-employed. Consequently, collaboration can create an avenue should for shared responsibilities for effective training of METs students.

STATEMENT OF THE PROBLEM

Although the fundamental role of STCs is to produce graduates that are sound in skills, this appears not attainable because of lack of exposure of students to modern production methods, machines and equipment to the level of the industry (Okoli, Igwe & Elmo, 2019). This is a cause for concern particularly in METs courses and a potential threat to developing competent technical manpower in the Metalwork industry. For Bauchi state this challenge constitute a serious problem in meeting the needs of mechanical production experts that can boost its quest for accelerated economic development. While METs courses are found in STCs, literature has revealed that graduates of the programs lack the necessary skills for employment. A more effective method of training METs could be through a program that integrates school based learning and industrial experience. The problem of the study therefore is the non-exposure of METs students to industrial

training that can enhance their skills and prepare them for easy transition to the work environment.

RESEARCH QUESTIONS

1. What are the strategies of industry for developing school-industry collaboration for skill acquisition in METs programs in STCs in Bauchi state?
2. What are the strategies for improving school-industry collaboration for student's skill acquisition in METs in STCs in Bauchi state?

HYPOTHESES

The following hypotheses are formulated to guide the study and will be tested at 0.05 level of significance:

1. There is no significant difference between the mean responses of industry-based supervisors and technical teachers on industry strategies for improving collaboration between technical colleges and industries for skill acquisition in METS.
2. There is no significant difference between the mean responses of industry-based supervisors and technical teachers on technical college strategies for improving collaboration between technical colleges and industries for METs student's skill acquisition.

METHODS

The study adopted a descriptive survey research design conducted in six Government technical colleges in Bauchi State of Nigeria. The sample were 20 respondents, comprising 13 technical teachers and seven Industry based Supervisors in South-East Zone of Nigeria. There was no sampling considering the small size of the population. The instrument was validated by experts who made sound judgments, corrections and suggestions which made the questionnaire items reliable and appropriate for the study. Reliability of .98 was established using Cronbach alpha coefficient. A Student's Skill Acquisition in Mechanical Engineering Trades Questionnaire (SSAMETQ) was developed for generating data. The instrument has three sections A, B and C. Section A require the respondents to tick as either a METs teacher or an industrial supervisor and gender. Section B and C were developed in line with the research questions using Likert scale. Data collected was analyzed using mean and standard deviation to answer the two research questions while t-test statistics was used to test the null hypotheses at 0.05 level of significance.

RESULTS

Research Question 1: *What are the industry strategies for improving collaboration between Science Technical Colleges and industries for skill acquisition in METs?*

Table 1:
Industry Strategies that can Improve School-Industry Collaboration for Skill Acquisition in METs to Match Skill Demand of Industries

S/N	Item Description	SA 5	A 4	U 3	D 2	SD 1	N	$\bar{X}$	SD	Remark
1	Provision of internship and on-the-job training by industries	9	7	1	2	1	20	4.05	1.191	Agreed
2	Assessment of training facilities in STCs to identify capacity for students training	9	8	-	2	1	20	4.10	1.165	Agreed
3	Participation in STC curriculum design	9	7	2	1	1	20	4.10	1.119	Agreed

4	Funding of STCs in METs programmes	14	4	-	1	1	20	4.45	1.099	Agreed
5	Exposing Technical teachers to industry practices to update their skills	14	4	1	-	1	20	4.50	1.000	Agreed
6	Provision of job placement of graduates of STC programme by the industries	12	5	-	-	3	20	4.15	1.424	Agreed
7	Provision of instructional materials to STCs by the industries	10	7	2	-	1	20	4.25	1.020	Agreed
8	Supporting STC with material for students practical activities by industry	12	4	2	-	2	20	4.20	1.281	Agreed
9	Organizing trade fairs and exhibition of TCs products	12	5	2	-	1	20	4.35	1.040	Agreed
10	Payment of allowances to students on industrial attachment by the industries	11	7	-	-	2	20	4.25	1.209	Agreed
11	Providing employment to graduates of STCs by the industries	14	5	-	-	1	20	4.55	.945	Agreed

Table 1 shows the results on the industry strategies for improving collaboration between technical colleges and industries for skill acquisition in METs to match skills demand of industries. From the result, all the items have mean scores (4.05, 4.10, 4.10, 4.45, 4.50, 4.15, 4.25, 4.20, 4.35, 4.25 & 4.55) above the criterion mean of 3.50, indicating that all the items 138-148 listed to answer the Research Question seven were accepted by the respondents. The standard deviation values of 0.945-1.424 indicate that the respondents are homogeneous in their responses to the items raised. This implies that both METS teachers and industry-based supervisors unanimously accepted all the items listed as industry strategies for improving collaboration between technical colleges and industries for skill acquisition in METs to match skills demanded by industries.

Research Question 2: *What are the technical college strategies for improving collaboration between technical colleges and industries for student's skill acquisition in METs?*

Table 1: Technical College strategies that can Improve School-Industry Collaboration for student's skill acquisition in METs to match skill demand of industries

S/N		SA	A	U	D	SD				
		5	4	3	2	1	N	$\bar{X}$	SD	Remark
12	Industries and TCs sharing of facilities can improve school-industry collaboration	14	3	1	2		20	4.35	1.27	Agreed
13	Involving of industries in evaluating students relevant learning experiences required in the TCs can improve school-industry collaboration	11	8	-	-	1	20	4.40	.940	Agreed
14	Organizing cross training between industries and TC personnel can improve school-industry collaboration	10	8	1	-	1	20	4.30	.979	Agreed

15	Industrial training attachment for TC students in industries can improve school-collaboration	12	5	2	-	1	20	4.35	1.04	Agreed
16	Engaging Mechanical Engineering trades professionals in industry in part time teaching in TC can improve school-industry collaboration	14	4	1	-	1	20	4.50	1.00	Agreed
17	Inviting guest speakers from industries to deliver lectures in TCs can improve school-industry collaboration	13	5	1	-	1	20	4.45	.999	Agreed
18	Award of scholarship to students by industries for further studies can improve school-industry collaboration	14	4	1	-	1	20	4.50	1.00	Agreed
19	Introducing ITP programme with enough time in TCs for those in National Technical Certificate NTC as in the case of Advanced National Certificate.	15	1	3	-	1	20	4.45	1.10	Agreed
20	Relating the practical on-the-job experience in the ITP programme to classroom teaching can improve school-industry collaboration	14	5	-	-	1	20	4.55	.95	Agreed

Table 1 shows the results on the technical college strategies for improving collaboration between technical colleges and industries for student's skill acquisition in METs to match skills demand of industries. From the result all the items have mean scores (4.35, 4.40, 4.30, 4.35, 4.50, 4.45, 4.50, 4.45 & 4.55) above the criterion mean of 3.50. The standard deviation values of 0.940-1.27 indicate that the respondents are homogeneous in their responses for the items raised. This indicate that the respondents agreed that all the items are strategies that could improve collaboration between technical colleges and industries for student's skill acquisition in METs to match skills demand of industries.

Hypothesis one

There is no significant difference between the mean responses of industry-based supervisors and technical teachers on technical college strategies for improving collaboration between technical colleges and industries for student's skill acquisition in METs to match skills demand.

Table 3:
Result of t-test on the Mean Responses of Industry-based Supervisors and Technical Teachers on technical colleges Strategies that could Improve Collaboration

Group	N	$\bar{X}$	SD	DF	Z _{cal.}	Z _{tab.}	α	Decision
Industry-based Supervisor	7	40.29	4.46	18	-.167	.869	0.05	Insignificant
Technical Teachers	13	39.62	9.99					

Table 1 shows the t-test result on difference between the mean responses of industry-based supervisors and technical teachers on technical college strategies that could improve collaboration between STCs and industries for students' skills acquisition in METs to match skill demand of industries. The result for industry-based supervisors yielded a mean score of 40.29 with standard deviation of 4.46 and the teachers mean score was 39.62 with a standard deviation of 9.99. The result further reveals that $t(18) = -.167$, $p > 0.05$. Since the p-value of .869 is greater than the 0.05 level of significance, the null hypothesis was retained, it can be inferred that there was no significant difference between the mean responses of industry-based supervisors and technical teachers on technical college strategies that could improve collaboration between technical colleges and industries for students' skills acquisition in METs to match skill demand of industries.

Hypothesis two

There is no significant difference between the mean responses of industry-based supervisors and technical teachers on industry strategies for improving collaboration between STCs and industries for skill acquisition in METs to match skills demand.

Table 17:
Result of t-test on the Mean Responses of Industry-based Supervisors and Technical Teachers on Industry Strategies that could Improve Collaboration

Group	N	$\bar{X}$	SD	DF	$Z_{cal.}$	$Z_{tab.}$	α	Decision
Industry-based Supervisor	7	46.29	6.78	18	.205	.840	0.05	Insignificant
Technical Teachers	13	47.31	12.12					

Table 4 shows the t-test result on difference between the mean responses of industry-based supervisors and technical teachers on industry strategies for improving collaboration between TCs and industries for skill acquisition in METs to match skills demand. The result for industry-based supervisors yielded a mean score of 46.29 with standard deviation of 6.78 and the teachers mean score was 47.31 with a standard deviation of 12.12. The result further reveals that $t(18) = .205$, $p > 0.05$. Since the p-value of .840 is greater than the 0.05 level of significance, the null hypothesis was retained, it can be inferred that there was no significant difference between the mean responses of industry-based supervisors and technical teachers on industry strategies for improving collaboration between STCs and industries for skill acquisition in METs.

DISCUSSION OF RESULTS

Findings of the study showed that all the items on table 1 are required as industry strategies for improving school-Industry collaboration for effective skill development of STCs students. This finding agreed with the findings of Mbah, Obi, & Ehimen, (2018) who found that granting work study permits to TVET students, Granting TVET students industrial experience opportunity and Industries and technical colleges sharing of facilities can improve school-industry collaboration that will suit the school academic calendar among others were all industry strategies required for improving school-industry collaboration. The study conducted by Okorie (2001) also affirmed that certain psychomotor deficiencies that existed in students will be reduced if not completely eliminated especially when industries participate in the training of students. The findings of hypothesis one shows that there is no statistically significant difference in the opinions of the respondents on the industry strategies for improving school-industry collaboration for effective skill development of technical college students. It was an indication that industry-based supervisors, lecturers and teachers did not vary in their opinion concerning the industry strategies

for improving school-Industry collaboration for effective skill development of technical college students.

This finding is similar to the findings in the study of (Scott 2014; Oviawe, Uwameiye, & Uddin, 2017) who found out that the aforementioned institutional strategies are elements of smooth transition of school classroom theories to work practice in an occupation of work. Such institutional strategies include provision of integrated curriculum, attracting industry representatives in planning with management of school skill development activities and narrowing the gap between theory/practical through field trips/excursions among others. (Guimon, 2013) affirmed that Collaboration between academia and industry is increasingly a critical component of efficient national innovation systems.

The outcome of hypothesis two showed that statistically significant difference exists among the group. By implication, their opinions varied as regards the strategies for improving school-industry collaboration for effective skill development of technical college students. This finding contradicts the findings of Mbah, Obi, & Ehimen, (2018) who found out that the respondents' opinion did not vary as regards the institutional strategies. It is possible because what an industrial supervisor perceived about school-industry may not be what a teacher perceived. Industrial based supervisors were not among their respondents which could also be the possible reason for the difference in our result. Industries in this changing world of work need extensive research to improve on their activities and services to maximize profit. Therefore, it is not out of place according to Jimoh, Maigida, and Adebayo, (2014) to organize joint programme of research as pointed out by the findings of this study which is paramount to both the institutions and industries.

CONCLUSION

The basis of this study was to ascertain the strategies for improving school-Industry collaboration for effective skill development of technical college students. Among the industry strategies identified are granting work study permits to TVET students and preparing skill training programmes that will suit the school academic calendar. Similarly, encouraging joint development projects initiative between school and industry as well as upgrading the curriculum to meet the labor market demand through industry participation were among the identified institutional strategies for improving school-Industry collaboration for effective skill development of technical college students. It was evident from the findings of the study that certain deficiencies that existed in students will be reduced if not completely eliminated especially when industries participate in the training of students.

RECOMMENDATIONS

1. The Federal government should review the STC curriculum to align with current developments in the industry.
2. Bauchi state government should set up Mechanical Production Technology Institute for special training programs in digital skills for students in METs.
3. Bauchi state should prepare special program for training and retraining of METs technical teachers for STCs
4. Industries in Bauchi state should participate in assisting STCs with personnel in teaching certain contents that are not available in schools.
5. METs instructors in Bauchi state should engage with industries for constant upgrade of their skills

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