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Technological Innovations in Bamboo Processing for Job Creation among University Students in Akwa Ibom State, Nigeria.

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Abstract
*This study aimed at investigating Technological Innovations in Bamboo Processing for Job Creation among University Students in Akwa Ibom State, Nigeria**.** Two specific objectives, two research questions and two null hypotheses were formulated to guide the study. A descriptive survey design was adopted on a population of 38 respondents. The entire population was studies as the population size was manageable. A 28 items structured questionnaire with a reliability coefficient of 0.78 was used to elicite data from the respondents. The Mean statistics was used to answer the research questions while independent t-test was used to test the null hypotheses at .05 level of significance. The study revealed 14 bamboo processing procedures and 14 requisite equipment manipulative skill for bamboo fabrication. It was concluded that when students acquire adequate knowledge on bamboo cultivation, fabrication procedure and develop all requisite equipment manipulative skills, they will be able to create job for themselves and others which will translate to wealth creation and poverty eradication in Akwa Ibom state and the country at large. It was recommended among others that all tiers of government and educational stakeholders should improvise means of acquiring requisite equipment for bamboo fabrication in Nigeria.*

Keywords: Creativity, Bamboo, Innovation, Technology, Processing

Introduction

Bamboo is a wood-like plant that is a part of the grass family, consisting of a cylindrical hollow shoot, or culm. This culm is covered with a waxy surface, which prevents moisture from escaping. At intervals, the culm has raised ridges called nodes, from which branches will offshoot. The general physical features of bamboo are shown in **Figure 1.**

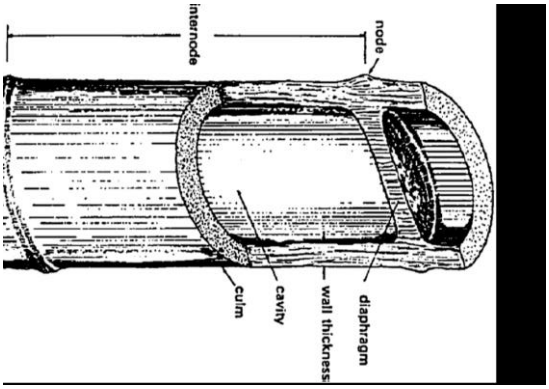

Figure 1: Cross Section of a Bamboo

Bamboo being a woody grass, with strong fibre and long culms, is one of the best natural materials for making furniture. Owing to the fact that bamboos exhibit various varieties like solid bamboo, hollow bamboo with various widths; that makes it ideal for making good quality furniture (Bui, Grillet & Tran, 2017). Nowadays there is a high demand of bamboo products for residential uses, schools, in the tourism sector. The bamboo industry is recognised globally for its potential to simultaneously tackle poverty and climate change while offering an excellent business opportunity to investors.

Bamboo is a fast growing, renewable, widespread, low cost, environment enhancing resource with great potential to improve poverty alleviation and environment conservation (Xuhe, 2003). Its growth is more rapid than any other tree species on the planet, even faster than Eucalyptus species that can be annually self-renewable and harvestable if managed properly. Bamboo is a high-yield renewable natural resource for agro-forestry and engineering based products' (Kassahun, 2015). Bamboo plant as a resource is available in plenty and plays a great role in socio-economic development (Panda 2011; Yeasmin et al. 2015). It is fast growing and most of it is grown organically (though very little is certified organic), and it has been claimed that growing bamboo usually requires no pesticides and fertilizers (Nieder, 2009) i.e. naturally organic.

Moroz, Lissel and Hagel (2014) posited that the plant grows up from a throng of underground stems and roots, called rhizomes. Some species can grow to a height of up to 30.5 meters, with a diameter as great as 305 milli-meters. Bamboo is a natural resource with very rapid renewability. Indeed, bamboo can have a very high growth rate, with some species growing up to 600 mm per day. However, it still takes four to five years for the bast fibers, or so-called wood fibers to mature. In the same vein, Bui, Grillet and Tran (2017) opined that bamboo can be used in environmentally friendly constructions as structural elements or as a substitute for steel reinforcement bars in low-cost buildings. However, like timber or the most of bio-based materials, bamboo is sensitive to water and moisture; it can absorb or release water/moisture depending on its environment. Engineering bamboo is being increasingly explored for structural use in the construction

sector. To ensure durability, products such as laminated bamboo undergo essential preservation treatment steps during their manufacture. However, the effects of hygro-thermal caramelisation and chemical bleaching too commonly used treatment procedures in industry on the surface and interfacial properties of laminated bamboo are not yet known. The later governs the structural quality of the final product.

The use of bamboo in Akwa Ibom and other parts of the country is limited to its application for scaffold making and supporting member in building construction work. It is not gain saying that the available and unharnessed bamboo resources could be used to permanently address some critical socio-economic issues bedevilling the country, especially the issue of toothpick importation in the country which has lingered on for a very long time thereby the millions of naira spent annually could be saved. This is achievable if technical students are empowered with necessary production skills without neglecting the equipment required for mass production of such goods.

It is in literature that countries like Uganda, Rwanda, Kenya and Tanzania adopted innovative technologies in bamboo processing to solve their unemployment problems. These technologies are capable of transforming the world of work thereby creating new job opportunities and making the labour market more innovative. Technologies are influencing employment both as industry that create jobs and as tool that empower workers to access new forms of work in new and more flexible manner (Vein, 2013). The emerging bamboo technologies have come up with new markets in areas of building boards (2ply, 3ply, 4ply among others), flooring, toothpicks, chopsticks, household furniture, bicycle construction to mention but a few. The International Network for Bamboo and Rattan (2002) positioned that there need to be a shift in methods of bamboo fabrication from the traditional use of hand tools and manual labour to the use of power tools for mass production of bamboo products such as toothpick. To achieve this, processing procedure and equipment handling skills among others need to be carefully selected, learned and established. The researchers hereby envisage a lucrative business opportunity for the teeming unemployed youths if they are appropriately empowered with necessary production skills. This therefore informed the researchers' decision to investigate the skills empowerment strategies and technological innovation in bamboo processing for job creation among university students in Akwa Ibom state.

Statement of Problem

Daily Trust (2019) published an article which revealed that Nigeria spent N26m importing toothpick from china and Germany in the last three years. This is despite the inclusion of toothpicks on the dollar access prohibition list by the Federal Government within the same period. The Federal government of Nigeria emphasized that toothpicks could be produced locally so there was no need spending foreign exchange importing them. Data sourced from the National Bureau of Statistics (NBS) showed that Nigeria imported wooden toothpicks worth N11.46million from China 2016. This value excluded the

amount spent on the import of rubber toothpicks which are not too popular among Nigerians. In 2016, Nigeria spent N166.979million on wooden toothpick imports from Germany in the third quarter of last year. It is an irony that despite the teeming graduates in the country without jobs, Nigeria as a country still spends whooping hundreds of million of naira to strengthen the economy of developed countries by importing such goods as toothpicks which can be mass produced locally while its youths languish in poverty. It is not clear what will happen to the economy of this country if such importation continuous.

Furthermore, Nigeria turns out thousands of graduates from universities, polytechnic, monotechnics and other tertiary institutions across the country without corresponding absorption of same into the world of work. Infinitesimally few get employed into the civil service and private sectors, leaving out a vast majority who wonder all over the country in search for menial jobs. It is the view of the researchers that if no deliberate efforts are put in place to empower students with trending technological innovative skills, the future of the youths and by extension, the country's economy might be in jeopardy.

This study determined the skills empowerment strategies and technological innovations in bamboo processing for job creation among university students in Akwa Ibom state. Specifically, the study determined:

1. the processing procedure in bamboo fabrication for job creation
2. the requisite equipment manipulative skills in bamboo fabrication for job creation.

Research Questions

1. What are the processing procedure in bamboo fabrication for job creation
2. What are the requisite equipment manipulative skills in bamboo fabrication for job creation

Null Hypotheses

$H0_1$: There is no significant difference in the mean responses of lecturers and Technicians on the processing procedure in bamboo fabrication for job creation

$H0_2$: There is no significant difference in the mean responses of lecturers and Technicians on the requisite equipment manipulative skills in bamboo fabrication for job creation

Methodology

The study adopted the descriptive survey design. The choice of a descriptive survey method was borne from the fact that it focuses on people and their attributes which will help the researcher to understand and explain the technological innovation for bamboo processing.

The study was conducted in Akwa Ibom State. The population of the study consists of all the 38 lecturers and technologists drawn from Industrial Technical Education Department, University of Uyo, Akwa Ibom state Polytechnic, Ikot Osurua as well as the

Department of Technical Education, College of Education, Afaha Nsit. There was no sampling hence; the entire population was used for the study.The researchers developed a structured questionnaire titled "Technological Innovation for Bamboo Fabrication Questionnaire (TIBFQ)" for data collection. Face validition of the instrument was carried out by three research experts in the Department of Industrial Technical Education, University of Uyo, The validated instrument was administered on 10 lecturers in other units of Vocational Education Departments who were not part of the study and Cronbach's Alpha reliability technique was adopted to determine the reliability of the instrument. A reliability coefficient of 0.78 was obtained indicating that the instrument was reliable.

Analysis and Results

Research Question 1: What are the processing procedure for bamboo fabrication for job creation among university students in Akwa Ibom state?

Table 1: Mean and Standard Deviation of responses of lecturers and technologists on the processing procedure in bamboo fabrication for job creation *(N = 38)*

S/N	Procedure for bamboo fabrication	$\bar{X}$	SD	Dec.
1.	Selection of bamboo species suitable for a desired product	4.42	0.50	SA
2.	Selection of proper machines/equipment for a desired product	4.08	0.71	SA
3.	Identifying process layout of product making	3.24	1.40	A
4.	Basic knowledge of bamboo cultivation	4.32	0.53	SA
5.	Application of various methods of bamboo treatment	4.05	0.87	SA
6.	Knowledge of safety in bamboo work	4.16	0.55	SA
7.	Knowledge of various joints	4.03	0.79	SA
8.	Knowledge of uses of various joints	4.25	0.92	SA
9.	Method of colouring bamboo	4.13	0.81	SA
10.	Knowledge of bending, buffing, polishing of bamboo	4.18	0.56	A
11.	Knowledge of making various jigs/fixtures for uniformity of product	3.89	0.10	A
12.	Knowledge of transportation of product	4.26	0.45	SA
13.	Concept of sales and services	4.53	0.51	SA
14.	Calculation of cost of finished bamboo product	4.34	0.58	SA
	Cluster Mean	**4.14**		**SA**

Data in Table 1 indicates that the Mean responses of Technical Education lecturers and technologists on the processing procedure in bamboo fabrication for job creation ranged between 4.03 and 4.53 with a cluster mean of 4.14 and the Standard Deviation values ranged between 0.10 and 1.40. The results show that Technical Education lecturers and technologists strongly agreed on 11 items and agreed on three items listed in Table 1 as procedure for bamboo fabrication. The low values of Standard Deviation indicate that the responses of lecturers and technologists were not far from the mean score. This implies that Technical Education lecturers and technologists strongly agreed that the items listed

are the basic procedure for bamboo fabrication. It is concluded that all items listed in Table 1 are the basic procedures for bamboo fabrication.

Research Question 2: What are the requisite equipment manipulative skills in bamboo fabrication for job creation?

Table 2: Mean and Standard Deviation of responses of technical education lecturers and technologists on requisite equipment manipulative skills in bamboo fabrication for job creation ***(N = 38)***

B.	Requisite Equipment Skills for Bamboo Fabrication are:	$\bar{X}$	SD	Dec.
15.	Round bamboo cross cutting using machine	4.21	0.53	SA
16	Bamboo splitting skill using machine	4.08	1.10	SA
17	Bamboo slicing using machine	4.08	0.91	SA
18	Square stick making using machine	4.45	0.56	SA
19	Round stick polishing using machine	4.32	0.53	SA
20	Stand drilling using machine	4.05	0.87	SA
21	Turning using machine	4.16	0.55	SA
22	Product spraying using machine	4.03	0.79	SA
23	Bamboo treatment skills	4.26	0.92	SA
24.	Bamboo drying skills using furnace	4.13	0.81	SA
25.	Hot pressing skills using machines	4.08	0.91	SA
26.	Edge sanding skills	4.45	0.56	SA
27.	Skills in safe handling of machines and tools	4.32	0.53	SA
28.	Veneer assembly skills	4.05	0.87	SA
	Cluster Mean	**4.19**		**SA**

Data in Table 2 indicates that the Mean responses of Technical Education lecturers and technologists on the requisite equipment manipulative skills in bamboo fabrication for job creation ranged between 4.05 and 4.45 with a cluster mean of 4.19 and the Standard Deviation values ranged between 0.53 and 1.10. The results show that Technical education lecturers and technologists strongly agreed on all the listed items in Table 2 as requisite equipment manipulative skills for bamboo fabrication. The low values of Standard Deviation on Table 2 indicate that the responses of lecturers and technologists were not far from the Mean score. This implies that Technical Education lecturers and technicians strongly agreed on the items listed as the requisite equipment manipulative skills for bamboo fabrication. It is concluded that all items listed in Table 1 are the requisite equipment manipulative skills for bamboo fabrication.

Null Hypothesis 1: There is no significant difference in the mean responses of lecturers and Technicians on the processing procedure in bamboo fabrication for job creation

Table 3: Summary of t-test analysis of Lecturers and Technologists' opinion on the processing procedure in bamboo fabrication for job creation *($N_1 = 27$, $N_2 = 11$)*

S/N	Procedure for Bamboo Fabrication	Lecturers $\bar{X}$	Lecturers SD	Technicians $\bar{X}$	Technicians SD	p-value	Dec.
1	Selection of bamboo species suitable for a desired product	4.52	0.51	4.18	0.41	0.14	NS
2	Selection of proper machines/equipment for a desired product	4.19	0.56	3.82	0.98	0.27	NS
3	Identify process layout of product making	3.22	1.40	3.27	1.49	0.92	NS
4	Basic knowledge of bamboo cultivation	4.37	0.57	4.18	0.41	0.26	NS
5	Methods of bamboo treatment	4.00	0.96	4.18	0.63	0.49	NS
6	Knowledge of safety and in bamboo work	4.19	0.62	4.09	0.32	0.54	NS
7	Knowledge of various joints	4.04	0.94	4.00	0.00	0.84	NS
8	Uses of various joints	4.33	1.04	4.09	0.54	0.35	NS
9	Method of colouring bamboo	4.33	0.56	3.64	1.12	0.07	NS
10	Knowledge of bending, buffing, polishing of bamboo	4.30	0.54	3.91	0.54	0.06	NS
11	Knowledge of making various jigs/fixtures for uniformity of product	3.78	1.19	4.18	0.60	0.76	NS
12	Knowledge of transportation of product	4.30	0.47	4.18	0.41	0.46	NS
13	Concept of sales and services	4.56	0.51	4.45	0.52	0.59	NS
14	Calculation of cost of finished bamboo product	4.37	0.63	4.27	0.47	0.60	NS

Summary of t-test analysis of Technical Education lecturers and technicians' opinion on the processing procedure in bamboo fabrication for job creation in Table 3 shows that the observed p-values of all the items are greater than 0.05 level of significance. This indicates that the t-test analysis of all the items are not significant. Therefore, the null hypothesis which states that there is no significant difference in the Mean responses of Technical Education lecturers and Technologists on the processing procedure and technological innovations in bamboo fabrication for job creation is retain.

Null hypothesis 2: There is no significant difference in the Mean responses of lecturers and technologists on the requisite equipment manipulative skills in bamboo fabrication for job creation

Table 4: Summary of t-test analysis of Lecturers and Technologists' opinion on the requisite equipment manipulative skills in bamboo fabrication for job creation ($N_1 = 27$, $N_2 = 11$)

S/N	Requisite Equipment Skills for Bamboo Fabrication	Lecturers $\bar{X}$	Lecturers SD	Technicians $\bar{X}$	Technicians SD	p-value	Dec
15	Bamboo cross cutting using the sawing machine	4.22	0.58	4.18	0.41	0.81	NS
16	Bamboo manual splitting using various knives	4.07	1.11	4.09	1.14	0.97	NS
17	Bamboo slicing using machine	4.15	0.87	3.91	1.04	0.51	NS
18	Square stick making using machine	4.44	0.57	4.45	0.52	0.96	NS
19	Round stick polishing using machine	4.37	0.57	4.18	0.63	0.41	NS
20	Stand drilling using machine	4.00	0.96	4.18	0.60	0.49	NS
21	Turning using machine	4.19	0.62	4.09	0.30	0.54	NS
22	Product spraying using machine	4.04	0.94	4.00	0.00	0.84	NS
23	Bamboo treatment skills	4.33	1.04	4.09	0.54	0.35	NS
24	Bamboo drying skills using furnace	4.33	0.56	3.64	1.12	0.07	NS
25	Hot pressing skills using machines	3.15	0.86	3.91	1.04	0.06	NS
26	Edge sanding skills	4.44	0.58	4.45	0.52	0.96	NS
27	Skills in safe handling of machines and tools	4.37	0.57	4.18	0.41	0.26	NS
28	Veneer assembly skills	4.00	0.96	4.18	0.60	0.49	NS

Data presented in Table 4 shows a Summary of t-test analysis of Technical Education lecturers and technologists' opinion on the requisite equipment manipulative skills in bamboo fabrication for job creation. The result reveals that the observed p-values of all items in Table 4 are greater than 0.05 level of significance. Therefore, the null

hypothesis which states that there is no significant difference in the Mean responses of lecturers and technologists on the requisite equipment manipulative skills and technological innovations in bamboo fabrication for job creation is retained.

Discussion of Findings

This study reveals 14 processing procedure and technological innovation in bamboo fabrication for job creation. This include selection of bamboo species suitable for a desired product, selection of proper machines/equipment for a desired product, identifying process layout of product making, basic knowledge of bamboo cultivation, application of various methods of bamboo treatment, knowledge of safety in bamboo work, knowledge of various joints, method of colouring bamboo, knowledge of bending bamboo, buffing, polishing of bamboo, knowledge of making various jigs/fixtures for uniformity of product, knowledge of transportation of product, concept of sales and services and calculation of cost of finished bamboo product. The study also reveals that Technical Education lecturers and technicians did not differ in their opinion on processing procedure and technological innovation for job creation. This finding is in line with that of Kebede (2018) whose finding revealed that certain basic procedures and traditional wisdom of bamboo processing in the locality and the possibility to learn from best practices of bamboo handicraft processing at global level are the opportunities which would be helpful to develop skills in this sector. This finding is also supports an earlier work carried out by Paudel (2001) who listed the following as bamboo processing procedures: Bamboo selection, cross cutting, splitting, conversion to strips, removal of outer/inner nodes, splitting strips into slivers, curtain weaving, drying, PF adhesive dipping, air drying, assembling hot-pressing and trimming.

This study also found 14 equipment manipulative skills required for bamboo fabrication, this include: bamboo cross cutting using the sawing machine, bamboo manual splitting using various knives, bamboo slicing using machine, square stick making using machine, round stick polishing using machine, stand drilling using machine, turning using machine, product spraying using machine, bamboo treatment skills, bamboo drying skill using furnaces, hot pressing skill using machines, edge sanding using machines, skills in safe handling of machines and veneer assembly skills. The study also reveals that Technical Education lecturers and technicians did not differ in their opinion on requisite equipment manipulative skills and technological innovation for job creation.This finding is in line with that of Nugroho and Ando (2001) who investigated a technique to process laminated bamboo lumber (LBL), the procedure, among others were crushing of Moso bamboo culms using roller press crushers to create zephyr strand mats, hot pressing in order to achieve dimensional stability, dipping specimen in hot water, passing the mat through a planner to remove inner and outer layers that contain wax and silica.

Educational Implication of the Findings

The findings of this study imply that basic processing procedure and requisite equipment manipulative skills for successful bamboo fabrication are expedient. Technical Education students need to learn and acquire the skills involved in the used of various machines and fabrication of bamboo into various products ranging from toothpick to laminated veneer. It also implies that ignorance of bamboo fabrication procedure and requisite equipment manipulative skills can mar students' ability to create jobs for themselves and vice-versa.

Conclusion

Based on the findings of this study, it concluded that when students acquire adequate knowledge on bamboo cultivation, fabrication procedure and develop all requisite equipment manipulative skills, they will be able to create job for themselves and others which will translate to wealth creation and poverty eradication in Akwa Ibom state and the country at large.

Recommendations

1. The lecturers, technologist and technicians should engage the students in active participation in bamboo processing procedure/activities for skills acquisition in bamboo fabrication for self-reliance
2. The students should be properly trained to master the equipment operating skill and technological innovations in bamboo fabrication to job creation
3. All tiers of government and educational stakeholders should improvise means of acquiring requisite equipment for bamboo fabrication in Nigeria
4. State government should facilitate and encourage the planting/cultivation of bamboos for sustainability of bamboo industry in Akwa Ibom state.

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