

A Comparative Study of Undergraduate Chemistry Students' Performance on Soap Production in North Central Nigeria, Using a Developed Entrepreneurial Skill Training Package.

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Abstract. The study compared federal and state undergraduate chemistry students' entrepreneurial skills and performance in soap production using a developed entrepreneurial skill training package. It specifically compared the entire undergraduate chemistry students of Federal and State Universities in the North Central region of Nigeria on one hand and the B.Sc and B.Sc(Ed) students on another hand. The objective was to assess the students' ability to use the developed package successfully to produce soap and to compare their entrepreneurial skills in soap production. Two research questions and two hypotheses guided the study. The non – randomized post – test only quasi experimental design was employed to carry out the study. Two hundred and thirty six (236) students and sixty(60) Chemistry lecturers were purposively selected for the study. Two instruments – the undergraduate chemistry students' soap production package (UCSSPP) and chemistry lecturers' rating scale (CLRS) were developed and used. Data were analyzed using mean(\bar{X}) and t – test statistical tools. The results showed a significant difference($P=0.006$) between the mean scores of State and Federal University Undergraduate chemistry students who were trained using the developed entrepreneurial skill training package for soap production in favour of the State Universities. There was also a significant difference ($P =0.152$) between the mean scores of the B Sc and B.Sc(Ed) undergraduate chemistry students in both Federal and State Universities trained using entrepreneurial skill training package on soap production. The findings revealed that there was a significant difference between the mean scores of federal and state universities in favour of state universities. With respect to gender of federal universities there was no significant difference in the mean scores of entrepreneurial skills for soap production. It was therefore recommended among

others, that chemistry lecturers in both federal and state universities should teach both male and female chemistry entrepreneurially for its economic relevance.

1. Introduction

Chemistry is an important course taught in the Nigerian Universities. Of the science subjects, chemistry is a key subject upon which the bulk of the present technological breakthrough is built(Gongden,1998). Chemistry is the study of the composition, properties, uses and structure of matter(Aniodo & Eze, 2014). Eze(2012) described chemistry as a branch of science which enables learners understand what happens around them; Abubakar & Ashiru (2010) viewed chemistry as a physical science with immeasurable intrinsic and utility values in all spheres of human activities which leads to its inclusion in school curriculum. The study revealed that Chemistry plays a vital role in national development, yet there is evidence in literature that the objective of teaching chemistry in schools is yet to be attained (Aniodoh &Eze, 2014). According to Ezeliora, chemistry education has a crucial role to play in helping to find answers to various human and socio – economic problems as well as making the society more scientifically literate. The author stressed that chemistry is one of the school subjects students find difficult to understand, many students perceived chemistry as a body of isolated facts to be memorized, lacking relevance to reality (Ezeliora, 2009). The reason why chemistry is perceived as a difficult mistress is the way it is been delivered to students, chemistry is a practical subject and therefore it is activity oriented. Learning chemistry is by students doing it not been done for them (NRC 2012). Teaching chemistry entrepreneurially is student centred which focused on active learning with an intrinsic motivation of chemistry

brought to reality of life for economic relevance of chemistry.

Chemistry forms a basis of various careers which individual learners may train in for example, Medicine, Pharmacy, Medical Laboratory Science, Biochemistry, Microbiology, Geology, Mining engineering, Industrial Chemistry, Nursing Science and Technology, Agricultural Science, Engineering, Extractive industry, Manufacturing industry, Petroleum and Petrochemical industries forestry, Food processing and teaching services.

One of the purposes of chemistry teaching is to enable individuals to use scientific process skills in order to attain self – reliance (Delmang, 2014). Teaching chemistry entrepreneurially to students to acquire skills to be self – reliant through their scientific process skills, ideas and the management abilities for self – employment rather than being employed will lead to value re – orientation, poverty eradication, job creation, wealth generation. The University education can be defined as education students received after secondary education at the tertiary stage. The main aim is to prepare the individuals for useful living within the society. The Universities in Nigeria are managed by the Federal government, State government and Private organizations. Each of the 36 states and the Federal Capital Territory has at least one Federal and State Governments' University funded and managed partially by the Federal government through the Ministry of Education. Admission into these Universities is based on merit determined by the Universities' requirement in addition to the general requirement in addition to the general requirements of the University Unified Tertiary Matriculation examination and direct entry.

Saponification (soap making) is a topic that runs from SS 1 curriculum for third term to the university level of education. The process of saponification (soap making) could be explained to students but they can not grasp or understand the concept and develop so much interest as the way it could be delivered to them entrepreneurially. Since entrepreneurship has become a global and unavoidable issue. The idea of becoming an entrepreneur is more and more attractive to students, because it is seen as a valuable way of participating in the labour market without losing one's independence (Aurora, 2008). In the view of Rinji (2013), entrepreneurship education has become an important phenomenon in the lives of Nigerians and institutions of learning. Therefore, Universities have

seen the need to include entrepreneurship in their curriculum. Regarding this the researchers opined that entrepreneurship education in chemistry is that which will help learners to redirect their minds towards the world of business and independence, increase innovative and creative spirit thereby increasing the number of employers than employees as well as ensuring stable national economic growth development and sustainability.

2. Statement of the Problem

At the university level of education, the 400 level undergraduate chemistry students are required to display a high level of chemical knowledge prowess, be able to effectively apply what they have learned theoretically in the class for self – reliance. However, research evidences have shown that formal education in Nigeria has not provided school learners with functional education (i.e education for self – reliance) rather, it has continued to turnout half – baked graduates with mere certificates which are not justified by such graduates in most labour markets and industries.

Chemistry which should be taught using hands – on and minds – on (practical) approach is based taught theoretically which makes the learner not to benefit maximally from their education. It was also revealed that (Udofia & Ekong, 2014) understanding of the principles and applications of knowledge gained for cognitive growth as well as technological advancement, hence development of useful skill necessary for self – reliant living is lacking. Beside this, teaching of chemistry theoretically to students is difficult because they are likely to complain that "theory is boring! Lectures are boring! School is boring! And so everything in the chemistry lecture becomes irrelevant. The purpose of teaching chemistry should be to assist the students to become skilled and self – employed.

The present trend of mass unemployment in Nigeria shows that the science education being taught in schools do not prepare Nigerian graduates to function well in the nation undergoing transition from rural economy to modern economy (Nwachukwu, 2009). The researcher further observed that the lack of skills occasioned by absence of training modules by teachers, thus, the concern of this research was to develop a module that would be used in the teaching and learning of chemistry to enhance the chemical entrepreneurial skills of graduates or youth so that they can acquire the right entrepreneurial habits, attitudes and saleable skills with

which they can explore their environments as means of surviving the face of unemployment.

3. Purpose of the Study

The objective of the study was to assess undergraduate chemistry students' ability to use a developed entrepreneurial skill training package to produce soap successfully. It also aimed at assessing their entrepreneurial skills.

Specifically, the study was carried out to:

- (i) Compare Federal and State Universities undergraduate chemistry students' performance in soap production using a developed entrepreneurial skill training package.
- (ii) Compare B.Sc and B.Sc(Ed) undergraduate chemistry students' performance in soap production using a developed entrepreneurial skill training package.
- (iii) There is no significant difference between the mean scores of the female federal university undergraduate chemistry students' and their counterpart in the state university who were trained using the developed entrepreneurial skill training package on soap production.

4. Research Questions

The study was guided by the following research questions:

- (i) What are the mean scores of federal undergraduate chemistry students compare to state undergraduate chemistry students in soap production using a developed entrepreneurial skill training package?
- (ii) What are the mean scores of B.Sc and B.Sc(Ed) undergraduate chemistry students trained using the entrepreneurial skill training package?

5. Research Hypotheses

- (i) There is no significance difference between the mean scores of state and federal university undergraduate chemistry students who were trained using a developed entrepreneurial skill training package for soap production.
- (ii) There is no significant difference between the mean scores of B.Sc and B.Sc(Ed) undergraduate chemistry students who were trained using a developed entrepreneurial skill training package for soap production.

6. Methodology

The study employed the non – randomized post – test only quasi experimental design. A sample of 296 undergraduate chemistry students and 60 chemistry lecturers from four North central Nigerian Universities was drawn from the lecturer, students' population of 1,640. The researchers developed two instruments known as chemistry lecturers' questionnaires (UCSSPP) and chemistry lecturers' rating scale (CLRS) were used for data collection. The instruments were validated by five experts from the Department of Chemistry and Science Education University of Jos and University of Agriculture Makurdi. The instrument were pilot tested using Cronbach Alpha formula(α) which yielded a coefficients of 0.87 and 0.83. The developed entrepreneurial skill training package was developed by the researchers on soap production. The treatment lasted two days during which data were also collected at various intervals using CLQ and CLRS. The data collected were analyzed using mean and standard deviations to answer the two research questions and the two hypotheses were tested at 0.05 level of significance.

8. Results

Research Question 1

What are the mean scores of Federal undergraduate chemistry students compare to state undergraduate chemistry students in soap production using a developed entrepreneurial skill training package?

Table 1: Comparison of the mean Scores of Federal and State Undergraduate Chemistry students' Entrepreneurial Skills For Soap production(ESSP)

S/N	ITEM	Mean $\bar{X}_{1(\text{State})}$	$\bar{X}_{2(\text{Federal})}$	REMARK Federal	State
1	Ability to measure the mass of caustic soda accurately	2.44	2.96	Low performance	Moderate performance
2	Ability to measure the concentration of chemicals during soap production	2.55	2.84	Moderate performance	Moderate performance
3	Ability to measure the concentration of chemicals during soap production	2.83	4.29	Moderate performance	High performance
4	Ability to prepare the standard solution of the substances accurately	2.84	2.72	Moderate performance	Moderate performance
5	Ability to measure the mass of caustic soda and soda ash accurately	2.73	4.25	Moderate performance	High performance
6	Ability to dissolve soda ash appropriately	3.50	3.83	Moderate performance	Moderate performance
7	Ability to dilute substances accurately	2.83	4.06	Moderate performance	High performance
8	Ability to take safety measures	3.20	4.06	Moderate performance	High performance
9	Ability to dissolve caustic soda appropriately	2.60	3.84	Moderate performance	Moderate performance
10	Ability to locate regulate supply or raw materials	3.31	3.78	Moderate performance	Moderate performance
11	Ability for good record keeping for soap production	2.26	3.61	Low performance	Moderate performance
12	Ability to manage crisis during soap production	2.00	2.86	Low performance	Moderate performance
13	Ability for self – motivation to accomplish the task for soap production	3.20	2.83	Moderate performance	Moderate performance
14	Ability for self – motivation to accomplish the task for soap production	2.90	3.65	Moderate performance	Moderate performance
15	Ability to identify and procure appropriate equipment and chemicals for soap	3.90	2.80	Moderate performance	Moderate performance
16	Ability to package the soap product very well	2.30	3.48	Low performance	Moderate performance
17	Knowing the need to register with regulatory body like NAFDAC	3.11	4.00	Moderate performance	High performance
18	Ability to estimate the cost of soap production	2.30	2.52	Low performance	Moderate performance
19	Ability to establish and sustain quality standards	2.63	3.68	Moderate performance	Moderate performance
20	Ability to identify market for the products	2.61	2.60	Moderate performance	Moderate performance
21	Ability to determine the PH values of the acid solutions	3.19	4.12	Moderate performance	High performance
22	Ability to take precaution during soap production	3.92	4.53	Moderate performance	High performance
23	Ability to identify perfumes that can react to heat and caustic soda	3.20	2.44	Moderate performance	Low performance
24	Ability to mix chemicals during soap production	3.19	4.06	Moderate performance	High performance
25	Ability to package the soap product very well	3.92	4.06	Moderate performance	High performance
26	Ability to identify and procure appropriate equipment and chemicals for soap production	3.20	4.20	Moderate performance	High performance
27	Ability for self – motivation to accomplish the task for soap production	3.20	3.82	Moderate performance	Moderate performance
28	Ability to manage crisis during soap production	3.12	3.50	Moderate performance	Moderate performance

Data from Table 1 revealed that all the 28 items on entrepreneurial skill for soap production were demonstrated by undergraduate Chemistry students in soap production. The mean scores of undergraduate Chemistry students by their lecturers ranged from 2.00 – 4.53.

Hypothesis 1

There is no significant difference between the mean scores of state and federal university undergraduate chemistry students who were trained using entrepreneurial skill training package for soap production.

Table 2: Independent sample t – test analysis for federal and state university undergraduate chemistry students on soap production module.

Independent variables	N	Mean	Std Dev	DF	T – cal	P – value
Federal university	166	63.09	10.16	234	-1.21	0.006
State university	70	67.27	11.53	122.72	-2.63	
Total	236					

From table 2, the result shows that p-Val (0.006) is less than 0.05 level of significance. It is also revealed that federal university undergraduate chemistry students and state university undergraduate chemistry students needed this equally and hence both groups put in as much zeal towards what was taught. It was revealed that there was significant difference between the skills and competence acquired by federal and state university undergraduate chemistry students in favour of State universities. Based on the result, the null hypothesis was rejected.

Research Question 2

What are the mean scores of B.Sc and B.Sc(Ed) university undergraduatry Chemistry students who were trained using the entrepreneurial skill training package developed in soap production?

Table 3: Comparison of the mean Scores of B.Sc and B.Sc(Ed) Undergraduate Chemistry students' Entrepreneurial Skills For Soap production(ESSP)

S/N	ITEM	Mean $\bar{X}_{(B.Sc)}$	$\bar{X}_{B.Sc(Ed)}$	REMARK B.Sc	B.Sc(Ed)
1	Ability to measure the mass of caustic soda accurately	2.54	2.96	Moderate performance	Moderate performance
2	Ability to measure the concentration of chemicals during soap production	2.55	2.84	Moderate performance	Moderate performance
3	Ability to measure the concentration of chemicals during soap production	2.83	3.29	Moderate performance	Moderate performance
4	Ability to prepare the standard solution of the substances accurately	2.84	2.72	Moderate performance	Moderate performance
5	Ability to measure the mass of caustic soda and soda ash accurately	2.73	4.25	Moderate performance	High performance
6	Ability to dissolve soda ash appropriately	3.50	3.83	Moderate performance	Moderate performance
7	Ability to dilute substances accurately	4.83	4.06	High performance	High performance
8	Ability to take safety measures	4.20	4.06	High performance	High performance
9	Ability to dissolve caustic soda appropriately	2.60	3.84	Moderate performance	Moderate performance
10	Ability to locate regulate supply or raw materials	3.31	3.78	Moderate performance	Moderate performance
11	Ability for good record keeping for soap production	3.26	3.61	Moderate performance	Moderate performance
12	Ability to manage crisis during soap production	3.00	2.86	Moderate performance	Moderate performance
13	Ability for self – motivation to accomplish the task for soap production	3.20	2.83	Moderate performance	Moderate performance
14	Ability for self – motivation to accomplish the task for soap production	2.90	3.65	Moderate performance	Moderate performance
15	Ability to identify and procure appropriate equipment and chemicals for soap	3.90	2.80	Moderate performance	Moderate performance
16	Ability to package the soap product very well	3.30	3.48	Moderate performance	Moderate performance
17	Knowing the need to register with regulatory body like NAFDAC	4.11	4.00	High performance	High performance
18	Ability to estimate the cost of soap production	2.53	3.52	Moderate performance	Moderate performance
19	Ability to establish and sustain quality standards	2.63	3.68	Moderate performance	Moderate performance
20	Ability to identify market for the products	2.61	2.60	Moderate performance	Moderate performance
21	Ability to determine the PH values of the acid solutions	3.19	4.12	Moderate performance	High performance
22	Ability to take precaution during soap production	4.02	4.53	High performance	High performance
23	Ability to identify perfumes that can react to heat and caustic soda	2.53	2.54	Moderate performance	Moderate performance
24	Ability to mix chemicals during soap production	4.19	4.06	High performance	High performance
25	Ability to package the soap product very well	4.22	4.06	High performance	High performance
26	Ability to identify and procure appropriate equipment and chemicals for soap production	4.20	4.20	High performance	High performance
27	Ability for self – motivation to accomplish the task for soap production	3.20	3.82	Moderate performance	Moderate performance
28	Ability to manage crisis during soap production	3.12	3.50	Moderate performance	Moderate performance

Data from Table 3 revealed that all the 28 items on entrepreneurial skill for soap production were demonstrated by undergraduate Chemistry students in soap production. The mean scores of undergraduate Chemistry students by their lecturers ranged from 2.53 – 4.53 and were above the bench mark of 2.50. This showed that both B.Sc and B.Sc(Ed) students demonstrated high level of entrepreneurial skills during production as rated by their lecturers.

Hypothesis 2

There is no significant difference between the mean scores of the B.Sc and B.Sc(Ed) degree undergraduate Chemistry students who were trained using the entrepreneurial skill training package developed in soap production.

Table 4: Independents sample t-test analysis for B.Sc and B.Sc (Ed) degree undergraduate chemistry students on soap production module

Independent variables	N	Mean	Std Dev	df	t-cal	p-value
Chemistry B.Sc	153	49.61	8.96	231	-1.43	0.152
Chemistry B.SC (Ed)	83	53.31	4.86	13.132	-1.52	
Total	236					

From table 4, the result shows that p-Val (0.152) is greater than 0.05 level of significance. Based on the result, the null hypothesis was accepted. It was revealed that there is no significant difference between the skills and competences acquired by B.Sc and B.S (Ed) Undergraduate chemistry students.

Result on Table 4 indicates that learning took place and the B.Sc undergraduate chemistry students learned as much as B.Sc (Ed) undergraduate chemistry students. This reveals that if B.Sc and B.Sc (Ed) undergraduate chemistry students are engaged, with the right equipment, positive results would be achieved.

9. Discussion of Findings

The purpose of the study was to compare the skill acquisition of federal and state undergraduate chemistry students using a developed entrepreneurial skill training package in North central zone of Nigeria. The findings are discussed based on the two research questions and two hypotheses. The finding showed that state undergraduate chemistry students had higher entrepreneurial skills for soap production than the federal undergraduate chemistry students. The finding also showed that the mean rating scores of chemistry lecturers on undergraduate chemistry students' entrepreneurial skills on soap production (ESSP) was significantly higher than those of federal university. This finding corroborates the finding of Olasehinde and Olatoye (2014) who found that there is a significant difference between public and private (in this case, state and federal) in science achievement. One possible reason here is the fact that most state universities are treated like private universities and so, they are not only well equipped for teaching but are closely monitored by the proprietors (the state governments) than the poorly funded(equipped) Federal Universities. Nbioho and Daodu (2014) had earlier found out that skills are required for the development of entrepreneurial skill training module for planning fish breeding and hatching. Similarly Ekpedu and Ekubo (2011) also found out that skills are required for the development of entrepreneurial skill training module for farmers in fish production and marketing occupation. There was also a significant difference between the mean scores of the male and female undergraduate chemistry students in both federal and state universities trained using the draft entrepreneurial skill training module for paint production. The male undergraduate chemistry students performed better than their female counterparts. This finding is consistent with those of Eribe and Ande (2006) who had earlier found out there exists gender

difference or inequality in science achievement among science students all over the world. Dhindsa and Emran (2011) observed that most studies on gender difference report male dominance. Ezeudu, Gertrude, Chiaha, Anazor, Eze and Omeke (2015) reported that male students performed better than female students in chemistry tasks. Casey (2001) reported higher problem solving among males than female students. Onekutu (2002) had also found that male students performed better than females with an increasing gap in chemistry examination. This is due to the fact that females encountered problem solving difficulties more frequently than their male counterparts (Adesoji and Babatunde, 2008). Gongden (2015) reported that male chemistry students have better reasoning ability than female. The life – world experience and interaction of male students with the environment helped them visualize abstract idea than females. They therefore learn and do better in tasks that require high level of abstract thinking. Another reason is the fact that males are generally more enterprising and business oriented than females. The society places much responsibility on males than females such that anything that will lead a man to succeed financially will have his interest and attention.

The finding however, is contrary to that of Olorundare and Aderogba (2009) who found out that no significant difference occurred between male and female students' performance in chemistry. Kumar and Helgeson (2000) in a study on the effects of gender on computer – based chemistry problem solving using hyper equation on the macintosh computer platform reported no significant difference between male and female students. The finding on gender shows no significant difference in the mean rating scores of male and female undergraduate chemistry students trained using the developed entrepreneurial skill training package. This finding is in line with the finding of Olasehinde & Olatote (2014) and Hudson (2014) who found no significant difference between male and female students in science achievement ($t=0.678$ $p>0.05$), ($F(1,181)=15.9$ $P< 0.01$) respectively. A possible reason for this finding could be that, with the use of a developed entrepreneurial skill training package both male and female undergraduate chemistry students one provided with equal learning experiences that strengthened the development of the entrepreneurial skills in soap production.

10. Conclusion

Based on findings of the study, the researchers have concluded that the state undergraduate chemistry students performed better in soap production using the developed entrepreneurial skill training package than their counterparts from federal universities. The result also showed that, there is no difference in the performance of male and female undergraduate chemistry students in both federal and state universities.

11. Recommendations

The study recommended the use of the developed entrepreneurial skill training package for the teaching of undergraduate chemistry students in universities to enable them acquire entrepreneurial skills in soap production. It also recommended that graduates of chemistry from universities be given low interest loans by government to embark on production of soap and other chemical products that are useful and economically. Empowering undergraduate chemistry students should be encouraged to learn to use the developed entrepreneurial skill training package for soap production so as to be self-employed.

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