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Creativity and Process Skills for Self- Reliance Using Demonstration Approach of Teaching Chemistry

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ABSTRACT

This study investigated the effects of demonstration approach of teaching and creativity level of students on the acquisition of scientific process skills for self-reliance among senior secondary school 2 (SSS2) students in Ogu-Bolo local government area of Rivers State. It is a quasi-experimental design which used purposive random sampling technique to get 70 students each from two schools representing two experimental groups. Thus, 140 students made the sample size. Two research questions and two hypotheses guided the study. The instruments for data collection constructed by the researchers were creativity ability test (CAT) and science process skills acquisition test (SPSAT) made up of 30 and 40 items respectively. The instruments were validated by experts in science education and chemistry. Reliability coefficients of 0.75 and 0.82 were obtained using test-retest method. The two experimental groups were taught the concept of saponification with validated lesson notes using teacher demonstration approach (TDA) and student-teacher demonstration approach (STDA). The hypotheses were tested using t-test at $p<0.05$. The result implicates that the high, average and low creative ability students performed significantly better when taught using STDA as against when taught using TDA. The study recommended based on this finding that chemistry teachers should embrace student-teacher demonstration approach in teaching chemistry for self-reliance.

Keywords: *Approach, Creativity, Process skills, Self-Reliance, Saponification*.

1. INTRODUCTION

Creativity is the phenomenon whereby a person creates something new (products, a solution, a work of art, a novel, et cetera) that has some kind of value. What counts as ‘’new’’ may be in reference to the individual creator, or to the society or domains within which the novelty occurs [1]. What counts as valuable is similarly defined in a variety of ways. Scientific creativity is the ability to find new problems and formulate hypotheses [2]. It usually involves some addition to our prior knowledge, whereas artistic creation may give some new representation of life or feelings. One of the purposes of science education is to enable individuals to use scientific process skills in order to attain self-reliance. In other words, scientific creativity is the ability to define, observe, analyze, hypothesize, experiment, conclude, generalize, apply et cetera. Scientists use their creativity at every stage of research and so creativity has a supplementary role in many scientific processes [3].

[4] Considered flexibility and original thinking as central features of creativity. Flexibility is the ability not to be bound by an established approach after that approach is found deficient, whereas, originality can be defined as an answer which is rare, which occurs only occasionally in a given population.

Structure of scientific creativity is different from other creativities since it is concerned with creative scientific experiments; creative scientific problem finding and solving. It is a kind of ability which includes intellectual factors [3]. He further opined that, scientific creativity depends on scientific knowledge and skills. Hence, it should be a combination of static and developmental structure. The adolescent and the mature scientists have the same basic mental structure of scientific creativity but that of the later is more developed. [5] summarized the characteristics of scientific creativity as being sensitive to any problem, ability to produce new ideas which are technologically accepted, ability to wonder, understanding the world around, designing experiments, ability to solve problems, imagination, identifying difficulties, making predictions or hypothesizing.

Process skills are avenues that scientists utilize in arriving at scientific knowledge [6]. A scientific mind studies events before drawing conclusions. Hence, a scientific approach to problems will not drag traditional beliefs along. This is because such beliefs will distort the correct interpretation of the events. Science process skills include skills that every individual could use in each step of his/her daily life by being scientifically literate and increasing the quality and standard of life by comprehending the nature of science, Therefore, these skills affect the personal, social and global life of an individual [7]. These process skills are; observing, classifying, measuring, manipulating, counting, predicting, interpreting, formulating, modeling, inferring et cetera.

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Self reliance is having or showing confidence in one's own abilities [8]. In this context, the researchers define self-reliance as the ability of an individual to acquire skills and create job opportunities such that the individual is self employed and possibly becomes an employer instead of being an employee. Nigeria as a developing nation is filled with many secondary schools and tertiary institutions' graduates who are roaming the streets in search of non-existing white collar jobs. Hence, [9], [10] reiterate that self-reliance is a viable alternative strategy to "dependent development" and donor-led "structural adjustment" in developing countries. Sequel to this, self-reliance is considered not "merely a necessity but a matter of survival" [11]. The dwindling Nigerian economy has led to embargo on employment blamed on non-approval of national budget which in turn has given rise to the number of white collar job seekers thus resulting in an un-diminishing poverty level of the populace. It is against this background that self-reliance becomes a ready alternative.

Experience has shown that adequate and efficient uses of instructional materials enhance the teaching and learning of science. Hence, the methods adopted in the teaching of science subjects are essential ingredients for the smooth and successful acquisition of skills that lead to self-reliance. Thus, the study examined how students' creativity level and demonstration method of teaching enhance the acquisition of science process skills.

1.1 Objectives of the Study

The study specifically aimed at:

a. Investigating the acquisition of observational skills by students of high, average and low creativity level when taught using teacher-demonstration approach and those taught using student-teacher demonstration approach.
b. Comparing effects of approach and creativity level on the acquisition of manipulative skills using teacher-demonstration approach and student-teacher demonstration approach.

1.2 Research Questions

To achieve the objectives of the study, the following research questions were raised.

a. What is the difference in observational skills acquired by students of high, average and low creative ability when taught using teacher-demonstration approach and those taught using student-teacher demonstration approach?
b. What is the manipulative skills acquired by students of high, average and low creative ability when taught using teacher-demonstrative approach and those taught using student-teacher demonstration approach?

1.3 Research Hypotheses

Two null hypotheses were formulated for the study:

a. There is no significant difference in the observational skills acquired by students of high, average and low creative ability when taught using teacher-demonstration approach and student-teacher demonstration approach.
b. There is no significant difference in the manipulative skills acquired by students' creativity level when taught using teacher-demonstration approach and student-teacher demonstration approach.

2. METHODOLOGY

The study adopted quasi-experimental design. It involved only students in Senior Secondary School two (SSS2) and covered the concept of saponification (soap making). Emphases were laid on observational and manipulative skills during the demonstration. The study population was made up of all senior secondary School 2 chemistry students in Ogu-Bolo Local Government Area of Rivers State. Purposive random sampling technique was adopted to select two out of the five public schools in the study area. 70 students from each school represented the two experimental groups. Thus, the sample size is 140 students. Two research instruments developed by the researchers were used for the study. The instruments are Creative Ability Test (CAT) made up of 30 items adapted from [3] which measure the students' creativity level and Science Process Skills Acquisition Test (SPSAT) made up of 40 items were used to assess the observational and manipulative skills of the students. The following observational skills were considered in the study; ability to observe colour changes, proper colour identification (naming) while proper handling of apparatus is the main manipulative skill tested.

To ensure both face and content validity of the instruments, the tests were subjected to scrutiny by four experts; two from chemistry and two from science education. For reliability of the instruments, a test-retest method was applied by using thirty students outside the study. The data collected were analyzed using the Pearson-product moment correlation statistics, thus obtaining reliability coefficients of 0.75 and 0.82 for the CAT and SPSAT respectively. The researchers adopted a scoring grid of four (4) points in order to access the students' observational skills: 4 points-Very accurate, 3 points-Accurate, 2 points-Fairly accurate and 1 point-Not accurate. Each student was assessed on the spot for observational and manipulative skills during a practical section of soap making (saponification). The graduate

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chemistry teachers in both sample schools were trained by the researchers and were used as research assistants.

Two days later, a pre-test tagged creativity ability test (CAT) was administered to the two groups. After two (2) weeks, the same test was re-administered. The scores obtained from the pre-test were used to stratify the students in both groups into low, average and high creativity levels. After 2 days, the concept of saponification was taught by the research assistants in the respective schools as extra mural lesson for 4 days using the validated lesson notes prepared by the researchers. The science process skills acquisition test (SPSAT) was re-administered as post test on both groups after the practical section by the research assistants in the two schools under the supervision of the researchers. The data were analyzed using mean statistics and t-test.

Table 1: mean difference in observational skills acquired by students of high, average and low creativity ability when taught using teacher demonstration and student-teacher demonstration approaches.

APPROACH	CREATIVITY LEVEL	NO. OF STUDENTS (n)	PRETEST SCORES $\dot{X}_1$	POST TEST SCORES $\dot{X}_2$	MEAN DIFF $\dot{X}_2 - \dot{X}_1$	GAIN PERCENTAGE
TDA	High	22	52.6	73.5	20.9	28.44
	Average	32	56.6	67.5	10.9	16.2
	Low	16	53.4	69.5	16.1	23.2
STDA	High	16	50.3	73.1	22.8	31.2
	Average	40	53.6	73.5	19.9	27.1
	Low	14	50.4	70.4	20.0	28.4

Table 1 shows a mean gain percentages of 28.44, 16.2 and 23.2 for students with high, average and low creative abilities respectively when taught using teacher-demonstration, while the mean gain percentages for students taught using student-teacher demonstration approach are 31.2, 27.1 and 28.4 for students with high, average and low creativity levels respectively in the observational skills acquisition.

Table 2: mean difference in manipulative skills acquired by students of high, average and low creativity ability when taught using Teacher demonstration and student-teacher demonstration approaches.

APPROACH	CREATIVITY LEVEL	NO OF STUDENTS (n)	PRETEST SCORES $\dot{X}_1$	POST TEST SCORES $\dot{X}_2$	MEAN DIFF $\dot{X}_2 - \dot{X}_1$	GAIN PERCENTAGE
TDA	**High**	**22**	**54.1**	**65.3**	**11.2**	**17.2**
	Average	**32**	**52.4**	**70.0**	**17.6**	**25.1**
	Low	**16**	**49.0**	**64.1**	**15.1**	**23.6**
STDA	**High**	**16**	**52.4**	**72.1**	**19.7**	**27.3**
	Average	**40**	**50.1**	**73.1**	**23.0**	**31.5**
	Low	**14**	**53.3**	**73.5**	**20.2**	**27.5**
		$\sum n=140$				

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Table 2 shows a mean gain percentages of 17.2, 25.1 and 23.6 for students with high, average and low creative abilities respectively when taught using teacher-demonstration approach, while the mean gain percentages for students taught using student-teacher demonstration approach are 27.3, 31.5 and 27.5 for students with high, average and low creativity levels respectively in the manipulative skills acquisition.

Hypothesis 1:

There is no significant difference in the observation skills acquired by students' creativity level when taught using teacher- demonstration and student-teacher demonstration approaches.

2. What is the difference in manipulative skills acquired by students of high, average and low creative ability when taught using teacher-demonstration approach and those taught using student-teacher demonstration approach

2.1 Results

Research Question 1: What is the difference in observational skills acquired by students of high, average and low creative ability when taught using teacher-demonstration approach and those taught using student-teacher demonstration approach?

Table 3: t-test observational skills analysis of TDA and STDA on students' performance

Approach	No of students	Ẋ	SD	Df	t cal	t crit	Decision at P<0.05
TDA	70	69.83	4.30	138	2.492	1.960	Sig.
STDA	70	72.80	4.23				

Table 3 shows that t-cal (2.492) is greater than t-cri (1.960). This indicates a significant difference between STDA and TDA at df 138, p<0.05. Research hypothesis I is therefore rejected.

Hypothesis 2:

There is no significant difference in the manipulative skills acquired by students' creativity level when taught using teacher-demonstration and student-teacher demonstration approaches.

Table 4: t-test manipulative skills analysis of TDA and STDA on students' performance

Approach	N	Ẋ	SD	df	t cal	t crit	Decision at P<0.05
TDA	70	67.17	5.22	138	2.492	1.960	Sig.
STDA	70	69.89	3.80				

Table 4 shows that t-cal (2.492) is greater than t-cri (1.960). This indicates a significant difference between STDA and TDA at df 138, p<0.05. Research hypothesis II is hereby rejected.

3. DISCUSSION OF FINDING

Observational and manipulative process skills as strategies have been basic requirements in learning of science. The issue of its application in science teaching and learning of alkanoate chemistry was focused in this study. The result on table 1 shows that the students' level of acquiring both observational and manipulative skills irrespective of their creative levels was higher when taught using student-teacher demonstration approach than when taught using teacher-demonstration approach with the mean gain percentages of 28.4,16.2 and 23.2 for those taught with TDA and 31.2,27.1 and 28.4 for those taught with STDA, for observational skills acquisition and 17.2, 25.1 and 23.6 for those taught with TDA and 27.3, 31.5 and 27.5 for those taught with STDA for manipulative skill acquisition with different creative levels. A significant difference was found when student -teacher demonstration approach was used over teacher demonstration approach t-cal (2.913, and 2.492 at df 138, p<0.05).

The finding of this study is that students taught using student-teacher demonstration approach perform better than those taught using teacher-demonstration approach. So also, students' observational and manipulative skills were better enhanced when student-teacher demonstration was used. This finding is consistent with the findings of [12] which opined that students' participation in teaching-learning sequence promotes the acquisition of useful skills. This result is in agreement with the findings of [13] who established that acquisition of skills in science teaching is a determinant of the teaching method and materials used.

4. CONCLUSION

There is a significant difference in the mean observational and manipulative skills acquired by students of varying creativity levels when taught saponification reaction using teacher-demonstration and student-teacher demonstration approaches. The finding is that students

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achieve better when taught using student-teacher approach than when teacher-demonstration is used. So also are their observational and manipulative skills better enhanced through student-teacher demonstration approach? Hence, to achieve self-reliance through creativity and process skills, students should be actively involved in the course of instruction.

5. RECOMMENDATION

Sequel to the finding that both TDA and STDA have positive impact on chemistry students' acquisition of observational and manipulative skills with STDA having a greater impact, it is hereby recommended that chemistry teachers should embrace the use of demonstration approach in general and STDA in particular.

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