

Original Paper

Chemistry Students' Science Process Skills Acquisition: Influence of Gender and Class Size

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Abstract

Science process skills are central to the acquisition of scientific knowledge which is useful in problem solving in our immediate environment. In Nigeria, most secondary school students' performances in chemistry in the West Africa Senior School Certificate Examination (WASSCE) are generally low which could probably be attributed to lack or poor exposure to science process skills. The study therefore investigated the influence of gender, and class size on Chemistry students' acquisition of science process skills. The design adopted for the study was descriptive survey design. The sample comprised of 720 students drawn through multi-stage random sampling from Adamawa and Taraba States in Nigeria. The research instrument was Science Process Skills Knowledge Test in Chemistry' (SPSKTC). The study indicated that gender have negligible influence on students' acquisition of science process skills; while large class size have great influence on students' acquisition of science process skills. The study concluded that most students in Nigerian schools experience difficulty in the acquisition of science process skills. Based on the findings, it was recommended that there should be reduction of student-teacher ratio in schools and training of teachers on science process skills to enable teachers adopt methods that lead students to have the appropriate skills.

Keywords

Gender, class size, science process skills acquisition, chemistry students

1. Introduction

Students are to be made able to acquire scientific knowledge by the processes of thinking, analyzing and interpreting observed facts. A new approach capable of triggering the processes of thinking, analyzing and inferring in the students' mind is needed. Process approach is designed to attain these

objectives in teaching science. Process approach presents the instruction in science in an intellectually stimulating and a scientifically authentic way. Here, emphasis is given to the ways of acquiring knowledge rather than to the content. This is a shift from the traditional approach. As a result, outlook on different aspects of instructional practice in science teaching, the designing of instructional objectives and the instructional strategies have changed totally, as also the method of evaluating the results of these processes, i.e., the process outcomes of science teaching. Process approach demands that students utilize their intellect and apply their ability to engage themselves in thinking and reasoning more dynamically. What is actually attained by the process approach is that students are initiated into being scientific investigators themselves. It is also expected to help students become better consumers of scientific knowledge and also enable them to make original scientific contributions to science.

The process approach to teaching science is meant to foster inquiry and manipulative skills in students and discourage rote learning. This approach embraces other methods of science teaching and is mainly activity based, superior to those in which students are not actively involved in the learning process (Akinbobola, 2008). This has made the West African Examinations Council (WAEC) and other bodies that conduct Senior School Certificate Examination (SSCE) to stipulate that practical Chemistry should form the basis of teaching. During examination, practical Chemistry is also assessed separately. Currently, Chemistry being one of the science subjects taught in senior secondary schools is taught both in theory and in practical. In both internal and external examinations, practical Chemistry is assessed separately as an integral part of the subject and students are expected to have acquired certain science process skills on completion of the senior secondary school.

The new science curriculum worldwide stresses science process skills and places emphasis on the development of higher cognitive skills through the student-centred approach (Shulman & Tamir, 2004). This approach, according to Molitor and George (2001) develops the understanding of science process skills through participation of students in activities in science classrooms. Ogunnniyi (2000) opined that the relevance of acquisition of process skills in science teaching is that it involves students' in "doing science". The acquisition of process skills by "doing science" enables students to, understand the concepts of Chemistry, one of the key science subject easily.

Science as a practical subject provides students with an opportunity to interact with science process skills that can be used to solve problems in everyday life and contribute to national development (Abungu, Okere, & Wachanga, 2014). Science process skills are activities, which students carry out in scientific investigations to enable the acquisition of scientific knowledge and skills. Science Process Skills (SPS) are also defined as the adaptation of the skills used by scientists for composing knowledge, thinking about problems and drawing conclusion (Farsakoğlu, Sahin, Karsli, Akpınar, & Utlar, 2008). They are also the abilities each individual is supposed to possess in a science-based community as a science literate person (Temiz, 2007).

Science process skills acquisition refers to a variety of abilities that affect the acquisition, retention, understanding, organization or use of verbal and/or non-verbal information (Amanso & Bassey, 2017). Science process skills acquisition in a generic term refers to a heterogeneous group ability manifested in the acquisition and use of listening, speaking, reading, writing, reasoning, or mathematical abilities, or of social skills (Hallahan & Mercer, 2007). Ajunwa (2000) observed that science process skills have general commonality in all science subjects, serving as tools for information gathering, problem solving, decision making and adaptation. Science process skills are classified as basic (observing, measuring, classifying, collecting data and using number relationships), causal (predicting, identifying variables and drawing a conclusion) and experimental (formulating hypotheses, making models, experimenting, controlling variables and making a decision) (Ayas, Cepni, Ozmen, Yigit, & Ayyaci, 2007). All of these science process skills are complementary of each other, providing students opportunities to reach meaningful learning goals in science.

Science process skills also help in preventing the memorization of facts and developing negative attitudes in science (Temiz, 2007; Dirks & Cunningham, 2006). Science process skills have great influence on education because they help students to develop higher mental processes such as problem-solving, critical thinking and making a decision (Tan & Temiz, 2003; Koray, Koksall, Ozdemir, & Presley, 2007).

Science process skills are cognitive and psychomotor skills employed in problem solving. They are the skills which the sciences use in problem-identification, objective inquiry, data gathering, transformation, interpretation and communication. Science process skills can be acquired and developed through training such as are involved in science practical activities. They are the aspect of science learning which is retained after cognitive knowledge has been forgotten. Using science process skills is an important indicator of transfer of knowledge which is necessary for problem-solving and functional living. The knowledge of process skills in science is very important for proper understanding of concepts in science. Alfredo, Natale and Lombardi (2006) stated that process skills are fundamental to science, which allow everyone to conduct investigation and reach conclusions. They observed that there is a serious educational gap in this area, both in bringing these skills into the classroom and in the training of teachers to use them effectively.

The skills in qualitative and quantitative analysis cannot be completed without creativity. Practical work is not just putting the apparatus together when seen, but it needs planning, designing a problem, creating a new approach and procedure and also putting familiar things together in the new arrangement. This implies that the knowledge of creativity exhibited by candidates in any practical class helps them to manipulate some practical equipment. According to Giddings and Fraser in Akinbobola and Afolabi (2010), achieving the objectives of science practical work depends a lot on the mode of assessment of laboratory work adopted by teachers and examination bodies. According to them, the mode of assessment directly influences teachers' teaching methods, students' learning styles and attitudes towards practical activities.

The West African Examinations Council (WAEC) makes use of practical test/examination to assess students' acquisition of various Chemistry practical skills. In these tests, students are required to carry out certain Chemistry practical activities following given instructions. The scores of the students indirectly indicate the levels of Chemistry practical process skills they could demonstrate during the practical examination. This mode of assessment is also adopted by Chemistry teachers who prepare the students for Senior School Certificate Examination (SSCE). This mode of assessment influences the teaching methods adopted by teachers. Also, students' learning style is influenced in such a way that students always try to find certain correct responses or answers, irrespective of the procedures adopted. In North-Eastern part of Nigeria, secondary school students' performances in chemistry in the West Africa Senior School Certificate Examination (WASSCE) are generally low which could probably be attributed to lack or poor exposure to science process skills. Series of reports from the chief examiners of WAEC, 2007-2017 and that of Ochu (2007), and Jack (2013) showed that Chemistry students were deficient in interpreting data, descriptive ability, calculative ability, drawing inference and also in qualitative chemical analysis. It, therefore, follows that the trend is not improving even in recent years. Gender and class size are some of the major factors affecting the quality of learning and chemistry students acquisition of science process skills. Ukwungwu and Ezike (2000) have noted that many factors have been known to affect the academic performance of students in science and Chemistry in particular; and among these factors is the difference between boys and girls or gender. Akpokorie (2000) researched on the effects of sex on difficulties experienced by students in 15 process skills using 600 JSS3 integrated science students from schools in Delta State and the study revealed that; gender has no significant effect on the magnitude of difficulties experience by integrated science students on each of the 15 process skills. This finding also supports the that of Omajuwa (2011) who found that gender have no influence on students experienced difficulty in science process skills acquisition; contradicts the works by Afif and Majdi (2015) whose results of the study indicated that there were significant differences in science process skills due to gender in favour of the females. Commeyras (2003) reported that effective teaching seems impracticable for teacher educators having large class sizes of 50, 75, 100 or more. According to Ajaja (2010) very large class sizes, which exist in schools, have made healthy interactions between students and teachers almost non-existent. Most teachers hardly know their students by their names. The large class size has reduced individual student's attention during practical lesson. Students seeking special attention as a result of lack of clear instruction in practical lessons are hardly attended to. All these culminate in very poor performances of students in test of practical knowledge in final year examinations. A number of studies have looked at the influence of class size on a variety of teaching and learning issues. Class size was also identified by most respondents as a major hindrance for effective teaching and learning. Adeyela (2000) found that large class size is un-conducive for serious academic work. Also Afolabi (2002) found no significant relationship among the class size and students' learning outcomes. Chemistry requires getting the students involved, as most of the topics involve demonstration, if they could be well understood but

this becomes very difficult when the class is large. But, out these studies reviewed the influence of class size on students' science process skills acquisition was not investigated which called for urgent attention to the researcher.

Chemistry is taught in most schools as a bundle of abstractions without practical experiences. This has resulted to students' low acquisition of science process skills which has become more evident in the mass failure of students in the subject in public examinations. All the questions asked to test Chemistry students' knowledge in practical skills require that they demonstrate one form of process skill or the other. The inability of students to carry out these activities properly results in low scores in the test of practical knowledge. The basic science process skills are useful in science and non-science situations while the integrated skills are the working behaviour of scientists and technologists. Thus, both basic and integrated science process skills are relevant and appropriate for all science subjects, in particular Chemistry at the senior secondary schools. Hence, there is need to find out the level of acquisition of the process skills, and influence of gender and class size since process skills are very fundamental to science and there exists a serious educational gap in this area both in bringing these skills into the classroom. Therefore, the problem of this study is: "will assess of secondary school chemistry students' acquisition on science process skills help in bringing the process skills into the classroom and minimizing difficulty encountered by the students"?

The following research questions were raised to guide this study:

- 1) What specific basic and integrated science process skills do Chemistry students experience difficulty in acquiring?
- 2) Does gender influence Chemistry students' difficulty in science process skills acquisition?
- 3) Does class size influence Chemistry students' difficulty in science process skills acquisition?

The following research hypotheses were formulated for testing at the 0.05 level of significance:

Ho₁ There is no significant difference in the mean difficulty of chemistry students' scores between basic and integrated science process skills.

Ho₂ There is no significant difference in the mean difficulty of process skills scores between male and female Chemistry students.

Ho₃ There is no significant difference in the mean difficulty of process skills scores between Chemistry students in small-class size and in large-class size.

2. Method

The design adopted for the study is a descriptive survey design. The sampling technique used for the study was a multi-stage random sampling technique. The first stage was selection of 25 Local Government Areas (LGAs) that have senior secondary schools offering the basic science subjects from each of the three senatorial districts of Adamawa and Taraba states of Nigeria. The second stage was selection of 36 public schools from the 25 LGAs that have science laboratories and qualified chemistry teachers who had taught the subject for a minimum of 5 years to ensure that teachers' qualification and

experience does not confound the result of the study. The third stage was random sampling of 20 SS III Chemistry students from each of the 36 schools giving a sample size of seven hundred and twenty students. Out of this total number sampled 202 males and 196 females.

The research instrument that was used for this study is; Science process skills Knowledge Test in Chemistry (SPSKTC) which consisted of two sections: Section A which demanded personal information on the school and respondent (bio data) and Section B which consisted of 70 questions on 15 items which include 6 basic or lower skills (observing, classifying, measuring, communicating, recording, using number relationships) and 9 higher or integrated skills (hypothesizing, predicting, inferring, identifying/controlling variables, interpreting data, defining operationally, experimenting, manipulating, and building mental models). The SPSKTC was a test of knowledge on 15 Science process skills, having options A-D where students are expected to choose only one correct answer. Each correct answer was assigned 1 mark while the incorrect (wrong) answer was assigned 0 mark. The mean scores for each process skill by each student were collated by counting the number of students that experienced difficulty in process skills acquisition and expressed in simple percentages. Tests of skills involve testing the application of students' knowledge to problems or situations so as to assess the level of student knowledge in comparison to a particular competence which was 15 items or process skills. The test of knowledge on Science process skills covers both the basic and integrated skills and these were adapted from WAECSSCE Alternative to practical Chemistry past questions of 10 years.

The Science process skills Knowledge Test in Chemistry (SPSKTC) was subjected to both content and face validity by three experts in science education and two in test and measurement. Two Chemistry teachers who had taught this subject for more than eight years also helped in the validation of the instrument. The items were actually tested on a sample of the target population to determine the reliability. The items were pre-tested using 20 SS III Chemistry students in two randomly selected secondary schools in Adamawa and Taraba States. The data obtained was subjected to Kuder Richardson formula 21 to obtain the correlation value. A correlation coefficient of 0.78 was obtained which was considered adequate for this study.

After the administration of the SPSKTC, students' answers were collected and scored. The data collected were arranged and analyzed so as to answer the research questions and test the stated hypotheses. Descriptive statistics in terms of means, frequencies, percentages and standard deviation were used to analyze the response measures on SPSKTC. The level of difficulty of a particular process skill was determined by the value of the mean as follows: means scores less than 50 (<50) were classified as "Difficult", and means scores equal to or above 50 (≥ 50) as "Simple". Each student was scored on each of the science process skills before the individual scores were aggregated to form a composite means scores. The data collected were analyzed using means and t-test. The hypotheses were tested at 0.05 level of significance with t-test statistics which were calculated with SPSS (Statistical Package for Social Sciences) 16.0 version.

3. Result

Research Question 1:

What specific science process skills do Chemistry students experience difficulty in acquiring?

Table 1. Areas of Chemistry Students' Difficulty in Science Process Skills Acquisition

Type of Skills	Science Process Skills	N	Mean	Std. Deviation	Remarks
Basic Skills	Observing	720	26.7160	14.82931	Difficult
	Classifying	720	45.9349	19.66844	Difficult
	Measuring	720	53.6389	15.79009	Simple
	Communicating	720	38.8889	17.13528	Difficult
	Recording	720	38.9167	18.58540	Difficult
	Using Number Relationships	720	35.7939	20.79647	Difficult
	Formulating Hypotheses	720	36.9444	19.75080	Difficult
	Predicting	720	32.6736	16.60422	Difficult
	Inferring	720	28.7500	16.98297	Difficult
	Identifying/Controlling Variables	720	27.9824	15.44749	Difficult
Integrated Skills	Interpreting Data	720	44.1111	19.98021	Difficult
	Defining Operationally	720	42.8125	18.54138	Difficult
	Experimenting	720	37.9722	19.21402	Difficult
	Manipulating Techniques	720	51.0284	18.41318	Simple
	Building Mental Models	720	51.8619	18.92849	Simple

The analysis showed in Table 1 and Figure 1 revealed the specific science process skills that students experience difficulty in acquiring in this order: observing (26.72), identifying/controlling variables (27.98), inferring (28.75), predicting (32.67), using number relationships (35.79), formulating hypotheses (36.94), experimenting (37.97), communicating (38.89), recording (38.92), defining operationally (42.81), interpreting data (44.11), and classifying (45.93); while manipulating technique (51.03), building mental models (51.86) and measuring (53.64) as simple. Out of these 5 basic skills with mean scores of 39.98 and 7 integrated skills with mean scores of 39.35 were found difficult in acquiring by Chemistry students. Out of the 15 science process skills, 12 (80%) were found difficult by students in acquiring.

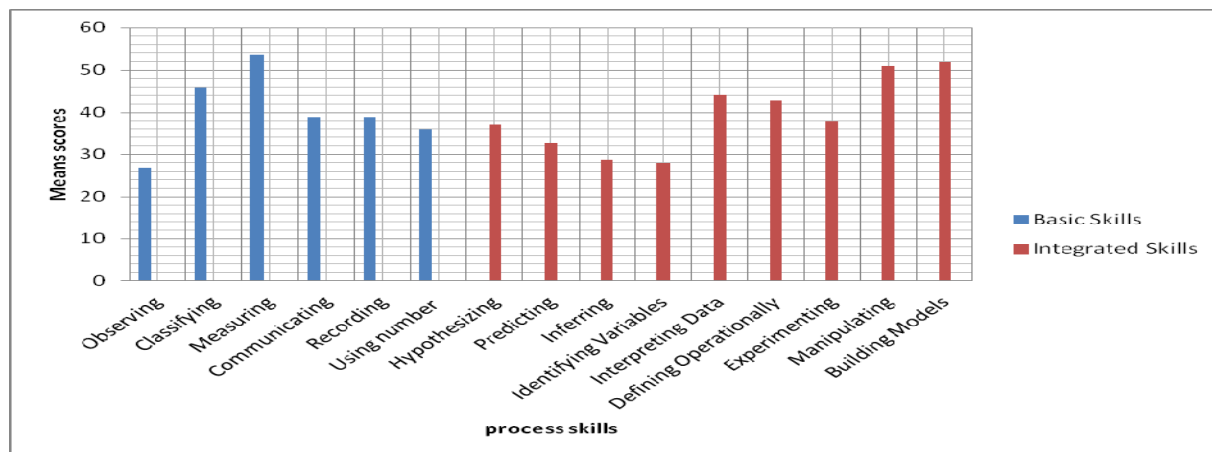


Figure 1. Areas of Chemistry Students' Difficulty in Science Process Skills Acquisition

Research Hypotheses 1:

There is no significant difference in the mean difficulty of chemistry students' scores between basic and integrated science process skills.

Table 2 was used to answer research hypothesis 2.

Table 2. T-Test Summary Table Comparing Mean Difficulty of Chemistry Students' Scores between Basic and Integrated Science Process Skills

Scores	Type of Skills	N	Mean	Std. Deviation	Df	t	α	$P \leq .05$	Decision
	Basic Skills	720	40.0020	19.77573	718	.483	0.05	.637	Not Significant
	Integrated Skills	720	39.3485	20.05593					

*Significant at $p \leq .05$ Decision=Not Significant at $p > 0.05$ level (H_0 Not rejected or Retained).

As indicated in Table 2 the t value for skills type is .483 not significant at $p = .637$: $p > 0.05$ level of significance; showing that the significant (2-tailed) is greater than 0.05 showing non-significant difference between students' difficulty in basic and integrated skills, hence the null hypothesis was retained. Thus the hypothesis 1, no difference between students' difficult in basic and integrated skills was not rejected.

Research Question 2:

Does gender influence Chemistry students' difficulty in science process skills acquisition?

The analysis showed in Table 3 and Figure 2 revealed that the total mean scores of the male students who experienced difficulty in science process skills acquisition was 42.20 while; the mean scores of the female students who experienced difficulty in science process skills acquisition was 40.40. Both males and females experienced insignificant difficulty in process skills acquisition. Also in Table 3, the t values for sex for the 15 process skills

are .637, .484, .458, .677, .635, .639, .638, .644, .637, .794, .553, .522, .528, .520 and .558 which are greater than; 0.05 level of significance. This shows that gender have negligible influence on students' difficulty in science process skills acquisition but was tested with hypothesis 2.

Table 3. Means Scores and T-Test Summary Table for Process Skills Difficulty Experienced by Male and Female Chemistry Students

Process skills	Gender	N	Mean	Std. Deviation	Df	T	α
Observing	Male	366	26.8269	14.682	718	.637	0.05
	Female	354	26.5590	14.831			
Classifying	Male	366	45.7285	19.817	718	.484	0.05
	Female	354	46.1483	19.539			
Measuring	Male	366	54.4262	16.736	718	.458	0.05
	Female	354	58.4746	19.482			
Communicating	Male	366	41.1202	19.401	718	.677	0.05
	Female	354	39.4068	18.362			
Recording	Male	366	39.2896	18.328	718	.635	0.05
	Female	354	38.4746	18.710			
Using number relationships	Male	366	38.5792	19.533	718	.639	0.05
	Female	354	38.4746	20.111			
Formulating hypotheses	Male	366	35.8470	19.023	718	.638	0.05
	Female	354	38.0791	20.441			
Predicting	Male	366	33.8115	17.038	718	.644	0.05
	Female	354	34.6751	16.935			
Inferring	Male	366	27.5273	16.305	718	.637	0.05
	Female	354	24.4350	3.817			
Identifying/Controlling variables	Male	366	27.1457	14.742	718	.794	0.05
	Female	354	29.0077	16.071			
Interpreting data	Male	366	43.9891	19.985	718	.553	0.05
	Female	354	44.2373	20.003			
Defining operationally	Male	366	43.0328	18.853	718	.522	0.05
	Female	354	42.5847	18.237			
Experimenting	Male	366	34.5355	18.921	718	.528	0.05

	Female	354	41.5254	18.891			
Manipulating techniques	Male	366	52.9246	18.360	718	.520	0.05
	Female	354	51.1621	18.464			
Building mental models	Male	366	53.7445	18.211	718	.558	0.05
	Female	354	52.9154	19.4778			

Total mean scores (Male)=42.20. Total mean scores (Female)=40.40.

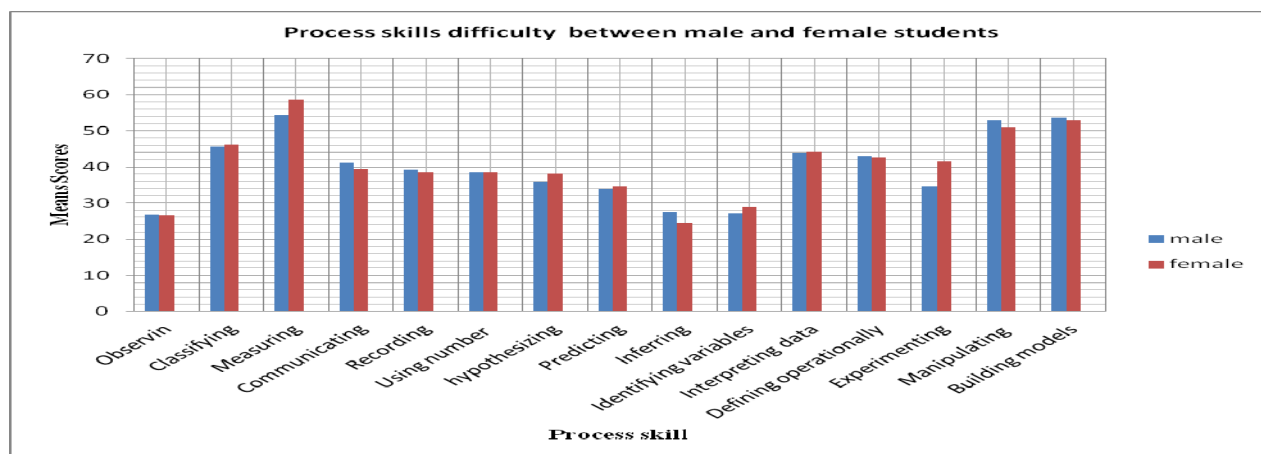


Figure 2. Process Skills Difficulty between Male and Female Students

Research Hypothesis 2:

There is no significant difference in the mean difficulty of process skills scores between male and female Chemistry students.

Table 4. T-Test Summary Table Comparing Process Skills Difficulty Experienced by Male and Female Chemistry Students

	Gender	N	Mean	Std. Deviation	Df	t	α	$P \leq .05$	Decision
Scores	Male	366	39.79	20.166	718	.731	0.05	.465	Not Significant
	Female	354	40.08	20.319					

*Significant at $p \leq .05$ Decision=Not Significant at $p > 0.05$ level (H_0 Not rejected or Retained).

In Table 4, the t-ratio for gender is .731 is not significant at $p = .465$: $p > 0.05$ level of significance; showing that the significant (2-tailed) is less than .05. The result showed that there was no significant difference in the mean difficulty process skills scores between male and female Chemistry students. Based on this, hypothesis two was not rejected.

Table 5. Means Scores and T-Test Summary Table for Process Skills Difficulty Experienced by Chemistry Students in Large Class and Small Class Sizes

Process skills	Class size	N	Mean	Std. Deviation	Df	t	α
Observing	Large	420	23.8937	12.75058	718	.000	0.05
	Small	300	36.6740	16.01602			
Classifying	Large	420	41.3177	18.79779	718	.001	0.05
	Small	300	52.3411	18.98985			
Measuring	Large	420	49.9048	15.60217	718	.003	0.05
	Small	300	58.8667	14.54030			
Communicating	Large	420	35.8333	17.49247	718	.000	0.05
	Small	300	47.8333	18.38747			
Recording	Large	420	30.7619	17.04663	718	.001	0.05
	Small	300	46.2667	18.45347			
Using number relationships	Large	420	34.7619	19.07629	718	.000	0.05
	Small	300	44.0667	19.58078			
Formulating hypotheses	Large	420	30.3333	17.00437	718	.000	0.05
	Small	300	46.8000	19.74147			
Predicting	Large	420	28.3929	12.76651	718	.001	0.05
	Small	300	39.5000	19.23930			
Inferring	Large	420	21.6667	13.40870	718	.002	0.05
	Small	300	32.8333	15.87384			
Identifying/Controlling variables	Large	420	25.4416	13.09896	718	.000	0.05
	Small	300	32.7288	17.47558			
Interpreting data	Large	420	38.9524	18.50879	718	.000	0.05
	Small	300	51.3333	19.75322			
Defining operationally	Large	420	39.2857	15.39346	718	.001	0.05
	Small	300	48.2500	17.79728			
Experimenting	Large	420	26.8571	13.70081	718	.000	0.05
	Small	300	54.2667	14.22921			
Manipulating techniques	Large	420	48.6604	18.44942	718	.002	0.05
	Small	300	56.4552	17.43564			

Building mental models	Large	420	49.0573	18.75935	718	.003	0.05
	Small	300	59.5667	16.84533			

Total mean scores (large class size)=35.01. Total mean scores (small class size)=50.80.

The analysis showed in Table 5 and Figure 3 revealed that the mean scores of students that are from large class sizes that experienced difficulty in acquiring Science process skills were 35.01; while the mean scores of students that are from small class sizes who experienced difficulty in acquiring Science process skills was 50.80. Table 5 also showed the t values for class size for the 15 process skills which are .000, .001, .003, .000, .001, .000, .000, .001, .002, .000, .000, .001, .000, .002 and .003 which are less than 0.05. This shows that class size have great influence on students' difficulty in Science process skills acquisition since the mean percent is significant; but was tested with H_0 .

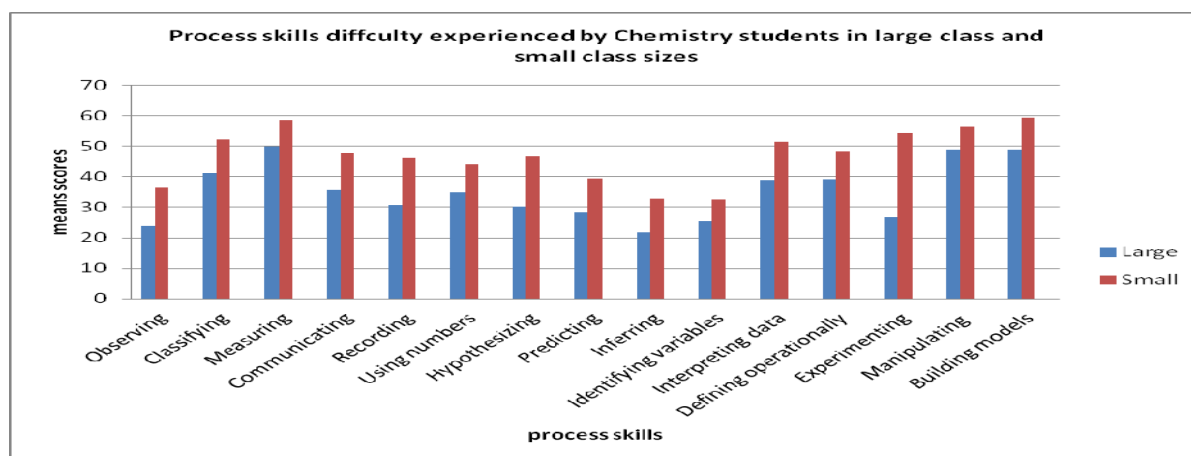


Figure 3. Process Skills Difficulty Experienced by Chemistry Students in Large Class and Small Class Sizes

Research Hypothesis 3:

There is no significant difference in the mean difficulty of process skills scores between Chemistry students in small-class size and in large-class size.

Table 6. T-Test Summary Table Comparing Process Skills Difficulty Experienced by Chemistry Students in Large Class and Small Class Sizes

	Class size	N	Mean	Std. Deviation	df	T	α	$p \leq .05$	Decision
Scores	Large	420	35.011	18.614	718	-30.500	0.05	.000	Significant
	Small	300	46.362	19.702					

*Significant at $p \leq .05$ Decision=Significant at $p < 0.05$ level (H_0 Rejected).

As indicated in Table 6, the t-ratio for class size is -30.500 at $p=.000$: $p<0.05$; showing that the significant (2-tailed) is less than .05 hence the null hypothesis H_0 was rejected. The result showed that there was a significant difference in the mean difficulty process skills scores between Chemistry students in small-class size and those in large-class size.

4. Research Findings

The results of the analysis showed that:

- i. 12 science process skills (80%) were found difficult by students in acquiring which includes: observing, identifying/controlling variables, inferring, predicting, using number relationships, formulating hypotheses, experimenting, communicating, recording, defining operationally, interpreting data, and classifying; with a total mean scores of 39.35 out of the 15 science process skills.
- ii. There was no significant difference in the mean difficulty process skills scores of Chemistry students between the basic and integrated science process skills acquisition.
- iii. There was no significant difference in the mean difficulty process skills scores between male and female Chemistry students.
- iv. There was a significant difference in the mean difficulty process skills scores between Chemistry students in small-class size and in large-class size.

5. Discussion

The analysis of the data collected gave rise to the following findings which are discussed.

The findings of the study as presented in Table 1 revealed the specific science process skills that students experience difficulty in acquiring in this order: observing, identifying/controlling variables, inferring, predicting, using number relationships, formulating hypotheses, experimenting, communicating, recording, defining operationally, interpreting data and classifying; while manipulating technique, building mental models and measuring as simple. Out of these 5 basic skills with mean scores of 39.98 and 7 integrated skills with mean scores of 39.35 were found difficult in acquiring by Chemistry students respectively. Out of the 15 science process skills, 12 (80%) were found difficult by students in acquiring. This variation in difficulty levels of Science process skills can be attributed to the type of activities to which the students were exposed. Adeyemi (2000) found that not all the process skills in Chemistry are found difficult by students. The findings of this study which indicated that students found controlling variables very difficult, contradicted earlier findings of Omajuwa (2011) who found controlling variables less difficult; but agrees with the study by Akpokorie (2000) which showed that students found controlling variables very difficult. According to Adeyemi (2000), when students are always exposed to practical lessons, with good quality of teachers and quality of teaching methods, they will obviously find most of these process skills less difficult.

As indicated in Table 2 the t value for skills type is .483 not significant at $p=.637$: $p>0.05$ level of significance; showing that the significant (2-tailed) is greater than 0.05 showing non-significant difference between students' difficulty in basic and integrated skills, hence the null hypothesis was retained. Thus the hypothesis one, no difference between students' difficult in basic and integrated skills was not rejected. The result showed no significant difference in the mean difficulty process skills scores between Chemistry students who experience difficulty in acquiring the basic and integrated science process skills acquisition. This finding may be hinged on the quality of teachers and instructional modes used by the teachers. This finding supports the work of Akpokorie (2000) and Omajuwa (2011) whose study showed that students find most process skills difficult. According to earlier work Ajaja (2010), the reason why students may find all process skills difficult could be due to the persistent use of lecture methods for teaching Chemistry as against the recommended use of laboratory and discovery/inquiry approaches which are student-activity centred.

The analysis showed in Table 3 revealed that the total mean scores of the male students who experienced difficulty in science process skills acquisition was 42.20 while; the mean scores of the female students who experienced difficulty in science process skills acquisition was 40.40. Both males and females experienced insignificant difficulty in process skills acquisition. This shows that gender have negligible influence on students' difficulty in science process skills acquisition but was tested with hypothesis 2. In Table 4, the t-ratio for sex is .731 is not significant at $p=.465$: $p>0.05$ level of significance; showing that the significant (2-tailed) is less than .05. The result showed that there was no significant difference in the mean difficulty process skills scores between male and female Chemistry students. Based on this, H_{02} was not rejected. The result showed that there was no significant difference in the mean difficulty process skills scores between male and female Chemistry students. Based on this, hypothesis two was not rejected. The findings of this study is in agreement with those of Akpokorie (2000) and Omajuwa (2011) who found that gender have no influence on students experienced difficulty in science process skills acquisition; contradicts the works by Afif and Majdi (2015) whose results of the study indicated that there were significant differences in science process skills due to gender in favour of the females.

The analysis showed in Table 5 revealed that the mean scores of students that are from large class sizes that experienced difficulty in acquiring Science process skills were 35.01; while the mean scores of students that are from small class sizes who experienced difficulty in acquiring Science process skills was 50.80. This shows that class size have great influence on students' difficulty in Science process skills acquisition since the mean percent is significant; but was tested with H_{03} . As indicated in Table 6, the t-ratio for class size is -30.500 at $p=.000$: $p<0.05$; showing that the significant (2-tailed) is less than .05 hence the null hypothesis, H_{03} was rejected. The result showed that there was a significant difference in the mean difficulty process skills scores between Chemistry students in small-class size and those in large-class size. This implies that there was a significant difference in the mean difficulty process skills scores between Chemistry students in small-class size and those in large-class size. This

result agrees with the work Adeyela (2000) whose studies revealed that large class size is un-conducive for serious academic work for students and process skills acquisition but; disagrees with the works by Afolabi (2002) and Commeyras (2003) who found no relationship among class size and students' academic performance and process skills acquisition. According to Ajaja (2010) very large class sizes, which exist in schools, have made healthy interactions between students and teachers almost non-existent. Most teachers hardly know their students by their names. The large class size has reduced individual student's attention during practical lesson. Students seeking special attention as a result of lack of clear instruction in practical lessons are hardly attended to. All these culminate in very poor performances of students in test of practical knowledge in final year examinations. But, Brophy (2004) opined that large class size can be handled through proper classroom management and group or cooperative teaching in science labs.

The following conclusions were made, based on the findings of this research work. This study highlighted the difficulty experienced by Chemistry students in the acquisition of Science process skills. Based on the findings and discussion, it could, therefore, be concluded that majority of the science process skills (80%) with means scores of 39.35 are found difficult by chemistry students' in acquiring. These process skills include observing, identifying/controlling variables, inferring, predicting, using number relationships, formulating hypotheses, experimenting, communicating, recording, defining operationally, interpreting data, and classifying and this may be as a result of persistence use of lecture method which does not promote active learning in science classrooms. Therefore, an effective, efficient and innovative method that provides students with an opportunity to acquire/interact with science process skills that can be used to solve problems in everyday life and contribute to national development should be encouraged in the teaching learning process to help improve students' performance in chemistry. The study also revealed that gender have negligible influence on students' process skills acquisition while large class size have great influence on students science process skills acquisition. Chemistry requires getting the students engaged; as most of the topics involve practical activities but this becomes very difficult when the class is large since it is un-conducive to acquire the appropriate science process skills required by students. The finding of this study implies that small class-sizes in schools enable chemistry students to acquire the appropriate science process skills, therefore large class-sizes should be discouraged from our secondary schools.

Based on the findings and conclusions of this study, the following recommendations are made:

- 1) The study has established that a large proportion of science process skills 80% are found difficult by Chemistry students in acquiring. Teachers should therefore assess students on the different kinds of science process skills needed in science classes; and educate them on the relevance they play on their everyday life so as to arouse students' interest towards chemistry and also reduce students difficulty on process skills acquisition.
- 2) The number of periods per week for practical Chemistry lessons should be increased to create room for more elaborate laboratory activities with students. This may help eradicate students'

difficulties in science process skills acquisition and enhance meaningful teaching-learning process which will lead them in acquiring more process skills.

3) The study has also reaffirmed that majority of the chemistry students' found difficulty in acquiring both the basic and integrated science process skills. Teachers should therefore make a "Question Collection on both basic and integrated science process skills" and periodically choose a question to initiate a science exploration or activity to reinforce scientific and critical thinking amongst students in order to promote active learning in science classrooms and acquisition of science process skills.

4) The study has also reaffirmed that chemistry students' acquisition of science process skills is negatively affected by large class size. The student-teacher ratio should be drastically reduced to help improve small class sizes such that adequate attention will be paid to students during laboratory exercises since large class size was identified as a major hindrance for effective teaching and learning in this study.

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