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An investigation of undergraduate chemistry education students mastery and use of standard nomenclature in Rivers State

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Abstract
The study aimed at elucidating the extent to which Chemistry education students in the universities based in Rivers State had displayed mastery for the use of conventional nomenclature and standard units in the learning of organic, inorganic and physical Chemistry. The design was a cross-sectional survey. The sample of 115 students composed of, students from Rivers State University, University of Port Harcourt and Ignatius Ajuru University of Education obtained through stratified random sampling technique were tested with 30 test items (code named TUNIC) that was well validated and had reliability coefficient of 0.96 via Pearson Product Moment Correlation Technique. The relevant data gathered were subjected to mean, standard deviation, t-test and ANOVA. The results of the study showed that, the three universities exhibited poor mastery of conventional nomenclature in inorganic and organic Chemistry, moderate mastery of conventional units in physical Chemistry. Rivers State University and University of Port Harcourt exhibited moderate mastery in the use of conventional nomenclature and units in Chemistry while Ignatius Ajuru University of Education exhibited poor mastery in the use of conventional nomenclature in Chemistry. University type and gender were not significant factors influencing undergraduate Chemistry education students' mastery and use of conventional nomenclature in Chemistry.

Keywords: chemistry education students, mastery, standard nomenclature, units

Introduction
Nomenclature is the system of assigning names to a compound. Chemical nomenclature is a set of rules to generate systematic names for chemical compounds. It is a system of naming chemical compounds and for describing the science of Chemistry in general. The nomenclature used most frequently worldwide is the one created and developed by the International Union of Pure and Applied Chemistry (IUPAC). The use of nomenclature is mostly found in organic and inorganic Chemistry. The rules for naming organic and inorganic compounds are printed in two publications - The Blue book for the organic and the Red book for the inorganic chemistry. Following the need for generally accepted chemical names and the concatenation of unfolding events that came in the wake of that need, nomenclature in chemistry has eventually crystallized to a point of universal acceptability, relating names to symbols and to structures being named. First, there was the presentation in 1784 of a general system for naming inorganic compounds by a group of French chemists, among whom were two eminent chemists: Lavoisier and Berthoilet. This was followed by a committee of the American Chemical Society on Nomenclature and Notation when in 1856; it recognized the value of a uniform practice among English speaking chemists (Ilegbedion, 1996). The first international gathering was in 1892 tagged the Geneva Congress; it formulated a set of principles for the naming of chemicals (Encyclopedia of Chemical Technology, 1962). In 1913, the Council of the International Association of Chemical Societies at its third plenary session in Brussels appointed various commissions of inorganic and organic nomenclature. Unfortunately, the activities of these various commissions were disrupted by World War I but were re-activated and revitalized in 1921 when the war ended. It is worthy of note to state that the International Union of Chemists (IUC) has produced many valuable reports. In 1957, the International Union of Pure and Applied Chemists (IUPAC) was formed with its Headquarters in Paris. This Union formulated a new method of naming substances, a system that has become acceptable to chemists in the world. In spite of all the advantages, the IUPAC system has some shortcomings. Consequently, they had observed that the IUPAC system of nomenclature was never taught or applied in teaching of Chemistry due to the fact that most of the teachers who were to teach chemistry with the IUPAC system of nomenclature lacked formal exposition in this area of chemistry knowledge. Chemical nomenclature is a set of rules to generate systematic names for chemical compounds (Guyton: Lavoisier; Barthollet & Fourcroy, 2011) [13]. The nomenclature used most frequently worldwide is the one created and developed by the International Union of Pure and Applied Chemistry (IUPAC). Chemists use specific and convention to name different compounds the primary aim of chemical nomenclature is to ensure that a spoken or written chemical leaves no ambiguity concerning which chemical compound the name refers to thus each chemical name usually refers to a single substance. It aims at ensuring that each substance has a single name, although a limited number of alternative names are acceptable in some cases.

Types of nomenclature
Nomenclature is mostly used in organic and inorganic Chemistry. In IUPAC nomenclature of organic Chemistry, the following types exist:

1. Compositional nomenclature

The term is used to denote the named constructions based on composition species or substances being named, against the systems that involve structural, composition or information. One among them is the generalized stoichiometric name substance or the elements are named with multiple prefixes in order to give the overall stoichiometry of an element or compound. When there are more components, then they are divided into two namely; electropositive and electronegative components. Examples Sodium Chloride (NaCl), trioxygen (O_3), Phosphorous trichloride (PCl_3).

2. Substitute nomenclature

It is based on approach where parent hydride is changed by replacement of hydrogen atoms with atoms or group of atoms. It is a system where organic compounds are named using functional group as the suffix or prefix to the name of parent compound. This system is also used in naming compounds derived from hydrides of specific group elements in the periodic table. Similar to that of carbon, these elements may form rings and chains that will have many derivatives. Rules come in handy in naming parent or main compounds and their substitutes hydrides belong to group 13-17 of the periodic table are named suffix one. For examples Borane, Phosphane, Oxidane etc.

3. Additive nomenclature

This method is mainly formulated for the coordination compound even though it has wide applications. An example for its application is Pentamine ChloroCobalt Chloride ($CoCl(NH_3)_5)Cl_2$) will have the prefix Chloro while ligand will have chloride. Examples PCl_3 – trichlorido phosphorus, ($CoCl_3(NH_3)_2$) triamine trichlorido Cobalt. There are other types which include replacement, fusion, multiplication, functional class, conjunctive etc.

Similarly in inorganic Chemistry, the following exists:

4. Substitutive nomenclature

It is essentially on organic invention and follows the historical development of organic Chemistry. It starts with the designation of an appropriate parent compound from which the compound under discussion can be developed formally by substitution or replacement processes. In organic Chemistry, they are generally land arbitrarily, taken to be the hydrides of the elements of periodic group 14, 15 and 16 plus boron, which also has an additional rather specific number of its own. This naming method usually follows IUPAC organic nomenclature. Hydrides of the main group elements (groups 13-17) are given – are base name e.g. Borane (BH_3), Oxidane (H_2O), Phosphane (PH_3). Although the name Phosphane is also in common use, it is not recommended by IUPAC. The compound PCl_3 would thus be named substitutively as trichlorophosphate (with chlorine "substituting"). However, not all such names (or stems) are derived from the element name. For example NH_3 is called "azane".(Zundahl &Zundahl,2003)

5. Additive nomenclature

This naming method has been developed principally for coordination compounds although it can be more widely applied. An example of its application is ($CoCl(NH_3)_5)Cl_2$ - pentaamine chloridocobalt (iv) chloride ligand, too have a special naming convention whereas chloride becomes the prefix chloro – in substitutive naming in a ligand it becomes chloride. In IUPAC system, every name consists of a root, a suffix and many prefixes as necessary. The name of a compound is formed from the root hydrocarbon by adding a suffix and prefixes to denote the substitution of the hydrogen atoms. A suffix is added to a root to indicate the presence of the principal substituent, which is usually the principal functional group in the molecule. In nomenclature of organic compounds, the ones that have the same functional groups such as those belonging to the same homologues series would carry a common suffix at the end of their name. Tabinas (2012) [12]. asserts that some teachers and some brilliant students may say " learning inorganic nomenclature is easy," results of a focus group discussion on randomly selected students identified inorganic nomenclature as one of the difficult topics they encountered in learning general Chemistry. This was later supported by the results of the departmental examination (final summative test prepared by the department of Chemistry for general Chemistry) that includes items on inorganic nomenclature. Item analysis of the test papers showed inorganic nomenclature as one of the difficult topics in general Chemistry. Nwokocha and Ahiakwo (2013) [18] studied the use of stereochemistry models in teaching organic compounds nomenclature: effect on senior secondary students' performance in River State, Nigeria. The design adopted for the study was a quasi-experimental design. The sample was made up of 260 senior 1 and 2 chemistry students in four intact classes of a university demonstration school. The instrument for data collection is the organic compound nomenclature test. Data was analyzed using the analysis of covariance (ANCOVA). The result show that students taught using stereochemistry models performed better than those taught using chart model. The mean difference between performance of boys and girls was not significant. Similarly, Wulfsberg, Sanger, Melton, and Chimeno (2006) compared the learning of ionic nomenclature by three different methods; one used the traditional method where students worked problems at the end of a chapter, while the other two methods used similar game formats (Rainbow Wheel and Rainbow Matrix) to learn chemical nomenclature. The statistical analysis of student performance revealed that the game format methods were more effective in helping students develop a working knowledge of chemical nomenclature than the traditional method. All students identified the same factors as being important in their instruction: the role of visualization, the role of the instructor, the role of practice, the role of game playing, and the importance of nomenclature. Eze (1995) [9]. in Anyanwu (2018) [3] studied the secondary school students' difficulties in the application of the current IUPAC system of nomenclature in inorganic Chemistry. The study was carried out in Nsukka Education Zone. A sample of five hundred and eighty-four (584) SS3 students randomly selected from fifty (15) schools, constituted the sample. The instrument used was IUPAC nomenclature diagnostic test (INDT). Five research questions were answered using frequency tables while two hypotheses were tested using chi-square test. The result of the study showed that:

- Students had poor knowledge of the rules guiding the determination of oxidation numbers of elements.
- Students use wrong oxidation numbers of central elements in naming compounds containing such elements.

- Sex had no influence on the extent of difficulties encountered by students in IUPAC nomenclature.

Inygang & Ekpeyong (2000) did a research work on the investigation into mastery and use of standard nomenclature and units out in Higher Education Chemistry. The study was carried out in the former East Central State. A sample of one hundred and fifty eight (158) higher institution Chemistry students randomly selected from the three types of tertiary institution by simple balloting. The instrument used was thirty (30) test items drawn from organic, inorganic and physical Chemistry in equal proportions of ten, each were constructed, produced and code-named TUNIC (Test on Units and Nomenclature in Chemistry). Seven research questions were answered using chi-square test. The study found out that students have poor mastery and use of standard nomenclature and units. Gondgen and Lohdip (2011) studied the difficult areas of O'level Chemistry syllabus in ten (10) secondary schools in North Central Nigeria. A total of ten (10) out of twenty (20) topics identify were perceived as difficult. The ten (10) topics were chemical reaction, redox reactions, balancing redox reactions, electrode potential and electrochemical cells, laws of electrolysis, chemical equilibrium, reversible reactions, solubility, sulfur and its compound and IUPAC nomenclature. There was no significant relationship between students' perceived difficulty and their achievement. Reasons given for the perceived difficulty included unfamiliarity with the ideas, confusing language, ideas too demanding, insufficient explanation and practical work, topics too mathematical, lack of formal exposition in these areas by the Chemistry teachers and lack of interest among both sexes. In an investigation carried out by Abdulahi and Aninyi (1992) into the difficult areas of O' level Chemistry syllabus for Nigeria schools. IUPAC system of nomenclature topped the list. The study revealed that this system of nomenclature presented a veritable integral part of most of the difficulties encountered in the learning of Chemistry. Studies carried out by Chinda, (2012) [21]. Festus and Chinda (2012) [21] in science, showed that boys achieved better than girls in the affected science subjects. Girls do not go into such science, Mathematics and technology; such female teachers unconsciously discourage girls who are in, or planning to go into such disciplines. Also in the study carried out by.Dike, Mumuni and Chinda (2017) [8]. on difficulties encountered by senior secondary school Chemistry students in the understanding of the nomenclature and units is dependent on gender. Unit concept is fundamentally mathematical in background and most females shy away from Mathematics related areas and sciences. Ezeliora, (2009) [10].worked on students' difficulties in IUPAC nomenclature and showed that the extent of difficulties encountered by students in IUPAC nomenclature is independent of sex. This result is in agreement with the result of an earlier studies carried out by Njoku (2009) [17],.Ikiroma, and Chind**a** (2015) [14].in Chemistry respectively. These researches found out that sex had no significant effect on students' performance in their respective subject area. From the foregoing, one can conclude that results of previous studies on gender-related differences in students' achievement in science have been generally inconsistent. In the same vein, Olatoye, Aderogba and Aanu (2011) [20]. determined that cooperative and individualized coaching methods have great consequences on students' success in organic Chemistry and there no interaction impact among treatment and gender. Gaffoor and Shina (2014) studied gender and concept mapping in identifying student's difficulties in high school organic Chemistry. The result revealed that there is no gender effect on achievement in organic Chemistry and there is interaction between gender and teaching method and it is in favour of the girls. Chinda (2018) [6] found out that there is significant difference in the achievement of Chemistry students in organic compounds nomenclature when taught with metacognitive teaching strategies. However, self-assessment was the best strategy for teaching organic compounds nomenclature the study reveals. The findings also revealed that there is no interaction effect between gender and teaching strategies. In addition self-assessment model of metacognitive teaching strategy was found to have superior impact on students' achievement in organic compounds nomenclature and thus is advocated for use in our secondary schools. Sakrin, Laothrp and Vinich (2014) agree that teaching organic Chemistry with other innovative method promote students learning achievement and retention of organic chemistry concepts. Olatoye, Aderogba and Aanu (2011) [20] also found out that there no significant interaction effect between treatment and gender in organic Chemistry achievement. Gafoor and shilna (2014) [12] revealed that the interaction between gender and test formats in organic Chemistry score is in favour of the girls. It was observed that students gave answers to questions aimed at the nomenclature of compounds that contain proper-noun anions, oxyacides, oxysalts and hydrates at a very low rate in CNAT, which is applied before empiric proceedings. These results showed that students have information deficiencies on these subjects. Frequent faults of the students in the pre-test applied before the empiric processes can be listed as such; (1) to name the monatomic anions and cations like elements, (2) to misspell the charges of the named ions, (3) to name the monatomic, multiple valance cations without specifying the stock number, (4) misnomenclature of the oxy-anions, (5) misspell the suffixes of the anions during the nomenclature of the ionic compounds, (6) to name the ionic compounds like covalent compounds, (7) not to specify the stock number of the cations during the nomenclature of the ionic compounds of the monatomic, multiple valance cations, (8) to misspell the suffix of the 2nd element in the nomenclature of the covalent compounds, (9) to name the acid solutions like ionic compounds, (10) misspell the formulas of the ionic compounds including hydrate (Turaçoğlu, Alpat & Ellez, 2013) [23]. While the rate of students to give correct answers to questions in CNAT that is applied after empiric proceedings is very high especially for the experimental group, it was observed that the aforementioned mistakes that are made in the pretest are also considerably lower in the experimental group compared to the control group. This condition shows that the jigsaw is an effective method for students to learn the subject. It was determined that the academic achievement scores of experimental group students, on which the jigsaw performed, were significantly different from the academic achievement scores of control group students, on which the traditional teaching method was performed, in terms of the chemical nomenclature. This difference statistically shows that academic achievements of experimental group students' increase compared to that of control group students. In a study conducted by Baah

(2009), 334 senior high school students were asked to write the chemical formula for copper (I) oxide. Of those who participated in the study, 199 could not correctly write the formula. Of those who answered incorrectly, 120 wrote the formula as CuO and noted that this was because copper (I) is Cu and oxide is O. In the same study, the students were asked to write the formula for iron (II) sulphide. More than half (53.3%) could not write the formula for the compound. Of those who could not write, 107 students wrote the formula as Fe_2S, their reason being that iron (II) is Fe_2 and sulphide is S. It was clear from the study that students lacked the understanding of the meaning of the Roman numeral in the bracket. They lacked knowledge of valency and the role valencies play in the writing of chemical formulae Baah and Anthony-Krueger (2012) [5] found out that students' inability to write the correct names of certain elements in compounds, students' inability to determine the central atom in compounds, students' inability to determine or calculate the oxidation numbers of central atoms in compounds, students' inability to write the correct names of radicals, and students' lack of knowledge about valency. The results of the study show that students from less-endowed secondary schools have increased difficulty naming inorganic compounds using IUPAC nomenclature when compared with students from well-endowed schools. The results also suggest that students from both well-endowed and less-endowed secondary schools have difficulty naming..Ikiroma and Chinda (2015) [14] carried out a work on the challenges of effective teaching of Chemistry. He stated that the type of institution has an active role to play in the performance of undergraduate chemistry education student in Chemistry. He was able to illustrate that the attitudes and professionalism of the teachers in Chemistry. Most universities do not have enough lecturers in physical, organic and inorganic Chemistry. Chemistry workshop and laboratory adequacy was also pointed out by him. Pepple, and Chinda (2012) also carried out a work on it. Their findings showed that attitudes and professionalism of the teachers plays an active role in teaching and learning Chemistry. Undergraduate Chemistry education students have been finding the use and mastery of nomenclature and unit difficult from their secondary school days. It is worthy to note that members of IUPAC still meet from time to time for review and assess progress made so far, and organic workshops, seminars, conferences etc. to enlighten and research studies carried out in the sciences and science education in general. Consequently, it is against the above brief background that this study is aimed at elucidating the extent to which undergraduate Chemistry students in tertiary institutions in Rivers State had displayed mastery for the use of conventional nomenclature and standard units in the learning of organic, inorganic and physical Chemistry. This scenario emanated from the fact that teachers have failed to teach or use the IUPAC system of nomenclature and units due to its difficult nature. The study therefore elucidates how undergraduate Chemistry education students have been able to cope with and use the conventionally accepted standard nomenclature and units in the learning of physical, inorganic and organic Chemistry. To this end the objectives, research questions and hypotheses for the study are as follows;

Objectives of the study

1. To find out the extent to which undergraduate Chemistry education students have mastery for the use of conventional nomenclature in Chemistry.
2. To establish whether undergraduate Chemistry education students' mastery and use of conventional nomenclature in Chemistry is influenced by gender.
3. To establish whether undergraduate Chemistry education students' mastery and use of conventional nomenclature in Chemistry is influenced by university type.

Research questions

1. To what extent have undergraduate Chemistry education students show mastery for the use of conventional nomenclature in Chemistry?
2. What is the gender difference in undergraduate Chemistry education students' mastery and use of conventional nomenclature in Chemistry?
3. What is the influence of university type on undergraduate Chemistry education students' mastery and use of conventional nomenclature in Chemistry?

Hypotheses

1. Gender is not a significant factor influencing undergraduate Chemistry education students' mastery and use of conventional nomenclature in Chemistry.
2. University type is not a significant factor influencing undergraduate Chemistry education students' mastery and use of conventional nomenclature in Chemistry.

Methodology

The design of the study was a cross-sectional survey design involving undergraduate Chemistry education students in Federal and State Universities within Rivers State. The population of the students in the three (3) universities is two hundred and thirty students. This population is the total population of 300 level students in the three (3) universities; University of Port Harcourt has eighty (80) students, Rivers State University has one hundred and twenty (120) students and Ignatius Ajuru University of Education has thirty (30) students as at the time of this investigation. By means of a multistage random sampling technique on the institutions, followed by stratified random sampling at which technique 50% of the student population was obtained for each of the three types of institutions by simple balloting. The number of samples obtained from each institution was as follows:

- University of Port Harcourt (UNIPORT) 40
- Rivers State University (RSU) 60
- Ignatius Ajuru University of Education (IAUOE) 15
- Total students 115

The instrument for the study was a 30 item test drawn from organic, inorganic and physical Chemistry in equal proportions of ten each were constructed, produced and code-named TUNIC (Tests on Units and Nomenclature in Chemistry) by the researchers. The thirty (30) items were scored as follows:

For the naming of organic or inorganic compounds

Correct naming = 1 point
One error naming or complete derailment = 0 point

Units in physical Chemistry

For the endorsement of the correct unit = 1 point
One error during endorsement or complete derailment = 0 point

The research questions were answered with mean and standard deviation while, the hypotheses were tested with t-test and ANOVA at 0.05 level of significance. The extent to which students demonstrated mastery for the correct use of units and nomenclature were computed and interpreted as follows:

0.78 - 1.00 - Extensive Mastery
0.52 - 0.77 - Moderate Mastery
0.26 - 0.51 - Poor mastery
0.00 - 0.25 - Complete derailment

Results

Research question one

To what extent have undergraduate Chemistry education students show mastery for the use of conventional nomenclature in Chemistry?

Table 1: Mean analysis of mastery of conventional nomenclature in Chemistry

Schools	Mean			Polled mean	Interpret
	Physical	Organic	Inorganic		
RSU	0.70	0.47	0.46	0.54	Moderate Mastery (MM)
UNIPORT	0.68	0.5	0.48	0.55	Moderate Mastery (MM)
IAUOE	0.54	0.45	0.40	0.46	Poor Mastery (PM)

Table 1 showed that RSU students on the whole displayed moderate mastery on the use of nomenclature in organic, inorganic and physical Chemistry. UNIPORT students on the whole displayed moderate mastery on the use of nomenclature for organic, inorganic and physical Chemistry while, IAUOE students displayed poor mastery on the use of nomenclature for organic, inorganic and physical Chemistry.

Research question two

What is the gender difference in undergraduate Chemistry education students' mastery and use of conventional nomenclature and units in Chemistry?

Hypothesis 1.

Gender is not a significant factor influencing undergraduate Chemistry education students' mastery and use of conventional nomenclature Chemistry.

Table 2: Mean, Standard deviation and t-test analysis of the influence of gender on students' mastery and use of conventional nomenclature and unit in Chemistry

Gender	N	Mean ($\bar{X}$)	SD	T	Df	Sig.	Decision
Male	58	15.74	5.469				
				-1.302	113	.196	Not Significant
Female	57	17.05	5.327				

Table 2 indicates that the calculated t-value was-1.302, and with a df of 113, p (.196) > 0.05 level of significance, hence not significant. Thus the null hypothesis is accepted. The result is that gender is not a significant factor influencing undergraduate Chemistry education students' mastery and use of conventional nomenclature Chemistry.

Research question three

What is the influence of university type on undergraduate Chemistry education students' mastery and use of conventional nomenclature in Chemistry?

Hypothesis 2.

University type is not a significant factor influencing undergraduate Chemistry education students' mastery and use of conventional nomenclature in Chemistry.

Table 3: Summary of ANOVA analysis on the influence of university type on students' mastery and use of conventional nomenclature and unit in Chemistry

University		N	$\bar{X}$		*SD*	
RSU		60	16.57		5.410	
UNIPORT		40	16.90		4.851	
IAUOE		15	14.33		6.673	
Source of Variation	Sum of square	df	Mean Square	F	Sig.	Decision
Between Group	75.725	2	37.862	1.298	.277	Not significant
Within Group	3267.667	112	29.176			
Total	3343.391	114				

Table 3 above shows that the calculated value of $F_{(2, 112)}$ was 1.298, which was not significant since p (.277) > 0.05 level of significance. That is, the null hypothesis is accepted. The result is that University type is not a significant factor influencing undergraduate Chemistry education students' mastery and use of conventional nomenclature in Chemistry.

Discussion of findings

Based on the issue of mastery and use of nomenclature in organic, inorganic and physical Chemistry, the result showed that RSU students on the whole displayed moderate mastery on the use of nomenclature in organic, inorganic and physical Chemistry. UNIPORT students on the whole

also displayed moderate mastery on the use of nomenclature for organic, inorganic and physical Chemistry while, IAUOE students displayed poor mastery on the use of nomenclature for organic, inorganic and physical Chemistry. The observed outcome could be attributed to poor knowledge of names of compounds and units, misplacement of symbols and position of the functional group, lack of knowledge of valence of atom and radicals and lack of knowledge of correct chemical formulae of atom and compounds. This finding is in agreement with that of Baah and Anthony-Krueger (2012) [5], who also found out that students' inability to write the correct names of certain elements in compounds, is as result of students' inability to determine the central atom in compounds, students' inability to determine or calculate the oxidation numbers of central atoms in compounds, students' inability to write the correct names of radicals, and students' lack of knowledge about valency. The second issue which borders on the influence of gender, it was found out that gender is not a significant factor influencing undergraduate Chemistry education students' mastery and use of conventional nomenclature Chemistry. That is the extent of mastery of conventional nomenclature by the students in Chemistry is not significantly dependent on gender. This outcome agrees with the works of Sakrin, Laothrp and Vinich (2014) and Olatoye, Aderogba and Aanu (2011) [20]. A third concern of this study was whether or not university type could influence students' mastery and use of conventional nomenclature and units in chemistry. The result of the analysis show that students' mastery and use of conventional nomenclature and units in Chemistry do not depend on the university type. The finding disagrees with.Ikiroma,and Chinda**,** (2015) [8]. who stated that the type of institution has an active role to play in the performance of undergraduate student in chemistry.

Conclusion and recommendations

Based on the findings of the study it could be concluded that; Rivers State University undergraduate Chemistry education students displayed moderate mastery for the use of conventional units in physical chemistry, University of Port Harcourt undergraduate Chemistry students displayed moderate mastery and Ignatius Ajuru University of Education undergraduate Chemistry students displayed moderate mastery for the use of conventional unit in physical Chemistry. The three universities displayed poor mastery for the use of conventional nomenclature in inorganic Chemistry and also displayed poor mastery for the use of conventional nomenclature in organic Chemistry. However, the Rivers State University and University of Port Harcourt undergraduate Chemistry education students on the whole displayed moderate mastery on the use of nomenclature and units for organic, inorganic and physical Chemistry. Ignatius Ajuru University of Education undergraduate Chemistry education students on the whole displayed poor mastery on the use of nomenclature and units for organic, inorganic and physical Chemistry. In addition, gender was not a significant factor influencing undergraduate Chemistry education students' mastery and use of conventional nomenclature and units in Chemistry. Similarly, University type is not a significant factor influencing undergraduate Chemistry education Students mastery and use of conventional nomenclature and units in Chemistry. Consequently, the following are recommended based on the findings of the study and conclusion drawn in the study:

1. All pre-requisite concepts leading to the concepts of nomenclature and units should be properly taught before teaching the concept of nomenclature and units.
2. Chemistry teachers should make frantic efforts to expose students to as many areas in Chemistry regarding the use of the nomenclature and units, by repeat lessons several times on the concept of nomenclature and units and students given plenty of practices in the writing of the names of compounds and units of measurement.
3. There is a dire need for workshops based on nomenclature and units for all cadres of the teaching profession with the level of content complexity reflecting the level of the institution in attendance.
4. Books of recent edition, which hopefully are written to reflect current usage of IUPAC and S. I. units should be made available to students for further studies.
5. Chemistry curriculum should be broadened in order to incorporate into it the study of nomenclature and units as a separate topic.
6. Occasional meetings between university Chemistry teachers and their secondary school counterparts should be arranged for them to share ideas and appreciate problems unique to them and their students.

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