# EFFECT OF PROCEDURAL KNOWLEDGE INSTRUCTIONAL TECHNIQUE ON STUDENTS' INTEREST IN QUALITATIVE ANALYSIS FOR CREATIVITY, INNOVATION AND ENTREPRENEURSHIP EDUCATION AT THE POST- BASIC EDUCATION

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**Abstract**
*The study investigated the effect of Procedural Knowledge Instructional Technique on Students' Interest in Qualitative Analysis. The main purpose of this study was to determine the effect of procedural knowledge instructional technique on chemistry students' interest in qualitative analysis. This procedural knowledge instructional technique involves creativity, innovation and entrepreneurship through problem solving and skill acquisition.. The population of the study consisted of all SS2 chemistry students in Nsukka Education Zone of Enugu State. The sample size for the study was 247students from eight schools out of fifty- eight public schools in the area. The design of the study was non-randomized control group quasi-experimental design. A research question and a hypothesis guided the study. Mean and standard deviation were used to answer the research question. The hypothesis was tested at 0.05 level of significance using Analysis of Covariance (ANCOVA). Findings showed that: Procedural knowledge instructional technique (PKIT) increases students' interest in scientific investigation activities.*

**Key Words:** Procedural Knowledge Instructional Technique, Students' Interest, Qualitative Analysis, Creativity, Innovation and Entrepreneurship.

## Introduction

Procedural knowledge instructional technique is an innovative technique that guides teacher's action during practical work in qualitative analysis in chemistry. It is a problem solving technique. Procedural knowledge instructional technique is of paramount importance to a teacher's effective delivery of practical lesson in qualitative analysis (Jokari, Nor & Mahani 2012). For the purpose of this study, Procedural knowledge instructional technique is a structured and systematic technique to qualitative analysis in order to characterize chemical samples and identify their constituent ions. Procedural knowledge instructional technique is to follow a consistent sequence of carrying out qualitative analysis in order to arrive at the correct identification of the qualities of the substance being analyzed. Procedural knowledge instructional technique involves assisting individuals to acquire skills and knowledge so that they are able to perform a task to a specific standard. In procedural knowledge instructional technique, the outcomes to be achieved are clearly stated so

that students may know exactly what they have to do. A teacher knows what training or learning to be provided. The emphasis on procedural knowledge instructional technique is on doing rather than just knowing. Teachers are advised to adopt instructional techniques that can bring about attitudinal change and skills acquisitions by learners to facilitate problem solving in the subject. These techniques include creativity, innovative and entrepreneurial. These techniques were described as techniques of activity, enquiry and discovery which are cognitive, affective and psychomotor. Such techniques may arouse and genuinely promote the students' interest in qualitative analysis in chemistry.

Creativity is an instructional strategy. It is a concept concerned with the development of both innate ability and skills born out of constant practice or training(Bolaji,2007).The primary goal of education is to create men who are capable of doing new things, not simply of repeating what other generation have done. Entrepreneurial quality builds from creativity. Creativity has two parts namely goal-setting and problem- solving. Entrepreneurship is also being developed as a way of developing skills such as risk- taking and problem –solving that facilitate achievement of life goals and in education. .Entrepreneurship education prepares students to identify and address challenges and opportunities. There are many who believe that entrepreneurship is an inborn trait that cannot be taught. Innovation is defined as the process of making changes to .something established by introducing something new. Using innovative methods of teaching is a crucial skill for teachers. Scientific research has shown that innovative teaching methods and approaches can significantly enhance the student learning process. Creativity, innovation and entrepreneurship are all for problem solving like the procedural knowledge instructional technique and therefore should be encouraged.

Procedural knowledge can be measured using the science process skills (Basic scientific process skills and integrated scientific process skills). However, emphasis on students' mastery of science process skills should be regarded as an important element in the process of teaching and learning of qualitative analysis in Chemistry.

Chemistry is essentially a practical oriented subject which demands proper exhibition of science process skills acquisition and concept for effective interpretation of existing phenomena. Chemistry practical skills are science process skills. Science process skills are those skills which scientists employ in data gathering, transformation and interpretation in order to arrive at conclusions. The science process skills (SPS) are cognitive, psychomotor and affective skills which scientists employ in problem identification, objective inquiry, data gathering, transformation, interpretation and communication. Science process skills may be described as abilities which can be developed by experience and which are used in carrying out mental operations and physical actions. Studies by Okoli (2006) and Njoku (2005) assert that when one acquires the science process skills of observing, measuring, questioning, becomes specially equipped with the tools required for scientific inquiry or problem-solving as

well as ability to use these skills in the laboratory for a variety of investigations. The use of procedural knowledge instructional technique may enhance the acquisition of such science process skills. The importance of chemistry practical skills cannot be over stressed. The science process skills are the tools that teachers and students use to investigate the world around them and to construct science concepts, so it is essential for teachers to have a good understanding of these skills (Anaekwe & Ezeuchu, 2015). Qualitative analysis may be perceived to be difficult by students. This is because most of the times, chemistry teachers do not teach it effectively. Qualitative analysis should not be difficult to students if the teachers have adequate procedural knowledge and skills for teaching the students. Evidence of fluctuating and unsatisfactory poor achievement in chemistry at Senior Secondary Certificate Examination has been shown by the examiners' report. Data obtained from the West African Examination Council from the results of the years 2007 to 2016 confirmed the students' poor achievement. The WAEC Chief Examiners' reports have consistently indicated that Nigerian students perform very poorly in practical chemistry examination, especially the aspect of qualitative analysis. Conventional Demonstration Strategy for teaching practical skills in qualitative analysis had failed us. Conventional demonstration strategy as a teaching strategy refers to the visual presentation of the action and activities or practical work related to the facts and principles of a delivered lesson by the teacher in the classroom, aiming to facilitate the task of teaching and learning. Demonstration strategy of teaching serves as a model laboratory instruction but conventional demonstration strategy is teacher-centered. This is because in conventional demonstration strategy, the teacher does whatever the students are expected to do at the end of the lesson by showing them how to do it and explaining the process to them. The teacher must be sure he can do what he is supposed to demonstrate. Traditionally, demonstration can be used for introduction such as set induction during lesson and in practical work, but demonstration as a teaching strategy had not been effective in yielding the desired results. The poor performance in qualitative analysis in chemistry may be attributed to a lack of interest in the subject by the students, since a students' interest in qualitative analysis will induce him to behave and act in a certain way towards his studies.

Interest is another important determinant of performance in teaching – learning process. It is a component of attitude that measures the degree of a person's unalloyed likeness. Students' interest significantly correlates with their academic performance in school subjects and as such has significant influence on their learning outcomes (Ugwu, 2013). Interest determines the zeal with which students' study and solve their academic problems. It therefore becomes pertinent for teachers to explore and find avenues/ ways of arousing students' interest in teaching – learning process so as to help them perform creditably high in different school subjects especially science practical that acquaints them with scientific and technological skills. Interest is a feeling of like or dislike towards an activity. It is that innate tendency which helps

an individual to participate in a particular activity which includes science. The willingness to be involved in science activities depends on the degree of interest that students have in the subject. Studies have been conducted on students' interest in science (Nwoji 2015, Okoye, Okongwu & Nweke, 2015).

Also, the persistent lack of interest by students in science could be as a result of teacher's use of ineffective instructional approach. One of the issues at stake in education today is students' interest in relation to teaching and the overall success of learning outcome. Okoyefi and Nzewi (2013), examined the apparent lack of interest shown by female students towards science and concluded that students' aversion for mathematics and general lack of interest in sciences are due to various laws and principles to be committed into memory. Use of procedural knowledge instructional technique in teaching qualitative analysis may make qualitative analysis lesson more stimulating and interesting to the students. This study therefore, investigated if the use of procedural knowledge instructional technique increased students' interest in qualitative analysis. Procedural knowledge instructional technique engenders interest in the students when they were exposed to the teaching technique. Students' were made to follow the step- by- step process as can be seen, which is the procedure needed in PKIT. The students became excited with the instructional technique.

The frequent students' mass failure in this aspect of the chemistry examination raised questions as to what the chemistry teachers teach and whether the teachers themselves possessed procedural knowledge and skills for teaching the students. If chemistry teachers lack procedural knowledge, then they cannot teach their students practical procedures in qualitative analysis. Therefore, the problem of this study put in question form is: What is the effect of procedural knowledge instructional technique on chemistry students' interest in qualitative analysis?

**Purpose of the Study**

The purpose of this study was to determine the effect of procedural knowledge instructional technique on chemistry students' interest in qualitative analysis. Specifically, the research ascertained the effect of procedural knowledge instructional technique on students' interest in qualitative analysis

**Research Question**

The study sought answer to this research question:

What are the mean interest scores of students taught qualitative analysis using procedural knowledge instructional technique and those taught with conventional demonstration strategy

**Hypotheses**

**$HO_1$**: There is no significant difference in the mean interest scores of students taught qualitative analysis using procedural knowledge instructional technique and those taught with conventional demonstration strategy

**Methodology**

The design of the study was non-randomized control group quasi-experimental design. Specifically; the study adopted the pre-test and post- test non-randomized control group design. The study was carried out in Nsukka Education Zone of Enugu State. Nsukka Education Zone is made up of Nsukka, Igbo- Etiti and Uzo-Uwani Local Government Areas (LGAs). The LGAs have 30, 16 and 12 government owned secondary schools respectively

The population for the study comprised 2,134 SS2 Chemistry students (PPSMB, 2017) from 58 secondary schools in Nsukka Education Zone of Enugu State in 2017/ 2018 academic session. The sample size for the study was 247 chemistry students. Multistage sampling procedure which involved three stages was used to draw the sample size for the study. Purposive sampling technique was used to select twenty- two (22) out of the fourty- eight (48) schools in the zone that qualified for the study which include that the schools selected must have SS2 students studying Chemistry, have Chemistry laboratory, have Chemistry teachers and the school must be willing to participate in the study. The twenty-two schools selected met the criteria specified. Proportionate stratified random sampling technique with balloting was used to select eight (8) schools out of twenty – two `(22) schools from the zone according to each LGAs. Simple random sampling technique was used to assign four(4) schools for both experimental and control groups using intact classes.

Qualitative Analysis Interest Questionnaire (QAIQ) was used for data collection.

The QAIQ consists of 32- items, which were developed by the researcher. It is a 4-point rating scale type questionnaire designed which ascertained students' interest in qualitative analysis problem solving. The scoring for positively phrased items was: Strongly Agree (SA) = 4, Agree (A) = 3, Disagree (D) = 2, Strongly Disagree (SD) = 1. and for negatively phrased items the scoring was reversed as: Strongly Agree (SA) = 1, Agree (A) = 2, Disagree (D) = 3, Strongly Disagree (SD) = 4. The respondents were expected to indicate their degree of agreement or disagreement on number of statement about the qualitative analysis problems. Care was taken to write the items in simple language for easy understanding.

QAIQ was subjected to both face and construct validity. To determine the face validity, QAIQ was given to an expert in Chemistry Education and three experts in Measurement and Evaluation. Construct validity was carried out on the 60-items. Specifically, factor analysis (CFA) was used to determine the construct validity of the items and Steven's (2002) criteria of 0.40 and above for selecting items was employed. Based on this, 14 items were found to be factorially complex because they loaded in

more than one factor, 14 items were factorially impure because their indices were not up to 0.40 and 32 items were factorially pure because they loaded in just one factor. The 32 items were used for the study.

In order to determine the reliability of the instrument, QAIQ was trial tested using 64 SS 2 students of a co-educational school in Obollo-Afor Education Zone having same geographical characteristics with the area of study. The data obtained from the trial testing of the instrument was used to estimate the internal consistency of the instrument. The reliability coefficient of QAIQ was estimated using Cronbach Alpha ($\alpha$) method and reliability coefficient 0.86 was obtained.

Three (3) regular chemistry teachers who served as research assistants from each of the selected schools for the study were trained. At the end of the training, two (2) teachers were selected to serve as research assistants following their performance at the end of the training. The training was to drill them on the content, methodology and the procedural knowledge instructional technique design of the study. The other research assistant functioned as a stand-by instructor. Research assistants were also selected and given training conventionally using demonstration strategy before the practical exercise since they taught the control group using the conventional demonstration strategy. The training lasted for 4(four) day. The chemistry teachers (research assistants) were separated on the basis of whether they were in experimental group or control group. Each group of teachers was trained in one place.

Mean and standard deviation were used to answer the research question. The hypothesis was tested at 0.05 level of significance using Analysis of Covariance (ANCOVA). The pretest scores were used as covariates to the posttest scores.

**Results**

The results are presented in tables according to the research question and the hypothesis.

**Research Question**

What are the mean interest scores of students taught qualitative analysis using procedural knowledge instructional technique and those taught with conventional demonstration strategy?

**Table 1**: **Mean and standard deviation of students' interest scores taught qualitative analysis using procedural knowledge instructional technique and those taught with conventional demonstration strategy**

| Instructional Technique | N | Pretest Interest $\bar{x}$ | SD | Posttest Interest $\bar{x}$ | SD | Mean gain difference |
|---|---|---|---|---|---|---|
| Procedural Knowledge Instructional Technique | 133 | 81.35 | 11.53 | 94.71 | 6.46 | 13.36 |
| Conventional Demonstration Strategy | 104 | 80.64 | 10.33 | 86.14 | 4.30 | 5.50 |

Result on Table 1 showed that the experimental group taught qualitative analysis using procedural knowledge instructional technique had a pretest mean interest score of 81.35 with a standard deviation of 11.53 and a posttest mean interest score of 94.71 with a standard deviation of 6.46. The difference between the pretest and posttest mean interest scores for the group taught qualitative analysis using procedural knowledge instructional technique was 13.36. The control group taught qualitative analysis using conventional demonstration strategy had a pretest mean interest score of 80.64 with a standard deviation of 10.33 and a posttest mean interest score of 86.14 with a standard deviation of 4.30. The difference between the pretest and posttest mean interest scores for control group was 5.50. However, for each of the groups, the posttest mean interest score were greater than the pretest mean interest score with the experimental group having the highest mean interest gain. This is an indication that procedural knowledge instructional technique had more positive effects on students' interest in practical skills acquisition than the conventional demonstration strategy.

In order to ascertain if the observed difference is real or an error variance occurred, the result is further subjected to inferential testing.

**Hypothesis**

**HO:** There is no significant difference in the mean interest scores of students taught qualitative analysis using procedural knowledge instructional technique and those taught with conventional demonstration strategy

**Table 2: Analysis of covariance (ANCOVA) of students' interest scores by gender and by PKIT and CDS**

| Source | Type III Sum of Squares | Df | Mean Square | F | Sig. | Dec. |
|---|---|---|---|---|---|---|
| Corrected Model | 3653.757[a] | 4 | 913.439 | 29.778 | 0.00 | |
| Intercept | 29182.093 | 1 | 29182.093 | 951.341 | 0.00 | |
| Pretest Interest | 268.244 | 1 | 268.244 | 8.745 | 0.00 | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Group | 3084.154 | 1 | 3084.154 | 100.544 | 0.00 | S |
| Gender | 19.399 | 1 | 19.399 | .632 | 0.42 | NS |
| Group * Gender | 16.625 | 1 | 16.625 | .542 | 0.46 | NS |
| Error | 7116.530 | 232 | 30.675 | | | |
| Total | 1990147.000 | 237 | | | | |
| Corrected Total | 10770.287 | 236 | | | | |

S = Significant, NS = Not Significant at 0.05 level.

The result in Table 2 showed that with respect to the significant difference in the mean interest scores of students taught qualitative analysis using procedural knowledge instructional technique and those taught with conventional demonstration strategy, an F-ratio of 100.54 was obtained with associated probability value of 0.00. Since the associated probability value of 0.00 was less than 0.05,the null hypothesis ($H_0$) which stated that there is no significant difference in the mean interest scores of students taught qualitative analysis using procedural knowledge instructional technique and those taught with conventional demonstration strategy is rejected. This implies that there was a significant difference in the mean interest scores of students taught qualitative analysis using procedural knowledge instructional technique and those taught with conventional demonstration strategy. Thus, those taught with procedural knowledge instructional techniques had higher mean interest score in the posttest.

**Discussion of Findings**

The finding of the study showed that procedural knowledge instructional technique had positive effects on students' interest in practical skills acquisition than the conventional demonstration strategy. The result of this study also shows that, PKIT as a main effect has significant effect on students' interest in practical skills acquisition in qualitative analysis. However, for each of the groups, the posttest interest means scores were greater than the pretest interest means scores with the experimental group having the highest interest mean gain. This is an indication that procedural knowledge instructional technique had positive effects on students' interest in practical skills acquisition than the conventional demonstration strategy.

A student's interest in practical skills acquisition will induce him to behave and act in a certain way towards his studies (Owodunni, 2011). Also Hiland (1989) defined interest as persisting tendency to pay attention and enjoy some activities or contents. Obodo (2004) pointed out that the type of interest a student brings to the classroom is very important. This means that if a student has positive interest towards a particular subject, he or she not only enjoys studying it but would also derive satisfaction from the knowledge of the subject. Procedural knowledge interest is dichotomized into two kinds, basic interest, that is, the kind of thing that a person likes to do and occupational interest or the degree to which an individual is similar in

likes and dislikes to individual who are happily employed in a particular occupation. These two kinds of interest have led to different methods of measurement and assessment in that Doman. Hence the need to find out if student's interest may be raised in qualitative analysis (QA) through the use of procedural knowledge instructional technique (PKIT) for teaching QA in secondary school is significant to this study and has positive effects. Perhaps, this is because the PKIT is student centred and activity- based. The result of the study showed there was a significant difference in the mean interest scores of students taught qualitative analysis using procedural knowledge instructional technique and those taught with conventional demonstration strategy with those taught with procedural knowledge instructional technique had a higher interest mean in the posttest.

**Educational Implication**

PKIT improved interest of learners as interest relates with performance. This is because procedural instruction is expected to enhance performance and more participation of learners in science for creativity, innovation and entrepreneurship education.

**Conclusion**

Procedural knowledge instructional technique (PKIT) increases students' interest in scientific investigation activities. The findings of the study indicated that procedural knowledge instructional technique had positive effects on students' interest in qualitative analysis by enhancing creativity, innovation and entrepreneurship education at the Post- Basic Education..

**Recommendations**

Teachers of chemistry should be encouraged to use PKIT in teaching qualitative analysis. In so doing, the interest of students in qualitative analysis in chemistry could be enhanced for creativity, innovation and entrepreneurship education at the Post- Basic Education.

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