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UTILIZING SCIENCE PROCESS SKILLS ACQUISITION FOR NIGERIA'S SOCIO-ECONOMIC DEVELOPMENT

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Abstract
The paper highlights science process skills acquisition as an instrument for Nigeria's socio-economic development. It states the concept of science process skills acquisition as the foundation for the effective learning of science at all levels of education. The study made a survey of science process skills in the school curricula ranging from primary to tertiary institutions using Basic Science and Technology (BST), Biology, Physics and Chemistry curricula. It was observed that primary schools lay much emphasis on the basic skills of communication; the secondary schools utilize the skills of experimentation and manipulation while experimentation, manipulation, measurement and communication are prominent in tertiary institutions curricula. The paper pointed out that if these skills are properly utilized in teaching the pupils/students, it will lead to diverse career opportunities. It will also improve the standard of living, social status as well as help in national development. Conclusion drawn from this paper is that , the acquisition of science process skills is very vital in raising the socio-economic wellbeing of the nation. It is therefore recommended amongst others, that science process skills as identified and emphasized be properly implemented at all levels of education.

Introduction

Science is a dynamic process of seeking for knowledge about nature through systematic observation and experimentation (Anaekwe, Nzelum, Olisakwe and Okpala, 2010). This portrays science as a process and as a product. The process gives rise to the product. This gives science a holistic view and encourage understanding. Science process skills as a process refers to the basic tools, tactics or techniques that are utilized in the study of science (Anaekwe and Ezeuchu, 2015). These tools are important in the manufacture of products. Production of basic tools to teach science becomes a reality for easy science teaching and understanding. The Federal Government of Nigeria adequately emphasizes the acquisition of science process skills at all levels of education (FRN, 2014). Once these skills are mastered, they are transferable and form the basis for further studies of science, technology and mathematics as well as preparation of new products.

Science process skills emanated from science a process approach (SAPA) introduced by American Association for the advancement of science (AAAS). SAPA was a scheme for primary science. It was an attempt towards finding rational solutions to what one might describe as a psychological controversy in the teaching of science and mathematics in American schools. It was an attempt to teach science the way scientists claim to behave (Gbamanja, 1991).

Science Process Skills Acquisition

Science process skill acquisition is the foundation for effective learning of science at all levels of education. The acquisition of science process skills help learners to perceive the relevance of science in everyday life. The acquisition of science process skills is one of the basis of scientific inquiry, development of intellectual skills and attitudes that are needed to learn concepts. The skills in qualitative and quantitative analysis of science process skills seeks to answer questions as to how and why phenomena occur. These skills give indepth information on scientific practices and discoveries leading to informed decisions which cannot be complete without creativity. Science process skills promote creativity in learners. Creativity is the bedrock on which science process skills revolve because it enhances the quality of ideas put into products of science to make sense of appeal. Creativity improves the worth of practical work. Practical work is not just putting the apparatus when seen, but planning, designing a problem, creating a new approach, procedure and also putting familiar things together in the new arrangement. This implies that the knowledge of creativity exhibited by students in any practical class helps them manipulate practical equipment. Students are made to acquire scientific knowledge by the process of thinking, analyzing and interpreting facts. However, Ewers (2001) report that when science process skills are not acquired, it will be an obstacle for science literacy due to the fact that science literacy is not only limited to reading and hearing, instead it requires efficient use of science process skills. Saat (2004) and Yakar (2014) emphasized that science teaching should be planned in a way to include teaching science process skills. Meyers. Washburn and Dyer (2004) report that science process skills comprise the basis of science and thus have an important lace in the life of a scientist. It therefore becomes necessary to acquire these skills in science education.

Process skills are divided into basic (simpler) skills and integrated (more complicated) skills. The nine basic skills include observing, measuring, inferring, classifying, space/time, relationship, predicting, raising questions, communicating, counting and using numbers. The seven integrated process skills are controlling variables, hypothesizing, experimenting, data interpretation, manipulating, formulating models and operational definition (Aniodoh, 2012). If these skills are properly inculcated in the students, several career opportunities abound where the skills could be applied as illustrated in Table 1. Science education therefore, is a major contributor for equipping learners with skills for socio-economic development of a nation.

Table 1: Areas of Science and Job Opportunities

Area of Science	Career Opportunities
Genetics and Genomics	Bioinformatics scientists, cytogenetic technologist, genetic counsellor
Earth and Environmental Science	Aqua cultural manager, aquarist, cartographer or photogrammetric, climate change analyst, diver, emergency management specialist, environmental compliance inspector, environmental scientist, geographer, geoscientist, hydrologist, industrial health and safety engineer, meteorologist, surveyor, park ranger, soil scientist, soil and water conservationist, water and liquid waste treatment plant and system operator
Physical Science	Astronomer, audio and video equipment technician, aviation inspector, chemical technician, chemist, chemistry teacher, electrician, film and video editor, food science technician, forensic science technician, nuclear power reactor operator, occupational health and safety specialist, physicist, physics teacher, pilot, power distributor and dispatcher, power planet operator, precision instruments and equipment repairer, ship and boat captain, sound engineering technician

Engineering	Aerospace engineer, aerospace engineering/operations, technician, architect, automotive engineer, biochemical engineer, biofuel of biodigest technology/product development manager, CAD technician, chemical engineer, civil engineering technician, civil engineers, commercial and industrial designer, electrical engineering technician, energy engineer, engineering manager, environmental engineer, environmental engineering technician, fuel cell engineer, geographic information systems technicians, hydroelectric plant technician, industrial engineer, landscape architect, mapping technician, marine architect, materials scientist and engineer, mechanical engineer, mechanical engineering technician, methane gas generation system technician, Microsystems engineer, nuclear engineer, petroleum engineer, photonics technicians, radio frequency engineer, robotics engineer, robotics technician, semiconductor processor, solar energy systems engineer, solar photovoltaic installer, sustainability specialist, transportation engineer, transportation planner, water or wastewater engineer, weatherization installer or technician, welder, wind energy engineer, wind turbine service technician
Mathematics and Computer Science	Actuary, computer hardware engineer, computer network architect, computer programmer, computer software engineer, computer systems analyst, data scientists, database administration, economist, information security analyst, math teacher, mathematician, multimedia artist or animator, penetration tester, remove sensing scientist or technologist, software quality assurance engineer and tester, statistician
Human Biology and Health	Audiologist, biomedical engineer, cardiovascular technologist or technician, certified diabetes educator, certified registered nurse anesthetist (CRNA), chiropractor, cytotechnologist, dental hygienist, dietitian or nutritionist, emergency medical-technicians and paramedic, endocrinologist, epidemdogist, health educator, science writer, hematologist, respiratory therapist, medical and clinical laboratory technician, medical social worker, neurologist, registered nurse, nuclear medicine technologist, occupational therapist, optometrist, physical therapist, pathologist, physician assistant, pharmacist, physician, speech language pathologist
Life Science	Agricultural inspector, agricultural technician, animal breeder, animal trainer, anthropologist, athletic trainer, biochemist, biological technician, biologist, biology teacher, marine biologist, plant scientist, science manager, veterinarian, veterinary technologist and technician, zoologist and wildlife biologist
Behavioural and Social Science	Marriage and family therapist, political scientists, psychologists, sociologist
Interdisciplinary science	Patent lawyer, technical writer

Source: Science buddies, new STEM classroom kits 2017
www.sciencebuddies.org/science.engi...

These are all areas of science education career opportunities that promote skills acquisition and reduce unemployment among youths.

Science Process Skills Emphasized In Nigerian Schools

After the first Nigerian National Curriculum Conference in 1969, the Nigerian Education Research Council (NERC) adopted the Process Approach to science in developing the new National Science Curricula for Nigerian Schools. It was therefore necessary to examine reflected in the primary and secondary schools as well as the tertiary levels of education, using the 9 year Basic Education Curricula for Basic Science and Technology Primary 1-3, (FME, 2012), primary 4-6 (FME, 2012) JS1-3 (FME, 2012) senior secondary

curricula for Biology (FME, 2009), Physics (FME, 2009) and Chemistry (FME, 2009), General Chemistry 1 Laboratory Manual and Physics I Laboratory Manual of the University of Uyo. This was with a view to helping not only the teachers that are practicing but also the pre-service teachers to become aware of the curricula demands of science programmes at their respective levels.

As a guide in identifying the activities, emphasis was placed on the development of the outlined skills. Some verbs and phrases used in identifying the behavioural objectives for the various topics in the curricula were also stated as in Table 2 below: content, objectives, resource materials, teacher's activities and learner's activities.

Table 2: Verbs And Phrases Used In Defining The Behavioural Objectives For Each Process Skill

Process Skill	Verbs and Phrases used
Observation	Identify, note, know, recognize, discover, observe, compare, notice, depict, appreciate, locate
Classification	Collect and list, sort, give examples, classify, arrange, group, select, distinguish, between, compare
Measurement	Measure, calculate, estimate, determine, weigh
Counting numbers	Read meter, convert temperature scales, calibrate, plot graph, count, calculate
Communication	Explain, describe, mention, draw a list, list, show, outline, enumerate, name, narrate, state, educate, illustrate, discuss, recapitulate, write, give names, record, take readings, tabulate
Raising questions	
Inference	State implication, infer, deduce, draw conclusion
Prediction	Suggest reasons, propose measures, predict, use theory to explain
Hypotheses	Formulate hypotheses
Experimentation	Demonstrate, analyze, perform, show experimentally, filter, test, use instrument, locate parts, set up, carry out experiment, titrate, establish relationship, trace, dissolve, heat, boil, add, warm, cool, obtain images, care for instruments
Operation definition	Define, explain concepts
Model formulation	Construct a working model
Data interpretation	Show relationship, interpret symbols or plans
Controlling variables	State factors influencing, state precautions
Manipulation	Construct shapes, place and label, enlarge and reduce, fix drawing sheets, write freehand, sharpen pencil, draw border, use and sketch, carry out operations, produce, apply skills, create and send, connect, set up, edit, format, operate, load and exit, practice, print, open, save, mix, improvise, manipulate, derive, generate, verify, electroplate, compute, evaluate, solve, produce, fold and bend
Space/time relationship	Resolve vector, derive range, height and time of flight, use Cartesian system, plot distance/time graph
Operational Definition	Define, state the meaning of
Raising Questions	Ask, inquire

Source: Modern Aspects of Integrated Science (H.C.O Aniodoh)

From Table 2, it is observed that the skills of raising questions do not feature directly under performance objectives. This may be because scientific investigations begin with questions and the outcome of such investigations usually provide answers to such questions, hence indicating the learners' achievement. In assessing and evaluating the learners acquisition of process skills after practical instruction in the classroom/laboratory, words like how, when, why and where are always used. Raising questions is therefore a vital process skill.

Manipulative skills take various forms. Many instruments and processes are applied in development of this science process skill. These various instruments are dealt with using varying words and phrases. For instance in computerization, words like open, retrieve, format, save load create, send exit, close, etc are used. These terms may not apply in other areas of manipulation and thus a variety of words are used to measure it as observed in the curricula surveyed.

Results

Process Skills Emphasized in Primary, Secondary and Tertiary Levels of Education

Table 3: Process Skills in Lower Basic (Primary 1-3) Curricula

Class \ Process Skill	Observation	Classification	Measurement	Counting numbers	Communication	Raising Questions	Inference	Prediction	Hypotheses	Experimentation	Operational definition	Model formulation	Data interpretation	Controlling variables	Manipulation	Space/time Relationship	Total
Primary 1 BST	2	13	-	-	20	-	-	-	-	12	-	-	-	-	3	-	-
Primary 2 BST	6	1	-	-	2	-	-	-	-	3	-	-	-	-	6	-	-
Primary 3 BST	9	3	1	-	45	-	-	-	-	8	-	-	-	-	-	-	-
Total	**17**	**17**	**1**	**0**	**67**	**0**	**0**	**0**	**0**	**23**	**0**	**0**	**0**	**0**	**9**	**0**	

Data in Table 3 show that at the Primary 1-3 levels, BST teaching emphasizes science process skills of communication as the most frequently used skill (67), followed by experimentation (23), observation and classification (17) and manipulation in that order respectively.

Table 4: Process Skills in Middle Basic (Primary 4-6) Curricula

Class \ Process Skill	Observation	Classification	Measurement	Counting Numbers	Communication	Raising Questions	Inference	Prediction	Hypotheses	Experimentation	Operational definition	Model formulation	Data interpretation	Controlling variables	Manipulation	Space/time Relationship	Total
Primary 4 BST	8	12	1	-	63	-	-		-	6	2	-	-	-	17	1	
Primary 5 BST		29	1	-	67	-	-	1	-	2		-	-	-	12		
Primary 6 BST	2	25	1	-	63	-	-		-	6	2	-	-	-	41	1	
Total	**10**	**66**	**3**	**0**	**193**	**0**	**0**	**1**	**0**	**14**	**4**	**0**	**0**	**0**	**70**	**2**	

Data in Table 4 show that at the Primary 4-6 levels, BST teaching emphasizes science process skills of communication as the most frequently used skill (193), followed by manipulation (70), classification (66) and experimentation (14), observation (10), measurement (3), space/time relationship (2) and prediction in that order respectively.

Table 5: Process Skills in Upper Basic (Junior Secondary 1-3) Curricula

Class \ Process Skill	Observation	Classification	Measurement	Counting Numbers	Communication	Raising Questions	Inference	Prediction	Hypotheses	Experimentation	Operational definition	Model formulation	Data interpretation	Controlling variables	Manipulation	Space/time Relationship	Total
JS1 BST	13	11	1	1	82	1	-	-	-	19	8	-	-	-	6	-	
JS 2 BST	18	5	2	3	64	-	-	-	-		9	-	-	3	13	-	
JS 3 BST	15	2	-	1	14	-	-	-	-	13	4	-	2	-	31	-	
Total	**46**	**18**	**3**	**5**	**290**	**01**	**0**	**0**	**0**	**32**	**21**	**0**	**2**	**3**	**50**	**0**	

Data in Table 5 show that at the Junior secondary level JS1-JS3 BST teaching emphasizes science process skills of communication (290) as the most used, followed by manipulation (50), observation (46), experimentation (32), operational definition (21), classification (18), observation (10), measurement (3) and controlling variables (3), data interpretation (2) and raising questions (01) in that order respectively.

Table 6: Process Skills in Senior Secondary Chemistry Curricula

Class \ Process Skill	Observation	Classification	Measurement	Counting Numbers	Communication	Raising Questions	Inference	Prediction	Hypotheses	Experimentation	Operational definition	Model formulation	Data interpretation	Controlling variables	Manipulation	Space/time Relationship	Total
SS 1 Chemistry	5	10	-	-	34	-	1	1	-	7	5	-	-	-	4	-	
SS 2 Chemistry	6	8	1	-	79	-	-	1	-	14	8	-	2	-	13	-	
SS 3 Chemistry	3	4	-	-	48	-	-	-	-	9	1	-	-	-	2	-	
Total	**14**	**22**	**1**	**0**	**161**	**0**	**1**	**2**	**0**	**30**	**14**	**0**	**2**	**0**	**18**	**0**	

Data in Table 6 show that at the senior secondary level SS1-SS3 Chemistry teaching emphasizes science process skills of communication as the most frequently used skill (161), followed by experimentation (30), classification (22), manipulation (18), observation (14), operational definition (14), data interpretation (2) and prediction (2), measurement (1) and inference (1), in that order respectively.

Table 7: Process Skills in Senior Secondary Biology Curricula

Class / Process Skill	Observation	Classification	Measurement	Counting Numbers	Communication	Raising Questions	Inference	Prediction	Hypotheses	Experimentation	Operational definition	Model formulation	Data interpretation	Controlling variables	Manipulation	Space/time Relationship	Total
[illegible]ology	4	2	-	-	33	-	8	-	-	4	2	1	1	-	-	-	
[illegible]gy	6	8	1	-	44	-	-	1	-	14	8	-	2	-	13	-	
[illegible]ology	3	4	-	-	48	-	-	-	-	9	1	-	-	-	2	-	
[illegible]	13	14	1	0	125	0	8	1	0	27	11	1	3	0	15	0	

Data in Table 7 show that at the senior secondary level SS1-SS3 Biology teaching emphasizes science process skills of communication as the most frequently used skill (125), followed by experimentation (27), manipulation (15), classification (14), observation (13), operational definition (11), raising questions (8), data interpretation (3), measurement (1), and prediction (1) and model formulation (1) in that order respectively.

Table 8: Process Skills in Senior Secondary Physics Curricula

Class / Process Skill	Observation	Classification	Measurement	Counting Numbers	Communication	Raising Questions	Inference	Prediction	Hypotheses	Experimentation	Operational definition	Model formulation	Data interpretation	Controlling variables	Manipulation	Space/time Relationship	Total
[illegible] Physics	12	10	-	-	15	-	2	2	1	5	-	-	-	-	11	-	
[illegible] Physics	11	7	2	-	46	-	2	-	-	18	-	1	5	-	33	2	
[illegible] Physics	12	3	-	-	51	-	2	-	-	10	-	-	-	-	23	-	
Total	35	20	2	0	112	0	6	2	1	33	0	1	5	0	67	2	

Data in Table 8 show that at the senior secondary level SS1-SS3 Physics teaching emphasizes science process skills of communication as the most frequently used skill (112), followed by manipulation (67), observation (35), experimentation (33), classification (20), raising questions (6), data interpretation (5), measurement (2), and prediction (2) space/time relationship (2), hypothesis (1), model formulation in that order respectively.

Table 9: Process Skills in General Chemistry 1 Laboratory Manual of the University of Uyo

Experiment \ Process Skills	Observation	Classification	Measurement	Counting Numbers	Communication	Questioning	Inference	Prediction	Hypotheses	Experimentation	Operational definition	Model formulation	Data interpretation	Controlling variables	Manipulation	Space/time Relationship
Expt 1	-	-	8	4	5	-	-	-	-	4	-	-	-	-	17	-
Expt 2	-	-	5	2	4	-	-	-	-	23	-	-	-	-	12	1
Expt 3	4	-	4	4	6	-	-	-	-	18	-	-	-	-	14	-
Expt 4	-	-	1	-	-	-	-	-	-	3	-	-	-	-	6	-
Expt 5	2	-	3	-	1	-	-	-	-	7	-	-	-	-	-	-
Expt 6a	12	-	8	4	10	-	-	-	-	9	-	-	-	-	-	-
Expt 6b	1	-	2	2	-	3	-	-	-	-	-	-	-	-	-	-
Expt 6c	1	1	-	-	-	5	-	-	-	-	-	-	-	-	2	-
Expt 7	-	-	-	1	-	2	-	-	-	-	-	1	2	-	3	-
Expt 8	-	-	-	-	1	-	1	-	-	-	-	1	-	-	-	-
Expt 9	1	1	-	3	3	2	-	-		1	2	-	-	-	3	-
Total	**21**	**2**	**31**	**20**	**30**	**12**	**0**	**1**	**0**	**64**	**1**	**4**	**2**	**0**	**57**	**1**

Data in Table 9 shows Process skills in General Chemistry 1 Laboratory manual with experimentation as the highest utilized (64) followed by manipulation (57), measurement (31), communication (30), observation (21), counting numbers (20). questioning (12), model formation (4). classification (2), data interpretation (2). prediction (1) definition (1) and space/time relationship (1) in that order respectively.

Table 10: Process Skills in Physics 1 Laboratory Manual of the University of Uyo

Experiment \ Process Skills	Observation	Classification	Measurement	Counting Numbers	Communication	Questioning	Inference	Prediction	Hypotheses	Experimentation	Operational definition	Model formulation	Data interpretation	Controlling variables	Manipulation	Space/time Relationship
Expt 5.1	2	-	1	1	1	-	1	1	-	1	-	-	-	-	6	-
Expt 5.2	-	-	5	1	1	-	-	-	-	1	-	-	-	-	7	-
Expt 5.3	-	-	2	1	3	-	2	1	-	1	-	-	1	-	3	1
Expt 5.4	1	-	2	-	-	-	-	-	-	1	-	-	-	-	-	1
Expt 5.5	-	-	2	2	5	-	1	-	-	2	-	-	1	-	7	1
Expt 5.6	-	-	1	-	1	-	-	-	-	1	-	-	-	-	-	-
Expt 5.7	-	-	3	1	5	-	1	1	-	1	-	-	2	-	2	-
Expt 5.8	-	-	3	3	2	-	-	-	-	2	-	-	-	-	5	-

Expt 5.9	-	-	2	3	2	-	-	1	-	4	-	-	1	-	3	1
Expt 5.10	-	-	-	-	2	-	-	1	-	2	-	-	3	-	-	5
Expt 5.11	-	-	2	2	1	-	-	-	-	1	-	-	-	-	-	-
Expt 5.12	-	-	2	1	-	-	-	-	-	3	-	-	-	-	4	-
Expt 5.13	-	-	3	2	2	-	-	-	-	2	-	-	-	-	1	-
Expt 5.14	-	-	2	2	1	-	-	-	-	1	-	-	-	-	1	-
Expt 5.15	-	-	5	1	3	-	-	-	-	1	-	-	-	-	5	1
Expt 5.16	-	-	3	1	1	-	1	1	-	2	-	-	-	-	1	1
Expt 5.17	-	-	1		2	-	1	-	-	2	-	-	1	-	2	-
Expt 5.18	-	-	2	1	3	-	-	-	-	4	-	-	1	-	1	-
Expt 5.19	-	-	0	1	1	1	-	-	-	3	-	-	-	-	2	-
Expt 5.20	-	-	1	1	2	-	-	1	-	1	-	-	-	-	-	-
Expt 5.21	1	1	4	-	1	2	-	-	-	3	-	-	3	-	4	-
Expt 5.22	-	-	3	-	3	2	-	-	-	1	-	-	-	-	-	1
Expt 5.23	-	-	2	-	2	4	-	4	-	1	-	-	-	-	1	-
Expt 5.24	-	-	1	1	2	-	-	-	-	5	-	-	1	-	1	-
Expt 5.25	-	-	1	1	3	-	1	-	-	3	-	-	1	-	3	-
Expt 5.26	-	-	2	1	5	-	1	-	-	6	-	-	-	-	1	-
Expt 5.27	-	-	2	1	4	-	-	-	-	5	-	-	-	-	2	-
Expt 5.28	-	-	3	-	1	2	-	-	-	1	-	-	-	-	3	-
Total	**4**	**1**	**60**	**28**	**59**	**11**	**9**	**11**	**0**	**61**	**0**	**0**	**15**	**0**	**60**	**12**

Data in Table 10 shows Process skills in General Physics 1 Laboratory Manual with experimentation as the highest utilized experimentation (61) followed by measurement (60), manipulation (60), communication (59), counting numbers (28), data interpretation (15), space/time relationship (12), questioning (11), prediction (11), inference (9), observation (4), classification (1), data interpretation (2), definition (1) and in that order respectively.

Table 11: Process Skills in Biology 1 Laboratory Manual of the University of Uyo

Process Skill / Practical	Observing	Classifying	Measuring	Counting numbers	Communicating	Questioning	Inferencing	Predicting	Hypothesizing	Experimenting	Defining Operationally	Formulating model	Interpreting Data	Controlling variables	Manipulating	Space /time relationship
Practical 1	-	-	-	1	5	-	-	-	-	-	4	-	-	-	1	-
Practical 2	-	-	-	-	1	-	-	-	-	-	-	1	-	-	1	-
Practical 3	-	-	3	-	3	3	-	-	-	5	-	-	-	-	8	-
Practical 4	3	-	2	-	1	-	-	-	-	7	-	-	2	5	11	-
Practical 5	5	-	1	-	6	2	-	-	-	4	-	-	-	-	5	-
Practical 6	1	-	2	-	2	-	-	-	-	-	-	-	1	-	3	-
Practical 7	4	2	-	4	1	1	-	-	-	-	-	-	-	-	-	-
Practical 8	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Practical 9	6	2	3	4	6	2	-	1	-	6	-	1	-	2	7	-
Practical 10	6	4	2	2	1	-	-	1	-	3	-	-	-	1	7	-
Practical 11	3	3	3	2	1	-	-	2	-	1	1	-	-	2	4	-
Practical 12	1	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Practical 13	1	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Practical 14	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	31	14	16	13	30	8	0	4	0	26	5	2	3	10	47	-

Data in Table 11 shows process skills in General biology 1 Laboratory manual with manipulation (47), as the highest utilized skill, observation (31), communication (30), followed by experiment (26), measurement (16), classification (14), counting numbers (13), controlling variables (10), questioning (8), operational definition (5), inference (4), data interpretation (3), model formulation (2) in that order respectively.

Table 12: Number of Process skills Identified in each Level of Education

Skills	Lower Basic	Middle Basic	Upper Basic	SS Level	Tertiary Level	Summary
Observation	√	√	√	√	√	5
Classification	√	√	√	√	√	5
Measurement	√	√	√	√	√	5
Counting Numbers			√	√	√	
Communication	√	√	√	√	√	5
Raising Questions			√		√	
Inference				√	√	
Prediction		√		√	√	
Hypotheses				√		
Experiment	√	√	√	√	√	5
Operational definition		√	√	√	√	
Model formulation				√	√	
Data interpretation			√	√		
Controlling variables			√		√	
Manipulation	√	√	√	√	√	5
Space/time relationship		√		√	√	
Total	**6**	**9**	**11**	**13**	**14**	

As observed on Table 12 the number of process skills increase progressively from 6 in the lower basic level to 14 in the tertiary level of education. This corresponds with the level of cognitive and physical maturity of the students at the various levels of education.

With these process skills, several career opportunities abound in the different areas of science. Table 1 summarizes these areas of science and the various career opportunities.

Discussion

Socio-economic development is a process of qualitative change and quantitative growth of economic reality. It is the quality of science process skills students have acquired to generate capacity for career opportunities to plan into the future, while national development is a nation's ability to improve the welfare of its citizens. The numbers in Tables 3 to 12 represents the frequency of occurrence of the various process skills. In the lower basic, it could be observed that the following basic process skills-observation, classification and communication are emphasized while two integrated process skills-experiment and manipulation are also emphasized. Measurement, prediction, operational definition and space/time relationship are at a lover frequency of occurrence. A total of 9 process skills have been identified. In the middle basic, classification, communication, manipulation and experimentation are enhanced.

In the upper basic, controlling variables, counting numbers, raising questions and data interpretation have been added while space and time relationship have been dropped giving a total of eleven process skills, six basic and five integrated process

skills. In the senior secondary chemistry, emphasis is placed on observation, classification, communication, experiment, operational definition and manipulation with measurement, inference, prediction and data interpretation sparsely distributed. In senior secondary biology, the same trend is observed but the frequency of occurrence of inference is increased from one to eight and model, formulation is introduced. In the senior secondary physics, the pattern of biology is followed but with the introduction of hypotheses and space/time relationship here, twelve process skills have been identified. Looking at General Chemistry 1 Laboratory Manual of the University of Uyo, three process skills have not been identified. These are inference, hypotheses and controlling variables. From Physics 1 Laboratory Manual, hypothesis operational definition, model formulation and controlling of variables have not been identified. A total of fourteen process skills have been emphasized in the tertiary level of education. This is because students have developed critical and higher order analytical thinking for problem-solving.

Generally, communication runs through lower basic to senior secondary with highest frequency of occurrence. In the lower basic, experiment, observation and classification are also prominent in describing order.

- In the middle basic, manipulation and classification are prominent.
- In upper basic manipulation, observation and experiment are prominent.
- In senior secondary chemistry, experiment, operational definition are outstanding.
- In biology, experiment, manipulation, classification and observation are more frequent.
- In physics manipulation, observation, experiment and classification are prominent.
- In the tertiary institution, the frequency of communication skills is lower. Experiment has the highest frequency followed by manipulation, measurement and communication as observed in General Chemistry 1 Laboratory Manual. In Physics 1 Laboratory Manual, experiment has the highest frequency followed by manipulation and measurement and then communication.

From the above discussion one can infer that the basic skill of communication is emphasized in the primary and secondary levels of education although experiment and manipulation are also prominent, while experimentation and manipulation.-integrated skills are emphasized in the tertiary level although measurement and communication are very prominent. As the level of education increases, the number of process skills also increase (from six the lower basic to 14 in the tertiary level). Raising questions does not feature throughout primary and secondary level but feature in tertiary, operational definition features in primary and secondary level but not in tertiary level. Hypotheses and controlling of variables are rarely used at all levels but are mostly applied in a higher or special cognitive level of education during research work. From tables 3-10, four basic skills and two integrated skills are observed from primary level to tertiary level. They run through all the levels of education. Generally, all the sixteen process skills feature in the science curricula appearing and disappearing at one level of education or the other and sometimes with very low frequency count. All the skills are important in the child's development. Table 11 gives summary of the distribution of each process skill in the five levels of education.

Science process skills in STEM education enables learners to develop skills that could be used in solving everyday problems. Since process skills is activity oriented and learner centered, it encourages maximum students participation in the

learning activities. It motivates students and increases interest in the learning process. Science process skills enable the development of scientific method of thinking, facilitates concept formation emanating from primary experiences which the learner will encounter during the skills acquisition process. It also creates confidence in the learner acquisition of materials needed for its actualization. These skills are very vital in developing the socio economic health of the society and should be emphasized and property implemented at all levels of education.

Conclusion

Science process skills meet students' basic needs of career opportunities to contribute and respond to the socio-economic requirements of individuals and nation.

Recommendations

1. Science process skills as emphasized, should be properly implemented at all levels of education to facilitate students' acquisition of skills to explore abundant career opportunities.
2. Process skills should be taught by teachers to increase learners' skills content to boost their capacity for future engagement on global competitiveness.
3. More time should be allotted to science subjects since the inculcation of these skills is time consuming.
4. Educational stake holders like the science teachers association of Nigeria should channel large amount of resources into science education teaching to nurture and encourage emerging skill-based learning.

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