REASONING PATTERNS AMONG JUNIOR SECONDARY SCHOOL STUDENTS ABOUT BIOLOGICAL PHENOMENA IN BASIC SCIENCE IN ENUGU EDUCATION ZONE

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Abstract

This study was aimed at finding out the reasoning patterns among Junior Secondary school students about Biological phenomena in Basic science *in Enugu Education Zone. Survey research design was adopted. Ten (10) Schools were sampled out of the forty (40) secondary schools in the Zone. In each of the ten (10) schools, seven (7) students from the three Junior classes JSI, JSII and JSIII, was sampled for the research. The Instrument for data collection were structured questionnaire (SQ) that was administered to a sample of 210 respondents and structured interview Schedule (SIS) used in interviewing thirty (30) students that were further sampled out from the 210 respondents, (ie 3 students from each school). Data Collected for research questions 1 and 2 were answered using mean and Standard deviation while research question 3 was answered using Percentages. The findings are that the students answer questions on animal prompts more than plant prompts. They respond more correctly to questions on "How" biological phenomena occur, than question on "Why" biological phenomena occur.*

Introduction

Concepts are ideas used by an individual to organize or interpret phenomena. These could be acquired over time through learning. Piaget (2015) stated that cognitive development is a progressive reorganization of mental processes as a result of biological maturation and environmental experiences. He states that there is a stage in life when one will want to know everything, thereby proposing the questions of "why" and "how come". This is the stage of emergence in the interest of reasoning and wanting to know why things are the way they are.

According to Mbajiorgu (2003), learning involves more than acquiring a repertoire of correct responses which is the realm of verbal learning. It influences an individual's idea about phenomena, how he/she interprets it and how he incorporates new concepts into his existing understanding and belief. Again, individual's interactions with his/her environment right from birth help one to develop some knowledge structures and conceptions with which he/she explains phenomena. Ideas come as a result of previous interactions received by an individual.

Gagne (1965), in his submission, stated that the acquisition of knowledge is a process in which every new capability build on a foundation established by previously learned capabilities. Nevertheless, certain conceptions can be used on wrong assumptions or wrong sources of knowledge other than from science classroom. For instance, in the South Eastern Nigeria, the Igbo's in the olden days erroneously assumed that an uncircumcised female child was prone to live a promiscuous life. This stance remains an issue for debate. Female circumcision is currently becoming a thing of the past and there are no proofs that uncircumcised females live more promiscuous life than the circumcised females.

Conceptions based on wrong assumption as the aforementioned, have far- reaching effects on the qualities of explanation of biological phenomena given by students. Wrong conception otherwise called alternative conceptions has been defined by Wiggons and Mctighe (1998) as students' understanding of scientific concepts that are not aligned with the current understanding of scientists. According to Gelman (2003), students enter classroom with wealth of knowledge about their physical, scientific and social worlds. They construct their own ideas about how the world works and explain biological phenomena in terms of those ideas. These kinds of notions are referred to as natural beliefs, alternative conceptions and such preconceptions rarely match scientific explanations that are taught in science courses.

According to Mbajiorgu (2003), children's alternative conceptions are of great relevance to conceptual change theory. This is so because the aims of conceptual change theory are to shift or restructure wrong existing knowledge and beliefs to correct conceptions. Conceptual change theory has been generally defined as learning that changes an existing conception (i.e. beliefs, ideas, or way of is the stage of emergence in the interest of reasoning and wanting to know why things are the way they are.

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Misconception can arise as a result of how the child views the nature of objects and events. If the student views are wrongly placed, then misconception will arise. Also, the culture of a community can bequeath some non-scientific conceptions to an individual and expose him/her to sources of knowledge that are not scientific.

There are two schools of thoughts in the explanation of the nature of these alternative conceptions. These two schools of thought are the 'theory' theorists and the "knowledge in pieces theorists. The advocates of 'Theory" theory like Carey (1985) stated that the student's conception and knowledge are systematic enough to be called a theory. They conceive learner's knowledge as theory – like, and that knowledge structures are basically coherent, systematic and consistent. This theory has implications for classroom teaching and learning process because, if a learner already has a framework of wrong ideas prior to classroom instruction, it may be difficult to build in the correct or right ideas. Alternative conceptions should be identified and changed using the appropriate conception change model.

diSeassa (1988) postulated the theory of knowledge-in- pieces to describe the general position of the second school of thought. diSeassa stated that naïve ideas are many, diverse, fragmented and display limited integration or coherence. diSeassa emphasizes that student(s) explanation of the physical world are seen as spontaneous constructions and not coherent theories or systematic frameworks. These students' spontaneous constructions result from the activation of fundamental knowledge elements which diSessa (1993) described as phenomenological primitives (P-Prims). P-Prims are understood to be atomistic knowledge structures that are automatically and unconsciously activated by the learner in response to a particular situation.

The implication of the theory of knowledge-in- pieces to classroom teaching and learning processes are that teachers seek to shape students' reasoning patterns, building on what students know, instead of seeking to dismantle pre-existing fragmented structures. However, according to Atran (1995 & 1998) and Wellman and Gelman (1998), intuitive theorists provide some bases to make sense of everyday world without any formal training. They stated that the importance of intuitive biology and psychology is to help identify living things as being naturalistic, and that animate behavior is functional, intentional or natural.

Intuitive theories provide a conceptual framework that makes it possible for Individuals to make sense of their thinking). Posner (1982) defined conceptual change as a learning process in which an existing conception (idea or belief about how the world works) held by a student is shifted and restructured often away from an alternative or misconception towards the dominant conception held by experts in a field.

Learning for conceptual change is not merely accumulating new facts or learning new skill. In conceptual change, an existing conception must be fundamentally changed or even replaced. According to Davis (2000), conceptual change primarily involves:

1. uncovering student's preconceptions about topic or phenomenon and
2. using various techniques to help students change their conceptions.

Conceptual change instruction can help students overcome misconceptions and learn difficult concepts in all subject areas. In Mbajiorgu (2003), it was stated that for better understanding of conceptual change theory, one needs to understand the difference between an alternative conception, a prior or preconception and misconception.

Tanner and Allen (2005), stated that while there were rationales behind the use of each term, that alternative conception was used to denote student understanding of scientific concepts that are not aligned with the current understanding of that concept by scientists. In her own submission, Mbajiorgu (2003) states that alternative conception, which can also be referred to as pre or prior conception is an idea or conception that has not attained the status of a scientifically correct conception.

When an alternative conception continues to dominate an individuals' mind as well as a community of people, it means that it would be difficult to replace. Take for instance, in Mbajiorgu, Ezechi, and Idoko (2007) it is common place view, among the Igbo tribe that it was the fault of the woman to be giving birth to only baby girls. This view was held by an average Igbo man and surprisingly, even among some elites. This view was maintained despite the fact that science had shown that it was the man that possessed the chromosome for the determination of the sex of a child.

Misconception according to Mbajiorgu (2003), is a wrong conception that arises in the course of an instruction. She pointed out that during the course of an instruction, a student may misunderstand what the teacher is teaching. Tanner and Allen (2005), stated therefore, that in teaching towards understanding of major concepts in science and achieving conceptual change for students, it is necessary, to understand students prior knowledge, examine it, identify confusions and then provide opportunities for the old and new behavior of an ant colony or a beehive will convince most people that ant or bee activities are purposeful. These insects systematically search for food and bring it back to the home base to feed the younger ones.

Yet, insects, even ants, cannot reason about goals, because they cannot think, they are not wondering where the next meal is coming from or how to satisfy the different food needs of the young ones. Their behavior only appears to be goal directed, in reality, insects are responding to environmental cures and internal signals.

Intentional Reasoning

Human beings are naturally inclined to attaching meaning to issues and events. According to Malle (2001), human behaviour are to be treated as special. Intentional reasoning are those in which the agent believes that his or her action will lead to a desired outcome. Human behaviour is likely to be considered as intentional if the agent believes that his or her behaviour will lead to an outcome and if the agent has the skill and awareness required to perform the behavior that leads to the outcome.

Statement of the problem

As was observed by Amachi (2002), biology as a subject registers the highest percentage failure among science subjects offered by school certificate candidates. Adeyebe (1993) stated that some of the possible reasons for students' poor performances might be due to misinterpretation and ambiguous explanations of biological concepts arising from poor mastering and retention of scientific concepts. Junior Secondary Education forms the basis for development of students' explanatory patterns and poor understanding of biological concept at this level will affect their performance at higher levels, the question therefore is what are the reasoning patterns that these students adopt in their explanation of biological phenomena in Basic Science.

Purpose of the Study

The purpose of this study was to ascertain the reasoning patterns used by JS1, JSII and JSIII students in Enugu education Zone in their explanation of biological phenomena in basic science, using three animals and two plants as specimen prompts. Specifically, the researcher intended to find out the following:

1. The mean and standard deviation of the reasoning patterns used in explanation of biological phenomena in basic science by all JSI, JSII and JSIII students.
2. The mean and standard deviations of all JS1, JSII and JSIII students'

ideas to agree.

Misconception can arise as a result of how the child views the nature of objects and events. If the student views are wrongly placed, then misconception will arise. Also, the culture of a community can bequeath some non-scientific conceptions to an individual and expose him/her to sources of knowledge that are not scientific.

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The implication of the theory of knowledge-in- pieces to classroom teaching and learning processes are that teachers seek to shape students' reasoning patterns, building on what students know, instead of seeking to dismantle pre-existing fragmented structures. However, according to Atran (1995 & 1998) and Wellman and Gelman (1998), intuitive theorists provide some bases to make sense of everyday world without any formal training. They stated that the importance of intuitive biology and psychology is to help identify living things as being naturalistic, and that animate behavior is functional, intentional or natural.

Intuitive theories provide a conceptual framework that makes it possible for Individuals to make sense of their deviation of all JSI, JSII and JSIII students' response on animal and plant specimen prompts.

3. What percentage of JSI, JSII and JSIII students, responded correctly to 'how' and 'why' biological phenomena occur, in basic science.

Research Methodology

Survey design was adopted in the study. The researcher used a sample size of 210 students in Enugu Education Zone. The sampling techniques employed were multi-stage sampling. Firstly, simple random sampling techniques were used to obtain a sample of ten (10) Schools from the forty (40) secondary schools in Enugu Education Zone.

Secondly, simple random sampling techniques were used to obtain a Sample of twenty-one (21) students that responded to questionnaire items from each of the ten (10) sampled schools. Finally, simple random sampling techniques was used to obtain a sample of three (3) students out of the twenty-one (21) students from each school who were interviewed.

The instruments used for data collection were structure questionnaire (SQ) and Structured Interview Schedule (SIS), which were validated by three experts in science and computer education. The structured questionnaire contained 15 items developed based on five (5) specimen prompts. The questionnaire was of a four point rating scale. The responses obtained from the administered questionnaire were calculated using cronbach's alpha that gave a co-efficient of 0.86, indicating that the instrument has high reliability.

The structured questionnaire and the structured interview schedule were developed based on the following five (5) specimen prompts. These specimens' prompts were coloured pictures labeled Plates A- E.

Plate A = Agama Lizard with scales
Plate B = Rabbit with furry coat
Plate C = Dodder plant with sucker
Plate D = Cactus with spines
Plate E = Cockroach with antenna

Three questionnaire questions were structured for each specimen prompts, while interview questions ranging from 6 to 12 in number were asked for each specimen prompt. A total of 36 interview questions were asked excluding contingency questions. These structured questionnaire and structured interview schedule were meant to address the genetic features of the specimen prompts like;

- The purpose of the features in the organism.
- How the organism got those features.
- Whether the organism develop those features intentionally.

Both the SQ and SIS were designed to elicit data relating to students reasoning patterns and their explanation of biological phenomena in basic science curriculum.

everyday world, without any formal training (Atran, 1995, 1998, Wellman and Gelman,1998). Intuitive reasoning works wonderfully on a day to day basis. It only causes difficulty when we try to understand ideas that are outside the realm of everyday experience. There are cognitive premises from intuitive biology and psychology that identify living things as being separate stable and unchanging (Naturalistic), and that animate behaviour is goal-directed (functional) and with motives (intentional).

Naturalistic (Essentialist) Reasoning

Psychological essentialism (Medin and Ortoing, 1989) gives rise to essentialist beliefs in the unique identity of each living kind. Humans act as if each living kind has an underlying essence that makes it what it is. This is a very useful aspect of everyday reasoning in that we ignore the dynamic aspects of the world around us and focus on the stability. It is much easier for young children for example, to work out what is happening in a world that is perceived as essentially the same from day to day.

Naturalistic thinking may also underlie our ability to categorize and make inferences based on those categories. Gelman (2003),

Table 1
The mean and standard deviation of reasoning patterns used by JSI, JSII and JSII students in their explanation of biological phenomena

Patterns	Mean	Standard deviation	Decision
Intentional Reasoning.	3.25	0.75	Accept
Functional Reasoning	3.19	0.69	Accept
Naturalistic Reasoning	2.57	0.07	Accept

The table above reveals that intentional reasoning pattern has a mean of 3.25 and standard deviation of 0.75, therefore indicating that students are more inclines to attribute every phenomenon to the motive behind it. They believe that every phenomenon has intended outcome. It is only when motive is understood that the explanation of phenomenon will be best understood.

Research Question 2

What are the mean and standard deviation of all JSI, JSII and JSIII students on animal and plant specimen prompts?

Table 2
Mean and standard deviation of all JS1 JS11 and JS111 students' response on animal and plant specimen prompts.

	ANIMAL			PLANT		
Patterns	**Mean**	**Standard deviation**	**Decision**	**Mean**	**Standard deviation**	**Decision**
Intentional reasoning	3.48	0.98	Accept	2.99	0.49	Accept
Functional reasoning	3.29	0.79	Accept	3.05	0.55	Accept
Naturalistic reasoning	2.60	0.1	Accept	2.56	0.06	Accept
Grand Means	3.12	0.62	Accept	2.87	0.37	Accept

Table 2 above reveals that these students' response to questions on animal specimen prompts has grand mean of 3.12 and standard deviation of 0.62, while their response to questions on plant specimen prompts has grand mean of 2.87 and standard deviation of 0.37. These indicate that the students answer questions on or about animals better than plants.

Research Question 3
What percentage of JSI, JSII and JSIII students responded correctly to the "how" and "why" biological phenomena occur in basic science.

Table 1
The mean and standard deviation of reasoning patterns used by JSI, JSII and JSII students in their explanation of biological phenomena

CLASS	HOW	WHY	DON'T	TOTAL
JSI count in %	31 44%	22 32%	17 24%	70 100%
JSII count in %	32 46%	24 34%	14 20%	70 100%
JSIII count in %	32 46%	25 36%	13 18%	70 100%
Total count in %	95 45%	71 34%	44 26%	210 100%

The above table reveals that 95 student representing 45% responded correctly to "how" biological phenomena occur , 71 students representing 34% responded correctly to "why" biological phenomena occur and 44 students representing 21% did not know what to say about how or why biological phenomena occur in basic Science.

Summary of Findings

The results presented revealed the following:

1. That the students use more of intentional reasoning pattern with a mean of 3.25 in their explanation of biological phenomena in basic science.
2. That the students responded more to questions on animals with a mean of grand mean 3.12 than questions on plants;
3. That the students responded more correctly to questions on "how" biological phenomena occur in basic science with a percentage of 45% than they responded to questions on "why" biological phenomena.

Discussions

Table 1 reveals that those students are at close range in their use of intentional and functional reasoning patterns, however, they use intentional reasoning pattern more in explanation of biological phenomena in basic science. diSeassa

(1988) emphasized that students explanation of the physical world are seen as spontaneous construction (and not coherent theories or systematic frameworks). These students' spontaneous constructions result from the activation of fundamental knowledge elements which diSeassa (1993) described as phenomenological primitives (P-Prims). P-Prims are understood to be atomistic knowledge structures that are automatically and unconsciously activated by the learner in response to a particular situation.

Gopnik and Meltzoff (1997) stated that children's understanding of objects and object appearances start of as highly theoretical, and develops in response to new experience until they achieve adult form.

Carey (1985), stated that children's theory of life is focused initially around humans and only later becomes generalized as they discover commonalities among all animals and other living things, and that the very concept of living things comes to be acquired as this knowledge develops. This may be the reason why the mean response of Junior Secondary school students to animal specimen prompts were higher than their responses to plant prompts in all the reasoning patterns studied.

Fields (1961),stated that for every biological phenomena there are two causal explanations, a proximate one (which answers 'how' a change occur) and an ultimate one (which answers 'why' a change occurs). There are inherent problems in determining one correct answer to any question because of multiple levels of causality in biology.

Szymanowski (2008), in his submission said that the type of reasoning children and adults engage in was expected to be influenced by knowledge domain, age, and the type of question asked (why or how). He stated that within the animal domain, it was expected that naturalistic causes would be preferred by children and intentional causes by adults, particularly for "how" questions.

In conclusion, JS1, JS11, and JS111students in Enugu Education Zone use intentional reasoning pattern in their explanation of biological phenomena in basic science. They believe that every phenomenon has intended motive behind its occurrence and that any phenomena can only be understood from the perspective of its intention.

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