

Methods of Teaching SCIENCE, BASIC TECHNOLOGY AND COMPUTER STUDIES

Edited by

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PUBLISHED BY

FACULTY OF EDUCATION, UNIVERSITY OF ILORIN, ILORIN, NIGERIA

July, 2016

ISBN: 978-978-954-492-9

Printed by
Haytee Press and Publishing Company Nigeria Ltd
No 2, Mejindadi Street off Taiwo Rd, Ilorin Kwara State, Nigeria.
08038282074, 08033604983
email:tayo_haytee@yahoo.com

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CHAPTER 8

METHODS OF TEACHING SPECIFIC ASPECTS OF BIOLOGY

A.R. Ahmed

Introduction

In this chapter, the methods of teaching specific aspects of biology are discussed. Thus, methods of teaching vocabularies, concepts, rules, principles, laws, and problem solving are discussed. The strategies to be used by biology teachers in the instructions in these specific aspects will be discussed in detail.

1. Method of Teaching Vocabularies in Biology

Traditionally, vocabulary instruction has focused on having students look up for word meanings and memorize them. This teaching approach, however, provides only superficial and short-term learning of words. Students who simply memorize word meanings frequently have trouble applying the information in definitions and often make mistakes about the meanings.

To know a word, students need to see it in context and learn how its meaning relates to the words around it. An approach that includes definitions as well as context can generate a full and flexible knowledge of word meanings. When students are given several sentences that use a word in different ways, they begin to see how a word's meaning can change and shift depending on its context. For example, in the definition of the word biology. In Latin "bio" means life and "logy" study. This may probably be the reason why biology is defined as the study of life. Vocabulary development is an attainable goal. If given the opportunity to learn new words as well as effective instruction, most students can acquire vocabulary at rates that will improve their comprehension. This enables them to read increasingly challenging texts with understanding and their chances for success in school and afterward.

Effective vocabulary instruction should include the following three components:

1. Definitional and contextual information about a word;
2. Multiple exposures to a word in different contexts; and
3. Encouragement of students' active participation in their word learning

Why teach vocabulary?

The answer to this question is not farfetched, as Cynthia and Drew (2006) indicated that *"If we are serious about increasing standards and bringing a greater proportion of school children to high levels of academic accomplishment, we cannot continue to leave vocabulary development to parents, chance, and highly motivated reading."* (p. 1).

In the teaching of the word metamorphosis, in biology, for example, the teacher should show the stages of development of such organism, like the egg, larva, pupa and adult, or as the case may be, their models, or chart to illustrate the stages. Then he/she pronounces the name of each as he/she is showing the students, and then spells the word each on the board. The students will then do likewise, repeat (practice) the same till full understanding

2. Methods of Teaching Concepts in Biology.

A concept is an aggregation of facts that have shown certain significant relationships and patterns. It is a general idea or thought that was subject to further investigation. Such concepts in biology include cell, system, genetics, evolution and many others.

The aims of teaching major concepts in biology are for understanding and achieving conceptual changes for students. (Allen & Tanner, 2005). In teaching major concepts in biology, then, it is necessary for the biology teacher to:-

- i. Understand students' prior knowledge;
- ii. Examine this prior knowledge;
- iii. Identify confusion about the concept; and then
- iv. Provide opportunities for old and new ideas to interact through inquiry-based science strategies.

Furthermore, according to Hubbard(2005), when introducing a new concept, it is important to have an example, physically present to "get its' mass" that is present a physical example, then, a picture or diagram, meaning that learning cannot take place without visual aids. This may probably be the reason why in many biology textbooks, nearly every paragraph is accompanied by a picture. The abstractness of a concept varies from concrete to abstract in terms of its accessibility to observation and visualization. The complexity of a concept varies from simple to complex, in terms of how many other concepts are subsumed by a given concept. This dimension is what contributes to conceptual difficulty in Learning as indicated by Abimbola (2013). The sophistication of a concept depends on the degree of its refinement for learning purposes. It varies from descriptive level, through comparative with quantitative level. The easiest concepts to learn are simple, concrete and descriptive while the most difficult concepts to learn are complex, abstract and quantitative.

Lastly, in overcoming any conceptual difficulties the teacher should realize the nature of these difficulties and use exploratory questions to locate and define the difficulties and assist the students with good dictionaries to solve such problems.

3. Methods of Teaching Rules/Principles in Biology

Principles, canons, and rules imply something established as a standard or test, for measuring, regulating, or guiding conduct or practice. A principle is a general and fundamental truth that may be used in deciding conduct or choice. According to Pawan and Alessandro (2010) "*some of the 'laws' known to biologists are those of Mendelian Inheritance, Metabolic Scaling and the recent Power Laws. Jeong, Tomar, Albert, Oltoai and Barabashi(2000). However, even these laws are not absolute—they come with exceptions. For example, non-random segregation of chromosomes (White, Eykelenboom and Lopen-Vernaza. 2008) and homozygous mutants parenting a normal offspring are deviation from Mendelian Inheritance. The prevailing effect of these exceptions with the overwhelming role of boundary conditions makes paradigms of scientific laws too demanding, like those based on Popper's falsifiability concept which is of little or no use in biology (Stamos 2007).*"p.4

Teaching Rules/principles in biology therefore, involves:-

1. Teacher shows object (or exemplifies idea);
2. then teacher pronounces name and spells on board;

3. students do likewise, repeat (practise) and give name;
4. Teacher elicits statement of idea or description of object; and
5. Teacher asks students to use such rules/principles in context

4. Methods of Teaching Novel/Problems Solving in Biology

Teaching Novel/problems solving in biology involves various strategies. In one,

1. Teacher presents problem;
2. Teacher may ask questions from students to elicit alternative approaches to solution; and
3. Teacher emphasizes desirability of a variety of search strategies, individual work or small group discussions (data collecting, data analysis, making and testing conjectures)

While in another, the teacher

1. Asks students to weigh advantages and disadvantages of proposals (including processes) that arose from group discussions and or individual work;
2. Asks students to **identify specific problems, difficulties, or confusions**. Teachers should not waste time working through problems that students have already understood;
3. If students are unable to articulate their concerns, determine where they are having trouble by **asking them to identify the specific concepts or principles** associated with the problem.
4. Make students **articulate their problem solving process**;
5. In a one-on-one tutoring session, ask the student to **work his/her problem out loud**. This slows down the thinking process, making it more accurate and allowing the teacher to access understanding; and
6. When working with larger groups the teacher can ask students to provide a written **"two-column solution."** Have students write up their solutions to a problem by putting all in one column and all of their reasoning (in complete sentences) in the other column. This helps them to think critically about their own problem solving and helps teacher to easily identify where they may be having problems

It is equally essential for the teacher that when teaching novel/problem solving, he/she should.

- i. Encourage independent problem solving among the students;
- ii. Provide positive reinforcement to let students know when they have mastered new skill or concept ; and
- iii. Carry out the processes with patience and thoroughness with the pace of solving problems by the students till new discovery or invention is attained

5. Teaching Psychomotor Learning (Manipulative skills) in Biology

Traditionally, according to Farmer and Farrel. (1980), teaching psychomotor learning (manipulative skills) involves the following steps:

1. Teacher demonstrates (shows how) one step at a time;
2. Students do each step immediately after Teacher shows each step;

3. Teacher watches students perform each step and gets and gives feedback;
4. then teacher shows several steps put together;
5. Students do several steps put together;
6. Students practise to get closer approximations of correct performance; and
7. Then student practise to increase speed.

But in 2002, the National Guidelines for educating medical students on Psychomotor Skills with Emergency Medical Services (EMS) as applied in Medicine could probably be adapted in biology most especially during Practical's. Experts therefore suggest five levels of teaching psychomotor skills which include:

A. Imitation

1. Student repeats what is done by the instructor
2. "See one, do one"
3. Avoid modelling wrong behaviour because the student will do as you do
4. Some skills are learned entirely by observation, with no need for formal instruction

B. Manipulation

1. Using guidelines as a basis or foundation for the skill (skill sheets)
2. May make mistakes. Making mistakes and thinking through corrective actions is a significant way to learn
3. Perfect practice makes perfect for Practise of a skill is not enough, students must perform the skill correctly
4. The student begins to develop his or her own style and techniques
 - a. Ensure students are performing biologically acceptable behaviours

C. Precision

1. The student has practised sufficiently to perform skill without mistakes
 2. Student generally can only perform the skill in a limited setting
- Example: student may break parts of dissected specimen during biology practical

D. Articulation

1. The student is able to integrate cognitive and affective components with skill performance
 - a. Understand why the skill is done in a certain way
 - b. know when skill is indicated
2. Performs skill proficiently with style
3. Can perform skill in context

Example: student is able to dissect some specimen neatly without braking any part

E. Naturalization

1. Approximations of correct performance
- 2 Mastery level of skill performance
- 3 Can perform skill perfectly in any situation

The teaching of Vocabularies, Concepts, Rules/Principles, Novel/Problems solving and Psychomotor learning (manipulative skills) in biology is summarized with table 1

Table 1: Instructional strategies pattern in the teaching of some aspects of biology

Kinds of content outcomes	Examples	Instructional strategy patterns
Vocabulary	Biology Cell, nucleus, metamorphosis etc	Teacher shows object (or exemplifies idea); then pronounces name and spells on board; students do likewise, repeat (practice), give name; Teacher elicits statement of idea or description of object; Teacher asks students to use the words in context.
Concepts	Cell, Ecology, Genetics, Insect, Nucleus,	Teacher shows differentiated examples in sequence; gets essential and nonessential characteristics identified; elicits operational definition; models by analogy; elicits generalization of the concept to a variety of specific instances not previously used.
Rules/Principles/Laws	Cell theory, Law of thermodynamics, Mendel's laws,	Teacher gets students to recall or review prerequisites; indicates nature of expected terminal performance; cues(via questions, lab work, applications) students to find the pattern by chaining concepts; gets rule stated (by students if possible); asks students to demonstrate several instances of the rule in a variety of situations. Fix and maintain skills by spaced and varied drill.
Novel/Problem Solving	Biotechnology, genetic engineering, Sex Education, overpopulation, pollution	Teacher presents problem; may ask questions from students to elicit alternative approaches to solution; Teacher emphasizes desirability of a variety of search strategies, individual work or small group discussions (data collecting, data analysis, making and

		testing conjectures); Teacher asks Students to weigh advantages and disadvantages of proposals (including processes) that arose from group discussions and or individual work
Psychomotor learning (manipulative skills)	Use of microscope, burette, various balances, dissection instruments.	Teacher demonstrates (shows how) one step at a time; has Students perform each step immediately after Teacher shows each; Teacher watches students perform each step and gets and gives feedback; then teacher shows several steps put together; asks Students to perform several steps put together, practise to get closer approximations of correct performance, then practise to increase speed.

Source: Adopted from Farmer and Farrel (1980). *Systematic instruction in science for the middle and high school years*. Reading, Massachusetts.p173.

Conclusion:

In the teaching and learning of some aspects of biology, biology teachers should bear in mind that various instructional and learning strategies are involved. These could be used to teach and learn those aspects thereby attaining the goals and objectives of biology.

Revision Questions

1. Discuss your understanding of teaching vocabularies in biology
2. What are the learning strategy patterns that are involved in learning psychomotor skills in biology?
3. Select a concept in biology, describe it's teaching and instruction; stating the steps or patterns that are involved
4. How will you teach some laws, rules and principles in biology, for good understanding by the students?

References

- Abimbola, I.O. (2007). *Preparation of Lesson Plans*, Ilorin: Bamitex Printing and Publishing pp.8-12
- Abimbola I.O. (2009).SED 203. *Subject Methodology: Biology*. University of Ilorin, Ilorin, Nigeria. Retrived03/19/2016

- Abimbola, I. O. (2013). *The misunderstood word in science: Towards a technology of perfect understanding for all*. One Hundred and Twenty-third (123rd) Inaugural lectures delivered at the University of Ilorin, Ilorin, Nigeria.
- Abimbola, I.O. (2016). *Learning how to learn for perfect understanding*. Ilorin. Bamitex Printing & Publishing. Pp 58-62
- Alessandro G., & Dhar K.P.(2009). *System and synthetic biology*.retrived online 03/02/2016
- Allen, D., & Tanner, K. (2005). Cell Biology Education. A Journal of Life Science Education. 4, 2,112-117 retrieved on 03/02/2016
- Cynthia and Drew,J. (2006). www.epsbooks.com. retrived on 08/03/2016
- Fajemidagba, M.O. (2009). *Formal instructional methods ii*. In I.O. Abimbola & A.O. Abolade (Eds.). *Fundamental Principles and practice of instruction*. Ilorin: Bamitex Printing press. Pp 149-150.
- Farmer, W.A., &Farrel, M.A. (1980). *Systematic instruction in science for the middle and high school years*. Reading, Massachusetts: Addison-Westey publish company. Pp176-177
- George, P. (2016). *Teaching problem solving*. Centre for Teaching. Vanderbilt University, USA retrieved on 03/21/2016.
- Jeong, H., Tomar, B., Albert, R., Oltoai, Z.N., Barabashi, A.L. (2000) The large scale organisation of metabolic network. *Nature* 2000; 407: 651-654.
- Stamos, D.N. (2007) *Popper laws, and the exclusion of biology from genuine science*. *Acta Biotheor.*;55(4):357-375. doi: 10.1007/s10441-007-9025-6.
- Pawan, K.D., &Alesbandro, G. (2010). Laws of biology: why so few?*NCBI- National Institutes of Health* <http://www.ncbi.nlm.gov/princ/articles>
Principle | Define Principle at Dictionary.com<http://www.dictionary.com/browse/principle>
- White, M.A., Eykelenboom, J.K., &Lopez-Vernaza M.A.(2008) Non-random segregation of sister chromosomes in *Escherichia coli*. *Nature*. ;455:1248-1250.doi: 10.1038/nature07282.