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TEACHING DENSITY AND PRESSURE FOR MEANINGFUL UNDERSTANDING: THE PROBLEM - SOLVING APPROACH

By

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ackground to the Study

ı Nigeria, the importance of Science and Technology had been mphasized. The reason for the increasing concern for Nigeria's rapid evelopment as a nation is that there is no adequate pool of scientific nd technical manpower at all levels of its working population (David, 000).

: was as a result of the recognition given to Physics as a subject in the evelopment of individuals and the nation, that its teaching is accorded prominent position at the senior secondary level of education as ontained in the Nigerian National Policy of Education (FRN, 2004).

n Nigeria, secondary school students often show negative attitude to hysics and this negative attitude has been found to reduce students nrolment as they also perform poorly in the Senior Certificate xaminations The following have been identified to be the factors esponsible for poor learning outcomes in physics: improper exposure o laboratory activities (Ekpo, 1986), poor science background at the unior secondary school (Bello, 1996), lack of problem solving ability Onwioduokit, 2000), failure to read and understand questions before ushing to answer (WAEC, 1996,1999,2000 and 2004), nature of physics perceived as difficult, incoherent science curriculum, dearth of qualified teachers, lack of teaching facilities, lack of equipped laboratories, inadequate coverage of syllabus (House 2001 and Wenning, 2004).

Researchers in Science education such as Nworgu 2002, Danmole (2005), Owolabi (2002), Agbeyewa (1998) and Onwioduokit (2000) etc have suggested new ways of teaching science for meaningful learning on one hand and its application to real life experience on the other hand.

Kim (2002) compared in his study, the achievement of students who were taught physics concepts using lecture method and problem solving strategy. It was found that students in the group who were taught physics concepts with the problem solving strategy performed better. They also showed that they had better understanding of physics concepts.

Problem solving is a meta-cognitive strategy and a process which consists of a series of steps and the problem solver is involved in constructing the solution.

Heller and Hollabough, (1992) in their study stressed the fact that problem solving strategy is formulated on the idea that any problem can be solved if one has the right approach to the problem.

This study explores the benefits of problem solving strategy for the effective teaching of density and pressure.

Problem-Solving Approach necessary for Effective Teaching of Physics Concepts

Tolga (2004) in his study suggested two factors that can better physics problem solver. First of all, they must know and understand the principles of physics. Secondly, they must have a strategy for applying these principles to new situations in which physics can be helpful.

Many students say, "I understand the material, i just can't do the problem". If this is true of you as a physics student, then maybe you need to develop your problem-solving skills.

Braun (2006) combined and simplified (Greeno, 1989) proposed model for scientific problem solving into the following seven-steps:

1) Draw a simple diagram to represent the system.
2) Write down the information at relevant positions on the diagram.
3) Identify the unknown variable(s), indicating it at relevant position on the diagram.
4) Analyze the problem verbally and in writing to explain physics principle which is appropriate to the problem solution.
5) Write down the relevant equation (s).
6) Substitute numerical value and solve the equations algebraically.
7) Interpret numerical answers in words.

The steps encouraged intellectual engagement, prompting students to formulate arguments in classroom discussion and in writing their own situations.

Applying the Approach to Delivering Physics Instruction

A prepared lesson note which incorporates how the problem solving strategy can be used to teach physics concepts of density and pressure is given below:

Lesson Note:

Subject: Physics

Topics: Density and Pressure

Reference Books/ Materials:

My recommended Physics textbooks

Behavioural Objectives:

At the end of the lesson, students should be able to:

i. define mass
ii. define weight
iii. distinguish between mass and weight
iv. solve simple problems on areas of bodies
v. solve simple problems on volume of liquids and solids
vi. define force
vii. solve simple problems on force

Content:

Comprehensive note which explains the concepts of density and pressure is given on above listed objectives.

Presentation:

Step I: teacher writes the topic on the board

Step II: teacher introduces the lesson to the students

Step III: students are asked to give their understanding of Density and Pressure under teacher's guidance

Step IV: students are asked to sketch relevant simple (free body diagrams) to back the explanation above under teacher's guidance.

Step V: students are asked to state relevant formula or equations to be used to solve problems on Density and Pressure.

Step VI: students are asked to state the known and unknown quantities

Step VII: students are guided to solve simple problems on Density and Pressure.

Evaluation:

Students' conceptual understanding and achievement on density and pressure is evaluated by the teacher.

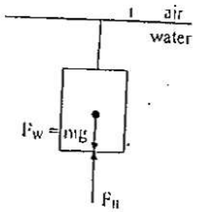
Assignment:

Assignments are given to students for further enhancement of the concepts of density and pressure.

Examples

1. A piece of alloy has a measured mass of 86g in air and 73g when immersed in water. Find its volume and density.

Solution: The situation is presented in the figure below: F



Assume, F_B = buoyant force of water on the alloy

F_T = upward force of the alloy

Fw = mg = weight of the alloy.

Density of alloy = ?

Volume of alloy = ?

Applying Newton's 2nd law of motion

$F_B + F_T = mg$

mass of alloy in air = 0.086kg

mass of alloy in water = 0.073kg

$F_B = Fr - mg$

$= (0.086)(9.8) - (0.073)(9.8) - (0.1274N)$

F_B must be equal to the weight of displaced water

F_B = weight of water = (mass of water)g

= (volume of water) (density of water) g

$F_B = V\ (1{,}000 kg/m^3)\ (9.81) m/s^2$

$V = 1.3 \times 10^{-5} m^3$

but,

density of alloy = $\frac{\text{mass}}{\text{vol}} = \frac{0.086kg}{1.3x15^5\ m^3}$

$= 6.6 \times 10^3 kg/m^3$

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