

**EFFECTIVE CLASSROOM COMMUNICATION IN  
SCIENCE FOR ACADEMIC EXCELLENCE**

*PRESENTED BY*

DEPARTMENT OF SCIENCE EDUCATION, UNIVERSITY OF UYO,

AT

THE WORKSHOP FOR TEACHING STAFF OF PRE-  
DEGREE AND BASIC STUDIES PROGRAMMES,

ORGANIZED BY

THE DIRECTORATE OF PRE-DEGREE STUDIES,  
UNIVERSITY OF UYO,

OCTOBER 05-07, 2015

# EFFECTIVE CLASSROOM COMMUNICATION IN SCIENCE FOR ACADEMIC EXCELLENCE

PRESENTED BY PROFESSOR FIDELIS A. ONWIODUOKIT, DEPARTMENT OF SCIENCE EDUCATION, UNIVERSITY OF UYO, AT THE WORKSHOP FOR TEACHING STAFF OF PRE-DEGREE AND BASIC STUDIES PROGRAMMES, ORGANIZED BY THE DIRECTORATE OF PRE-DEGREE STUDIES, UNIVERSITY OF UYO, FROM OCTOBER 05-07, 2015

**Key words:** Classroom, Communication, Science, Excellence

**Preamble:** I sincerely wish to appreciate the Director and the Directorate of Pre-Degree Studies of the University of Uyo for inviting me to participate in this workshop. Looking through various topics outlined for presentation in the workshop, carefully, I have come to conclude that the **Directorate is not just after quality control but quality assurance in Pre-Degree and Basic Studies programmes**. As you may have known, in education as well as other sectors of production in macro-economic setting, quality assurance is more preferred than the quality control. It is my hope that the proceedings of this workshop will enhance the desired assurance.

## **A. Concept of Concept:**

- a. **Classroom:** This is a place in an institution of learning where teaching takes place. Etymologically, classrooms are rooms where classes take place. The concept of classroom however goes beyond the four walls of a room. For a lesson that requires certain resources and scientific skills, different types of classrooms, both indoors and outdoors, are used, especially for **situated learning**. Generally in Science, the concept of classroom includes the laboratories (science and computer), flower garden, and zoo, among others. Similarly, in sports, a gymnasium, football field and any other place for training are considered as classroom.
- b. **Communication:** Communication, generally is an activity carried out to purposefully exchange information, knowledge or skills between two persons or parties. In every communication, there is always something to

pass across and the purpose for doing so. And until what is delivered is received and the purpose fulfilled, the communication is seen to have failed. It should be noted that it is possible to teach the same thing to the same group of learners, yet they understand differently. This is why effective communication is crucial.

Classroom Communication is more than just sharing and exchanging information. What is being taught has to be received and the expected changes in behaviour of the learners, observed. It is true that organismic factors do influence individual's understanding, but skillful and effective communication is capable of reducing individual differences to the minimum (Onwioduokit, 2013). Effective classroom communication therefore is not unidirectional but a two-way street (Robin, Segal and Smith, 2015). Both the teacher and the students are involved. Hence, the science concept to be taught should be precise and behavioral objectives clear and simply measurable.

#### B. Types of effective Communication in Science classroom:

- **Verbal Communication;**- should be distinct, clear and audible
  - Should be done facing the learners
  - Should mostly be in the form of guidance, expecting the learners to talk more.
  - Note that in science you are not to tell rather to lead the students to discover.
- **Communication using real objects;** - There is no need trying to describe what can be shown and is available in the environment. Remember that the three-fold ministry of a Scientist is to :
  - Describe
  - Explain
  - Predict natural events and occurrences.
- **Communicating using Mathematical symbols and equations;**- this has to do with the quantitative components of a concept. There are primarily three level of a concept in science. There are descriptive, comparative and quantitative and should be taught in that sequence. The use of mathematical equations in the quantification of concept in science is very useful and in some

cases, unavoidable. However, no lesson should start with such equations.

- **Communication using laboratory facilities**;- this has to do allowing learners to interact with laboratory facilities. The habit of starting a science lesson with theoretical presentation does not allow for academic excellence. Interaction with laboratory facilities should be such that will enhance development in the three domains of educational objectives- Cognitive, Psychomotor and Affective.
- **Integration of practical work in the teaching/learning of concepts.**

The tradition of separating science practical from the theory classes does not seem to help much. It is time to begin to see that there exists no dichotomy between theory and practical work in physics. Every topic or concept in science has practical orientation.

In making science real, practical work must be incorporated into the theory. A more effective teaching starts with practical work in most cases. This makes for effective communication and fosters better understanding than starting it theoretically.

For instance, many teachers approach the concepts of heat capacity and specific heat capacity by defining what they mean. The next thing is to give their equations and then begin to solve numerical problems, when the actual conceptualization of the concept is not fully grasped.

What could happen if the lesson starts with say 4 similar beakers containing the same volume of, say, water, kerosene, palm oil and groundnut oil and same amount of heat from a steady flame is applied to each beaker and its content for say 5 minutes after the initial temperature of each was taken? Taking the temperature of the liquids after the said time will indicate that within the same time frame, the temperature of the liquids rose up differently. That is, same amount of heat given to those substances caused their temperature to rise differently. Then find the time required for the liquid to have its

temperature risen for  $1^{\circ}\text{C}$ . This will give different time durations which shows different amounts of heat transferred to the system.

Moreover, **Students should be taught science in the same way scientists practice science. Guided Discovery** (Enquiry approach) is the generally recommended way of communicating science (Halfpap, 2010; Gagne, Briggs & Wager, 1992 ). Although very taxing and involving, this approach is efficient in the development of skills such as reflective thinking and creativity. As students are provided with certain information and are guided to discover some additional information, the subject will become real to them.

This approach, which is laboratory-oriented in most cases, should affect the type of practical questions we present. Some physics teachers for instance still adhere to cookbook practical physics.

### Case Study I

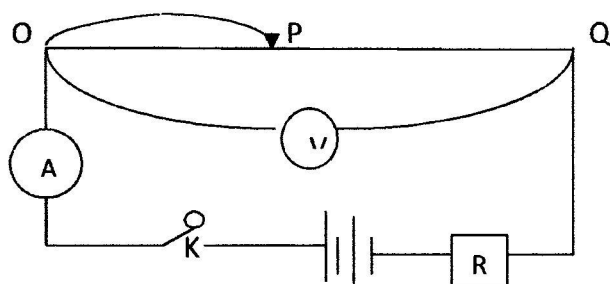


Figure 1: Potentiometer circuit

You are provided with a potentiometer, an ammeter, a voltmeter, a standard resistor and other necessary apparatus. Using the circuit diagram above as a guide, carry out the following instructions:

- (i) Connect the circuit as shown in the diagram above.
- (ii) Close the key, K read and record the Ammeter reading  $I_0$  and Voltmeter reading,  $V_0$  when Jockey J is not making any contact with potentiometer wire OQ.

(iii). Using Jockey, J, make a contact with the potentiometer wire OQ at a point P such that  $OP = 10\text{cm}$

(iv). Read and record the current,  $I$  and the corresponding value of the voltage,  $V$ .

(v). Repeat the procedure for other values of  $OP = 20\text{cm}, 30\text{cm}, 40\text{cm}, 50\text{cm}$  and  $60\text{cm}$ .

(vi). Tabulate your readings.

(vii). Plot a graph of  $V$  against  $I$ , starting both axes from the origin.

(viii). Determine the slope  $S$ , of the graph.

(ix). Determine the value of  $V$  when  $I = 0$

(x). State 2 precautions taken to obtain accurate results.

#### **Alternative case.**

1. Connect up the circuit as shown in the diagram.
2. Starting with  $V_0$ , make a contact with the potentiometer wire OQ at a point P such that  $OP = 10\text{cm}$
3. Make other similar contacts, taking the corresponding values of  $V$  and  $I$  in each case.
4. Determine the resistance  $R$  of the potentiometer wire.

By reducing the details from 10 to 4, students are given the opportunity to think. For example the problem of determining the resistance of the wire, given the clues, should lead the student to look for the following: that

- (i)  $R = V/I$
- (ii) to determine  $R$  a slope is needed.
- (iii) to have a slope, a graph is needed.
- (iv) to have a graph, there is need to have more readings than for the length of  $10\text{cm}$ . He/she will now use his/her discretion to determine the intervals.

- (v) there is need to arrange the readings in a tabular form..

### **Case Study 2.**

You are provided with a water bath (beaker) copper block, stirrer, polyethylene cup calorimeter, retort stand/clamp, a piece of thread and water.

- (i) Firmly support one end of the thread provided on the clamp of the retort stand and tie the copper block to the other free end of the thread.
- (ii) Heat the copper block in boiling water for at least 10minutes.
- (iii) Weigh the polyethylene cup calorimeter empty and again when about 2/3 filled with water at room temperature. Record the water temperature.
- (iv) Bring the calorimeter close to the bath and quickly transfer the copper block into it. What is your reason for the quick transfer?
- (v) Stir the water gently with the thermometer and carefully record the highest temperature of the mix (Note: The highest temperature is reached within about 30seconds of transferring the block).
- (vi) Weigh the copper block after it has cooled completely.

### **Alternative case:**

You are provided with a water bath (beaker), copper block, stirrer, polyethylene cup calorimeter, retort stand/clamp, a piece of thread, water and a thermometer.

- i. Heat up the copper block in water to a certain temperature before transferring it to the polyethylene cup calorimeter with water.
- ii. With this arrangement determine the amount of heat transferred by the copper block to water and the calorimeter.

- **Communicating using Multimedia**

Another primary way of effectively communicating science is by using a multimedia facility either through simulation or animations. My experience with

physics students has shown that the great majority of them do not understand the concepts they are

taught in physics, especially when the concept is a theoretical one. By using animation, the students will be able to see by multimedia arrangement the activities involved and will have their understanding and comprehension enhanced.

Free fall of objects: - It seems unimaginable ordinarily to believe that an elephant for instance can fall to the ground from a certain height using the same time with a feather from the same height.

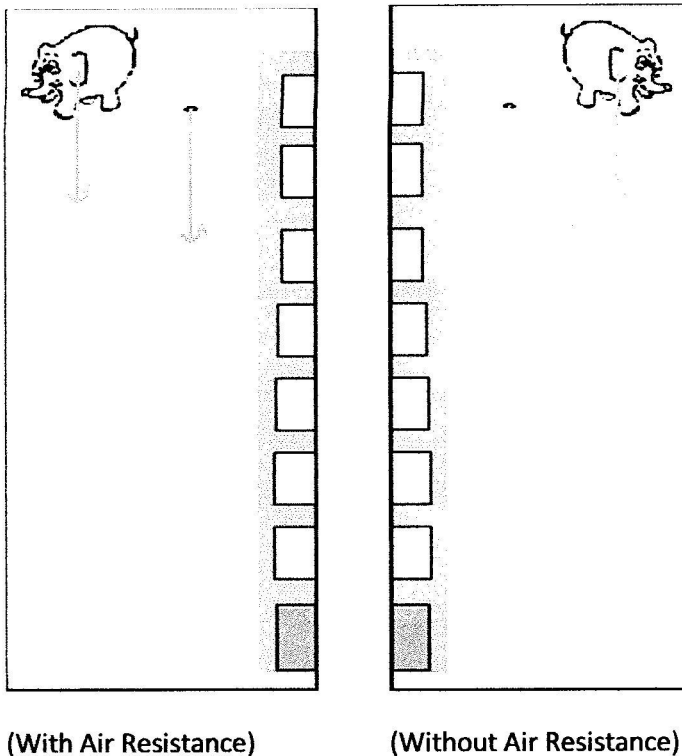


Figure 2: Elephant and feather in a free fall.

Source: <http://www.physicsclassroom.multimediasudio>

Reasons:

It is known that all objects irrespective of their masses will experience the same pull towards the earth if air resistance is neglected. This acceleration known as acceleration of free fall has a magnitude of  $9.8\text{m/s}^2$ .



Generally

$$F = ma$$

$$a = F/m$$

Note:

- i. The force on the elephant is greater than that on the feather.
- ii. The mass of the elephant is greater than that of the feather.
- iii. The greater force on the elephant is expected to cause it to accelerate more but its greater mass causes the Force: Mass ratio for the elephant to be the same as the Force: Mass ratio of the feather, thereby causing the two to have the same acceleration.

However, considering the effect of air resistance, the greater weight of the elephant will overcome air resistance much more than is the case with the feather ultimately; therefore the elephant will accelerate more than the feather and will therefore take a shorter period of time to land the earth surface, as shown in Figure 2 (Elephant and feather in a non-free fall).

## 2. Projectiles motion.

By extension the effect of the force of gravity is seen in the motion of projectiles.

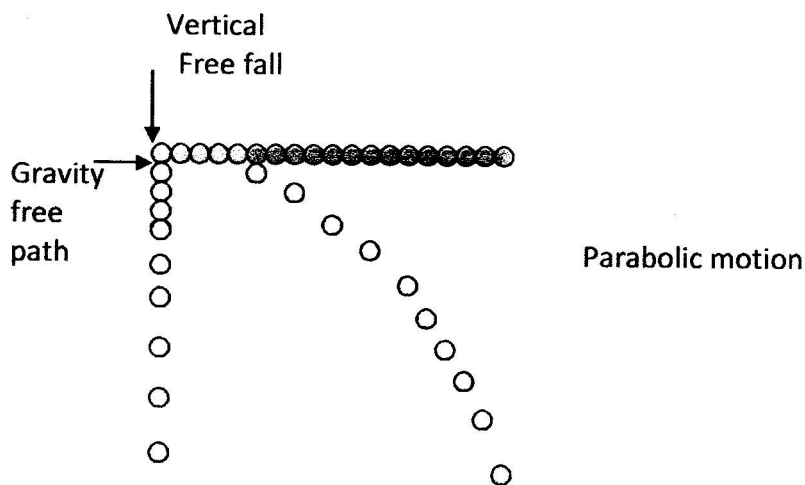


Figure 4: Effect of gravity on projectiles.

A projectile is an object upon which the only force is gravity. Although gravity attracts the projected downward, it does not affect its horizontal velocity. The only effect of gravity on the horizontally moving object is to alter its direction such that the path becomes parabolic.

For a horizontally launched projectile,

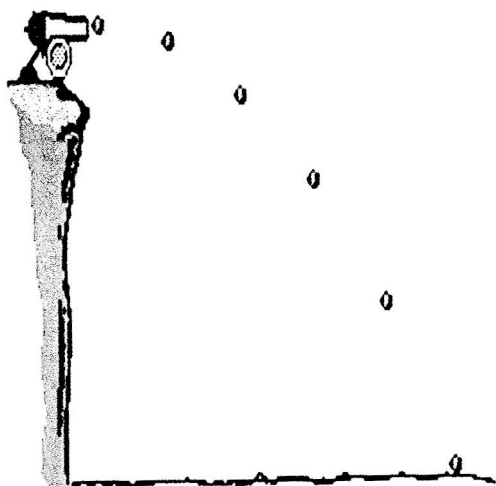
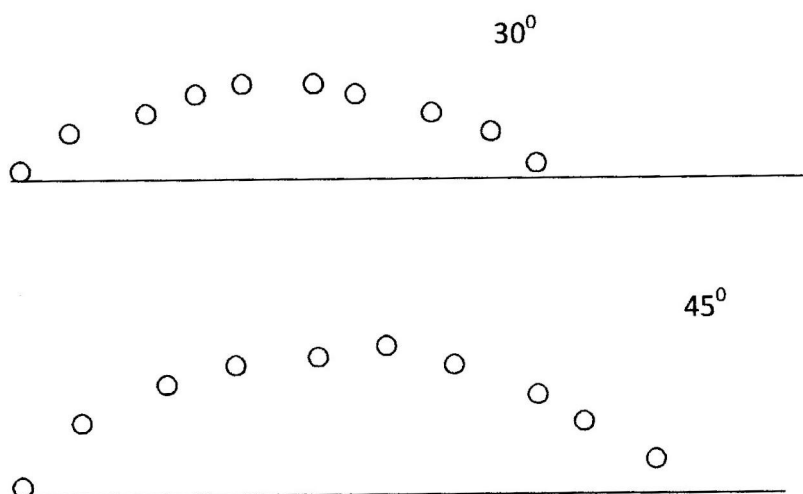


Figure 5: Horizontally launched project

The vertical and horizontal components of the velocities, downward acceleration as well as the parabolic path can be shown by animations. By using different projectiles, the concept of range with respect to the angle of inclination can be demonstrated.



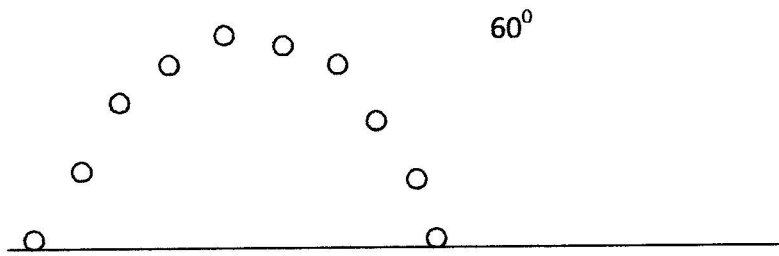


Figure 6 maximum range

Students could then be asked to observe and analyze, by the initial value, their observations to reflect the followings:

- (a) Each projectile follows a parabolic path.
- (b) Projectile launched at  $45^\circ$  angles had the greatest range, medium peak height.
- (c) The projectile launched at  $60^\circ$  angle had the highest peak height before falling.
- (d) The projectile launched at  $30^\circ$  angles reached the ground first.
- (e) The peak height of a projectile is determined by the initial value of the vertical velocity component.
- (f) The time taken by the projectile to come to rest is also determined by the initial value of the vertical velocity component.
- (g) Of the three projectiles, the third one has the smallest initial value of the horizontal velocity component,  $V_x$ .
- (h) The range of a projectile is determined by both its initial value of horizontal velocity component and the time taken by the projectile to come to rest.

### 3. Wave's motion: Standing waves.

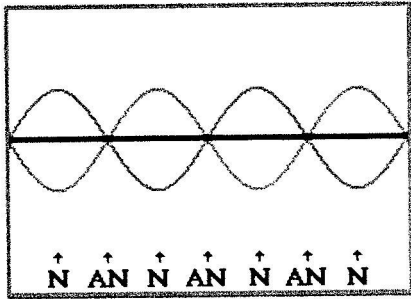


Figure 7: Standing Wave

Source: <http://www.physicsclassroom.multimediasudio>

With these we can demonstrate:

- (i) Standing waves.
- (ii) Interference of waves.
- (iii) Nodes – location where two waves interfere such that one is displaced upward and the other downward to the same amount.
- (iv) With this type of interference, there is no displacement and is therefore called destructive interference.

There are a variety of patterns which could be produced based vibration at certain frequencies.

Each pattern corresponding to vibration at a particular frequency is known as harmonic. The lowest frequency of vibration to bring about standing wave is what is seen in Figure 7 and is referred to the first harmonic.

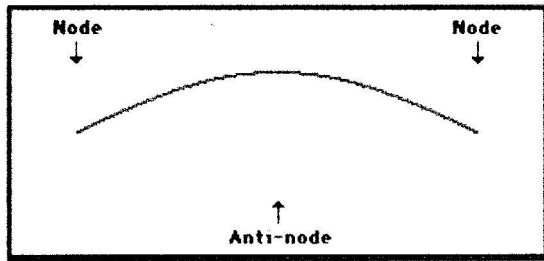


Figure 8a: First harmonic

Then we can then show the animation of second, third and fourth harmonics.

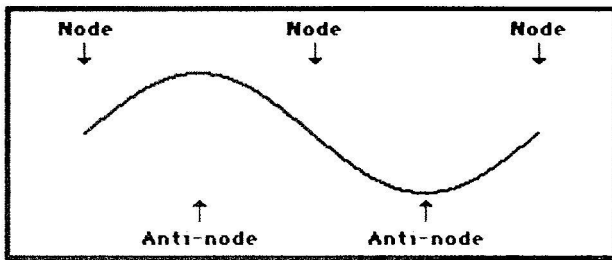


Figure 8b: second harmonic

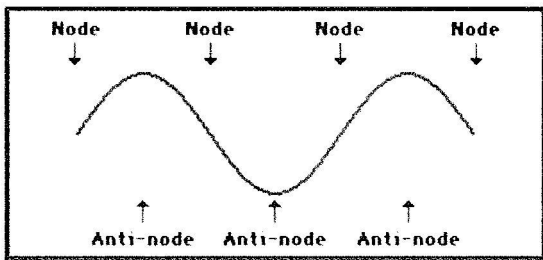


Figure 8c: third harmonic

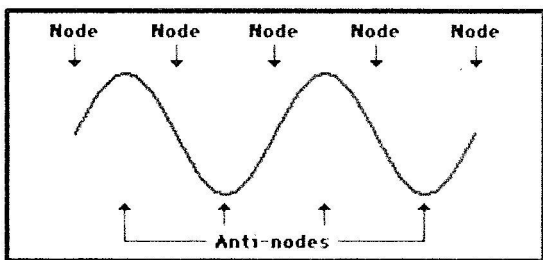


Figure 8d: fourth harmonic

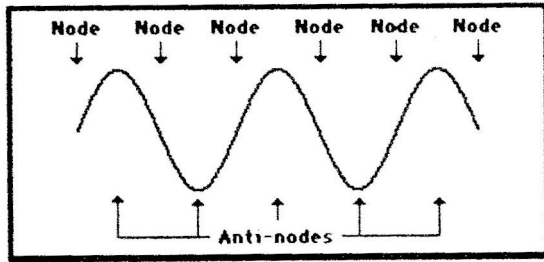


Figure 8e: fifth harmonic

#### 4. Energy conversion in a pendulum

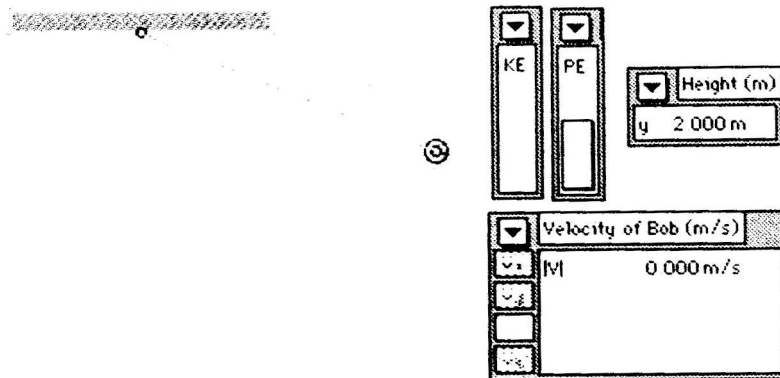


Figure 9: Energy conversion in pendulum

Source: <http://www.physicsclassroom.multimediasudio>

The following concepts can be demonstrated through this animation

- (i) Energy change in the pendulum
- (ii) Velocity change with height of the pendulum.
- (iii) Energy conversion in the system.

Let me round off by emphasizing that fundamental to all the areas we have considered in making science real is our commitment to work. Teaching is different from lecturing. It is more demanding than other forms of professions. As science teachers we are expected to be committed to:

- (i) knowing the subject matter;
- (ii) using of appropriate teaching methods, approaches and strategies;
- (iii) teaching and demonstrating using laboratory facilities;
- (iv) moulding students in character and in learning. To succeed in this, we must be role models.
- (v) firmness and honesty, upholding your integrity.

It should be noted that teachers are like pastors. They do not only teach what they know but also who they are. While the first part is often carried out consciously and overtly in the classrooms/ laboratories, the second is done unconsciously within and outside the institution. Failing in any of these aspects of teaching will amount to a complete failure in our callings as teachers. So you do not only impart your knowledge to your students but also your life.

It is indisputable that organismic factors in the students have significant impact on their performance, but it has been observed that environmental and teacher factors are stronger than organismic. To achieve Academic excellence which goes beyond just passing examinations, all factors involved should be carefully analyzed and integrated into classroom communication.

### **Conclusion:**

Let me say in conclusion that this crucial workshop is very timely and is expected to generate ideas, skills and techniques in classroom teaching and management. All hands must be on deck. Government, teachers, school managers, private sectors and all stakeholders should be involved in making teaching and learning of science real, meaningful and excellent.

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