Activities Used for Interactive Teaching of Magnetism and Electro-Magnetic Induction

Victor Arni Sicam, Rosea van den Berg, and Ed van den Berg
Physics Department, University of San Carlos, Talamban Campus, Cebu City, Philippines 6000
Science-Math Education Institute, University of San Carlos, Talamban Campus, Cebu City
Email: edberg@cnms.net

INTRODUCTION

Some physics teachers use the PC for interactive teaching of introductory physics courses (Sokoloff, 2000; Laws, 1996). To a large extent, this teaching strategy received positive responses from many students and teachers. However, even without the computer, interactive teaching can still be used effectively (Mazur, 1997; Andre, 1993). This paper reports the use of designed activities, without the use of PC's, for interactive teaching of Magnetism and Electro-Magnetic Induction.

METHODOLOGY

The following is a script on how interactive teaching can be done in an introductory physics course specifically for magnetism and electromagnetic induction. This procedure has been tried several times in workshops with physics teachers and students and was found effective. It has been revised based on how the workshop participants performed and responded.

Four activities on magnetism and electromagnetic induction are presented in boxes below. These activities can be done within a two-hour period. The protocol is the following:

1. A demonstration is presented to a group of 30-40 participants on the electric generator. The demonstration is done by rotating the lever arm of the generator and thereby making a connected light bulb glow. This demonstration is done as a motivation for the succeeding activities.

2. The group is asked to make a list of physics concepts involved in the generation of electricity.

3. To understand these physics concepts, the four activities are introduced.

4. Two set-ups can be prepared for each activity. The class can also be divided into 8 groups of 4-5 members and they can start performing the activities according to the written guide (see boxes 1-4).

5. After everybody has completed the activities, a plenary discussion is done. In this plenary discussion the physics concepts involved are discussed in detail.

6. When doing the activity with teachers, the physics discussion (5) is followed by a pedagogic discussion. The teaching strategy is explained and teachers are encouraged to react and to adapt the strategy to their own setting.

EXPERIENCES WITH TEACHERS AND STUDENTS

After going through the whole session, the participants saw a holistic approach to the teaching of physics concepts. They enjoyed the whole experience because they were very much involved in doing the experiments and analysing the physics concepts involved in each. Some teachers even went to the point of organizing workshops as a reaction to what they learned.

ACTIVITY 1: MAGNETIC POLES

Equipment: Two identical cylindrical magnets, compass

A. Try to make the flat surface of one magnet touch the flat surface of the other magnet. Since each of the magnets has two surfaces, you can try this for different combinations of surfaces.

1. Do the surfaces always attract each other? Explain your observation.

B. Label the surfaces of the two magnets such that surfaces that repel each other have the same name (for example, label one surface as side "A" and the other as side "B".)

C. With the compass determine the north-south direction and the east-west direction relative to the classroom. (You don't have to do this if you have observed the setting and rising of the sun relative to the room that you are in.)

D. Let a magnet roll on the floor or table in a North - South direction.

2. Observe how it moves. Suggest an explanation for your observation.

E. Roll the same magnet in the East-West direction. Repeat this several times until you have observed a pattern.

3. In which direction will the magnet maintain a straight line for a longer time? (North-South or East-West)

4. Does it matter if you roll in the South-North direction rather than North-South direction?

F. Let the magnet roll towards the North with side "A" facing the East. Make at least five trials on this and observe.

5. Does the magnet tend to roll in a straight line or a curved line?

6. Which side tends to face the North?

G. Repeat step F but this time letting side "A" face the West.

7. Is there any difference with what you observed in step F?

8. Which side now tends to face the North?

9. Which side of your magnet, A or B, is the north pole and which is the south pole? How did you determine this based on your observations?

ACTIVITY 2: MAGNETIC FIELD LINES

Equipment: Bar magnet, several compasses, and writing materials for graphing

A. Place the bar magnet on a piece of graphing paper. Trace the shape of the magnet on the paper. With the aid of a compass, determine the North and South end of the bar magnet and label it on the paper as capital N and S correspondingly. See figure on the right.

B. With the magnet placed exactly over the drawn figure, place a compass at every number indicated in the figure. (note: the compasses should not be placed near each other)

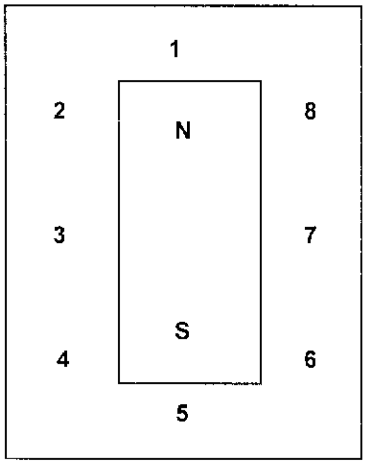
C. On a separate sheet of paper, copy the figure and indicate with an arrow the direction of the N-end of the compass at each point.

1. To which end of the magnet do the arrows point?

D. Connect all the arrows to each other by drawing a line.

2. At which end of the magnet does the line seem to originate?

3. At which end of the magnet does the line seem to end?



What you have just drawn is the conventional direction of the magnetic field around a bar magnet.

ACTIVITY 3: ELECTRIC CURRENT AND MAGNETISM

A. Make the circuit of the figure. Make sure to include the switch in the circuit.

B. Briefly close the switch and observe the compass needle.

C. Place the compass at different positions around the coil and every time, close the circuit a few seconds only.

1. What do you observe of the deflection of the compass needle? What do you conclude from your observation?

2. Does it make a difference where you place the compass with respect to the coil?

3. Why do we close the circuit only for a few seconds and not longer?

D. Change the direction of the current in the coil.

E. Repeat step C.

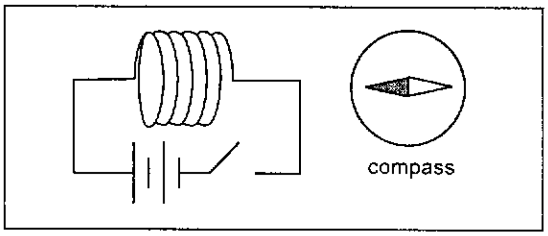
4. What do you observe of the deflection for the compass needle this time? Is it the same as step C?

F. Insert a piece of iron into the coil. Repeat step C.

5. Compare the deflection of the compass needle this time with your observation in step C.

6. How can you observe the strength of the magnetic field using the compass?

7. What is the effect of inserting the piece of iron on the strength of the magnetic field around the coil?



ACTIVITY 4: MOVING MAGNETS AND ELECTRIC CURRENT

A. Make the circuit in the figure. This set-up does not use batteries.

B. Move the magnet toward the coil.

1. What do you observe in the galvanometer?

2. What happens if you put the magnet in the coil and leave it there?

C. Pull the magnet out of the coil briskly.

3. What do you observe in the galvanometer this time? Is your observation the same as in step B? Explain your answer.

4. Based on your observations earlier, what can you conclude about the relationship between magnets and current?

D. Insert a piece of iron in the coil and repeat steps B and C.

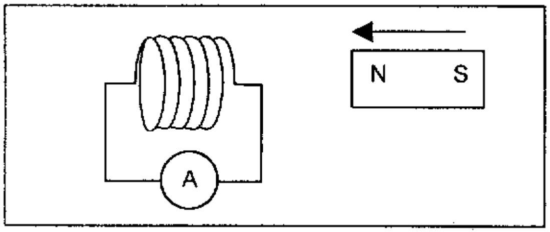
5. What is the difference of your observation this time from your observations in steps B and C?

6. When is the magnitude of the current in the coil greater? Explain you answer.

7. How could you find out whether the speed of the motion of the magnet has any effect on the magnitude of the current in the coil?

E. Perform the experiment.

8. Based on your observation, what is your conclusion regarding the speed of the motion of the magnet and the magnitude of the current in the coil?



REFERENCES

Andre, K.M., 1993. Cooperative learning: an inside story. *The Physics Teacher*. 37(6): 356-358.

Laws, P., 1996. Workshop physics. New York, John Wiley & Sons.

Mazur, E., 1997. Peer teaching – a user's manual. Engelwood Cliffs, N.J., Prentice-Hall.

Sokoloff, D., 2000. Real Time Physics. New York, John Wiley & Sons.