Degree IN TEACHER OF PRIMARY EDUCATION
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Chapter 5. Practical work & experiments

1. Importance of inquiry in science education. How to answer a scientific question? . 1

2. Problem solution activities and experimental assumptions 1

3. Experimental design activities..... 3

4. Experimental resources 4

1. Importance of inquiry in science education. How to answer a scientific question?

Science is concerned with the development of knowledge and understanding of the biological, chemical and physical aspects of the world. Scientific activity is the process to develop such knowledge and understanding.

Science is a human endeavour that depends on the creativity and imagination of people as they reflect critically to make sense of their experience.

For children, as well as for scientists, science involves imagining, testing, changing or confirming ideas about things and how they work.

Usually, scientists use scientific theories to explain observed phenomena or to predict events. These ideas and theories are subject to review and change and will be modified as new evidence comes to hand.

Scientific method

What distinguishes a scientific activity from other forms of enquiry is the process to develop these ideas. A scientific approach involves a sequence of processes such as: making observations, hypothesising, predicting, planning tests, analysing the results and arrive at conclusions. The first-hand investigation is a crucial element in how young children learns science.

Activities in science will involve the pupils in exploring, planning, making and evaluating objects that have a practical purpose. They can provide their answers to problems, and they can learn from their interaction with things around them.

2. Problem solution activities and experimental assumptions

Children will learn to investigate the world around them through processes such as defining hypothesis, observing, predicting, experimenting, analysing, testing, concluding…

These processes belong to the procedural content (or scientific skills) of the science curriculum. But, *what do we assume as the meaning of these skills in our students?*

Observing

Observing, using all the senses separately or in combination, is a fundamental skill in science. It requires focusing the attention on objects or events in our environment, where materials and living things are identified, described and classified into different categories. Teachers will ask the children to compare and describe the similarities and differences between the objects, such as their shape, size, colour, pattern, and texture. They should develop safe observational techniques and made observations by using all the senses (sight, taste, smell or touch). However, observing activities requires several of the other skills, such as classifying and communicating.

Classifying

Classifying involves children in sorting their observations according to one or more characteristics. The youngest children will recognise properties such as colour, shape and size. Also, they will be able to sort similar objects based on one property. Children will determine their criteria for classifying and will be able to explain them. As they are progressing, children will group objects into sets and sub-sets.

Recognising patterns

The ability to see patterns in objects and processes depends on the capacity to perceive links, to detect similarities and differences, and to recognise sequences. Identifying patterns involves the pupil in linking observations with ideas and possible explanations.

Examples: In (6-9) classes, children may associate falling leaves in autumn with a decrease in temperature. In (10-12) classes, children will suggest explanations and generalisations, as, for instance, relating overweight to a sedentary lifestyle and eating habits.

Estimating and measuring

Estimating and measuring are necessary skills used to obtain information during observations. The emphasis is on using appropriate ways of measuring that are suitable to the children's stage of development and the activity.

In the (6-9) classes, children will compare objects and describe them as large or small, heavy or light. They will examine a range of objects and arrange them in order, for example, from the smallest to the largest. They will begin to use standard units of measurement to measure length, area, time, temperature and weight.

In the (10-12) classes, as the activities increase in complexity, the need for more accurate measurement will be necessary. Children will use a range of measuring instruments (ruler, balances and thermometers) and will recognise the need to measure and repeat measurements during an investigation.

Questioning

Asking questions is an essential part of exploring and performing experiments. It is also a way of linking previous knowledge to new experiences. Children must learn to formulate questions in a way that becomes the starting point of designing an experiment to find an answer.

Formulating hypotheses

A hypothesis is an idea or explanation, a supposition, based on prior experience and knowledge. Posing questions about problems encourages children to attempt to formulate hypotheses. These

hypotheses or tentative explanations become the basis for further investigation. During their experimental activities, children can gain awareness of the need to revise or reject their hypotheses considering new evidence.

Predicting

Pupils make predictions to forecast what might happen in certain circumstances. Patterns identified in observations or experimental activities can form the basis for a prediction. The teacher should prompt these predictions.

Recording and communicating

Children will record their observations and results of their practical work through various media (drawings, collage, written reports...). On the other hand, students will communicate the results using information and communication technologies.

They also need opportunities to report to others how they plan their investigations, how they control or change variables, the observations and measurements made, and the results of their studies. Through this process, they may refine their thoughts and identify new problems to investigate.

3. Experimental design activities

Investigating is the systematic search for evidence that tests an idea or hypothesis. For children, studying and experimenting will involve them in planning and conducting fair tests to check their predictions. An appropriate investigation will involve children in processes as:

a) Identify the problem to be investigated: for example: Which shoes have the best grip?
b) Identify variables: which variables will change and measure or compare. It will be important that children realise that they must change or vary only one condition or variable at a time.
c) Select appropriate equipment and materials for an investigation
d) Order of various steps of the investigation
e) Select the most appropriate methods of recording
f) Analyse the results of the research; pupils will refer to the original problem and plan any further experimental work.

Finally, pupils record the results of the experiment systematically and state the conclusions. One important step is to identify the variables when we are designing a fair test. Therefore, in carrying out appropriate tests, pupils should be encouraged to ask:

1. What will be changed? (Identify the variable to change)
2. What will keep the same? (Identify the variables that will be controlled or held constant).
3. What will be measured or compared? (the variable that will be measured or judged)

Example: Design a test to identify the most absorbent kitchen towel. Children will participate in identifying a) the variable to change and b) the variables to keep the same

What will be changed? The type of kitchen towel

What will keep the same? The amount of water dropped onto each towel; the size of towel, and the time to measure the water absorbed

What will be measured or compared? The volume/amount of water that was absorbed by each of the towels.

4. Experimental resources

The provision of a range of resources will be necessary to enable children to undertake experimental activities in science. Some science topics will require consumable materials such as sand, sugar, salt or dried foods. Other topics will request to collect items of domestic reclaimable waste, for example, plastic bottles, jars, tins, lids, thread spools, and yoghurt pots.

The table below proposes examples of units and resources materials required in their experimental activities. Some are everyday materials, but others obtain from specialist science suppliers.

Experimental Resources	
Unit	**Resources**
Myself-Human life	mirrors (plastic); meter sticks, height chart, thermometer, measuring tape, bathroom scales
Animals and plants	flowerpot, insect cages, aquarium tank, old spoons, sheets of plastic, watering can, plastic tubing, magnifying glass, microscope, binoculars, bird table
Magnetism and electricity	magnets, bulbs and appropriate batteries, iron filings, clips, needles, wires, a range of magnetic materials, electric motor, a selection of metals, coil stripping pliers, steel wool, screwdrivers
Light	torches, curved mirrors, plane mirrors, triangular prism, shiny objects that will act as mirrors: spoons, biscuit tin lid, sheet metal, transparent, translucent and opaque materials, colour filters
Heat	thermometers, candles, objects made of different materials
Sound	tuning forks, rubber bands (different sizes and thicknesses), guitar strings
Forces	wheeled toys, inclined plane, sandpaper, springs, weights, marbles, balls, timers, stop clocks and watches, balloons, plastic syringes, pulleys
Materials	funnels, polystyrene sheets, blocks, balls and beads, sieves, plastic, various meshes, samples of different fabrics, food colourings, samples of soaps and detergents, dyestuffs, materials from the kitchen or bathroom (sugar, salt, soda, chalk, oil, soda water, lime water, tea, coffee, bath salts, flour), samples of different metals, pebbles, stones, bricks and rocks, samples of different woods and wood products, samples of different types of paper (blotting paper, tissue paper, paper towels, waxed paper, greaseproof paper, newsprint, corks.