Chapter 3. Methodological strategies in Science Education

1. Types of educational activities in experimental sciences

The first thing we must emphasise is the need to differentiate between what is an educational activity and an educational task since they are usually used indistinctly which leads to confusion. In that sense, we can say that:

Educational activity: It is an extensive and variable work that responses to its own purpose/objectives/competences/contents and has its entity as a part of a didactic unit. It should be evaluable and evaluated.

Educational task: It refers to concrete work related to answering a specific question. It can be used to evaluate

Starting from this point, we can consider the following question, **what are the activities?** In definition, they are organised, and oriented sets of school tasks focused on the acquisition of specific learnings. To be more specific, we can distinguish between the activities of the teacher and the students.

About the teacher's activities, the teacher must carry out the presentation of the content to work with, using different resources such as verbal communication, graphics, audiovisuals, digitals. Also, the teacher must be the one who directs and guides the activities of the students, that is to say, prevents a methodology, protocol, organisation…of the activity.

About the student´s activities, they are organised, and oriented sets of school tasks focused on the acquisition of specific learnings and should be carried out by students. These activities must be: understandable, miscellaneous, viable, significant and related to new fields of knowledge and practice.

Types of activities

These activities focus on students according to:

Requirements in its realisation: In this case, it is appropriate to highlight the following:

- Tasks on the text
- Tasks of organisation and structuring of contents
- Expression activities of previous knowledge and personal conception

- Activities of search, organisation and elaboration of various information
- Activities of expression of information elaborated by the students
- Outdoor activities/excursion
- Argumentation activities
- Practical/experimental activities

Objective of the activity: In this case, it is appropriate to highlight the following:

- Initial/motivation activities
- Development activities
- Synthesis activities
- Evaluation activities
- Interdisciplinary activities
- Activities related to transversal issues
- Attention to diversity (reinforcement and extension)
- Extracurricular activities

Below, we will describe the different types of activities based on the requirements to carry them out:

1. ***Tasks on the text***

Purpose: To help the learning of the conceptual aspects

Type: Search for information in the textbook to find answers to closed questions

Characteristics:

- They imply a comprehensive reading
- They are aimed primarily at conceptual learning with little impact on procedural learning

Example of task associated with a text:

Escribe en el recuadro verdadero (V) o falso (F), según corresponda.

_____ *El suelo está compuesto sólo por materia sólida.*

_____ *El suelo tarda miles de años en formarse.*

_____ *Las plantas son fundamentales para formar suelo*

2. Tasks of organisation and structuring of contents

Purpose: To help to learn the conceptual aspects in a multimedia material and promote the development of skills and procedures.

Types:

- Summary from a text, a movie, a book
- Development of conceptual maps
- Resolution of qualitative issues

Characteristics

- Intellectual demand: requires restructuring and content development sometimes absent in books

Example collected in a text of the 5th year:
Copia las propiedades de los gases seguidas de un ejemplo que explique cada una.
Los gases pueden comprimirse
Los gases tienden a ocupar el mayor espacio posible
Los gases no tienen forma propia

3. Expression activities of previous knowledge and personal conceptions

Purpose: To help students express and be aware of their previous knowledge and their conceptions.

Types:

- Answers to questionnaires or interviews
- Dialogue/Group discussion
- Brainstorming
- Production of some document or material

Characteristics

- At the beginning of the Teaching Unit or section
- Facilitate reflection and communication

Example 4th year:

¿Qué sabes sobre la respiración? Sin duda, has observado tu respiración muchas veces, y seguramente, ya tienes tus propias ideas sobre ella. ¡Exprésalas a partir de estas propuestas de actividad que ahora te sugerimos!

Haz el dibujo de una silueta humana y dibuja, dentro de ella, todos los órganos que tú crees que intervienen en la respiración.

Cuenta, como si fuera un viaje, el camino que hace el aire desde que entra en tu cuerpo hasta que sale. Por supuesto, tienes que contarlo tal y cómo tú te lo imaginas; luego, ya veremos qué tal está lo que has contado.

4. Activities of search, organisation and elaboration of information

Purpose: To promote the development of skills and procedures, related to the search, development and interpretation of information of varied sources

Types:

- Bibliographic works on a topic

Characteristics:

- The students prepare it after a search, systematisation and organisation of the information from different sources

Example 5th year:

Amplia tus conocimientos

Encuentre información sobre diferentes tipos de energías renovables y exponga las fuentes de donde obtiene la energía.

5. Practical/experimental activities

Purpose: Development of procedures, techniques and skills such as observation of objects and processes; experimentation, handling of instruments and devices, measuring, posing questions and hypotheses, inferring, predicting, classifying, planning, collecting samples and data, representing data and drawing conclusions.

Types:

- Experiences
- Practical exercises
- Research

Characteristics:

- In the class or outside

- ❖ Directed fundamentally to procedural learning and understand how the scientists work

Examples:

Experimentation 1st Primary: Mainly intended to obtain a familiarisation perceptive with object and phenomena.

Practical exercises: Mainly intended:

- ❖ To develop practical skills (measurement, manipulation of instruments, data processing, diverse techniques)
- ❖ To develop intellectual skills (observation, classification, emission of hypothesis, the design of experiments, control of variables, communication of results, etc.)…

Research:

Designed to give students the opportunity to solve problems working on a similar way as scientists or technologists. Examples of questions that lead to school investigations:

What material of a given series "holds more"?

What is kitchen paper "better"?

Is the tap water pure?

Experimental activities with the same content can constitute an experience, an exercise or research.

Example: An activity based on the separation of the pure substances that make up a mixture (for example, the separation of salt and water from a solution of both) can constitute:

- **An experience**: If our interest is mainly to perceive that a homogeneous system can contain more than one component, observing that when the water evaporates, the salt precipitates.
- **An exercise**: If our interest is to learn the separation technique
- **Research**: If separation is the method to solve the following problem: is tap water pure? Moreover, students have to find a way to answer this question.

To conclude with this type of activity, we can ask the following question: ***How to carry out experimental activities?*** The requirements for students vary depending on how the teacher presents the activities and the level of inquiry in the activity according to ILI, (The Inquiry Level Index).

The Inquiry Level Index (Herron, 1971)

It is an instrument to classify experimentation activities according to the level of inquiry required for students to complete them. It involves the role of the students to carry out independently them.

ILI method has four levels:

Level 0: Students receive the question, the method and the answer

Level 1: Students receive the question and the method, and they have to find the answer

Level 2: Students receive the question, and they must find the method and the answer

Level 3: Teacher indicates a phenomenon and the students have to ask a suitable question and find a method to answer it

6. Outdoor activities/excursions

Purpose: To work theoretical aspects in activities outside the classroom to motivate, work attitudinal and internalise the contents better

Types

- Museum visits
- Excursions to places, parks,...
- Private/public companies
- Cities/towns (culture, socio-scientific aspects)

Example 1st- 6th year:

Visita al Museo Principia

Visita al torcal de Antequera

Visita al Paraje Natural de la Desembocadura del Guadalhorce

7. Activities of expression of information elaborated by the students. Argumentation

Purpose: To promote the development of skills and procedures related to communication, based on information developed by the students

Types:

- Oral presentation of results of a work sharing of group results
- Written test/Reports
- Audiovisual/body expression

Example 2nd year:

Pensad entre todos una forma de ahorrar agua en el colegio. Confeccionar un mural con este tema y una presentación del mismo