Degree IN TEACHER OF PRIMARY EDUCATION
Subject: Science Education
Course: 2019-20

Chapter 1. Educational proposals in Science.

1. What is science?

The nature of science

Science is concerned with the development of knowledge and understanding of the natural world in their biological, chemical and physical aspects. At the same time, science means a way of working-conducting research: the scientific method. In teaching, both must adapt to the students´ levels.

This process is called "Didactic Transposition", that means the process of going from "knowledge as produced" to "knowledge taught". The natural sciences should seek knowledge and explanation about the natural world. However, it depends on the creativity and imagination of scientists, who use specific methods to develop their research, as well as in descriptions of laws, theories...

Scientific knowledge´s components: Processes and Products

Processes

Scientists use different processes (such as defining hypotheses, collecting data, analysing data, verifying, concluding) to explore the natural universe in a specific way. To understand the general principles of how the world works, scientists have developed the "Scientific Methodology", which involves the application of different processes, such as:

- Observation of specific facts or phenomena. Scientific observation includes measurement. Therefore, it is necessary to establish measurement units (force, mass, volume, time, temperature...) and the use of various devices, such as thermometers, dynamometers...
- Production of hypotheses relating to phenomena to explain.
- Formulation of generalisations about the nature of such phenomena (laws and theories).

Products

Scientific work must develop theories and uses them to explain phenomena or to predict events. They are part of the products of scientific work. Scientific ideas and theories are subject to review and change as new evidence comes to hand. The following are examples of definitions of some scientific products:

- **Fact**: It is the observation of something that has happened, repeatedly confirmed and defined.
- **Hypothesis**: It is a statement that contains a prediction about some aspect of phenomena of the natural world which can be proved or disproved through the development of scientific research.
- **Law**: It is a pattern or generalisation about how some aspects of systems from the natural world behave under stated circumstances. Frequently, mathematical expressions define scientific laws.
- **Theory:** It is a well-substantiated explanation that can contain and connect among them facts, laws, inferences, tested hypotheses, conclusions... of a series of scientific researches.

These results must undergo revisions by many scientists before being accepted as valid by the scientific community.

Aims of science education

Science education should be concerned with the teaching and learning of scientific knowledge. Also, it should provide the opportunity for children to work scientifically to gain experience in how scientists investigate the world.

Also, to help children acquire scientific knowledge, science in the school curriculum aims to foster their positive attitudes towards science. It is related to the development of their appreciation of the contribution of science and technology to our personal and social well-being. They must gain awareness that science and technology can contribute to the education of every citizen providing learning opportunities such as:

- Stimulate their curiosity, interest and concern about the natural environment through the experience.
- Understand themselves and the world around developing knowledge and understanding of essential science topics.
- Develop skills, habits of mind and attitudes necessary for scientific inquiry.
- Develop the habit of using scientific knowledge and methods in making personal decisions.
- Develop their appreciation of how science influences people and the environment.
- Develop their understanding of a variety of properties and interactions in the physical universe.
- Develop their scientific skills for investigating and exploring the natural world.
- Develop positive attitudes to science and their appreciation of the contribution of science and technology to society.

2. Designing teaching units. Principles and criteria

Systematic planning will be crucial for the success of a science program. Such plan should cover the acquisition of knowledge, the development of skills and attitudes and the use of appropriate assessment. In the design of the teaching units, the teacher should give special consideration to the following criteria:

- To select the topic from the science curriculum. The topics must guarantee continuity, progression between students´ real knowledge and our proposal concerning other courses.
- To know the previous learning experiences of the children. The learning experiences and science concepts and skills previously developed by children should be the starting point for science teacher planning. Therefore, the review of the children´s previous course records and ideas, consulting with the former teacher of the class will provide the teacher with useful information for planning a scheme of work and understanding possible student misconceptions.
- To identify and define the learning outcomes, aims, goals and objectives as results of working this unit. It will provide the basis for selection of the contents, the activities, the teaching and the assessment organisation.
- To clarify and identify the specific content cover in the unit. It will specify the concepts, skills and attitudes that children should develop.
- To consider the possible teaching approaches to apply (teacher explanations; individual, pair, small group working; reading; writing; lab activities; videos...)
- To design a work scheme focused on a wide range of scientific activities framed in a sequence that contributes to the maximum development of students´ skills, attitudes and concepts. The activities should:
    a) Promote and stimulate the curiosity, exploration and investigation
    b) Let them interact with laboratory materials and other sources (books, videos...)
- The work plan should incorporate activities that children may experience daily or weekly, such as recording the weather or taking care of animals/plants in the classroom.
- Teachers should also plan some activities in small groups to carry out without adult supervision. For example, investigation tables in the classroom with associated questions on cards, such as daily temperature, the humidity of the atmosphere, wind direction...
- To use a range of teaching approaches and methodologies will ensure the balanced development of knowledge, skills and attitudes.
- To provide a differentiated proposal to fulfil the social and learning needs of individual pupils (attention to diversity). Children should be able to complete the planned activities. However, also, the teacher should consider adapting activities for students with learning difficulties, as well as including reinforcement activities for students with higher skills.
- To identify the resources required for the topic and the equipment in the school. Teachers in the same school should manage to share the available resources to maximise the use of specialised equipment, such as thermometers, nature viewers, magnets, bulbs and batteries.
- To specify the methods of assessment.

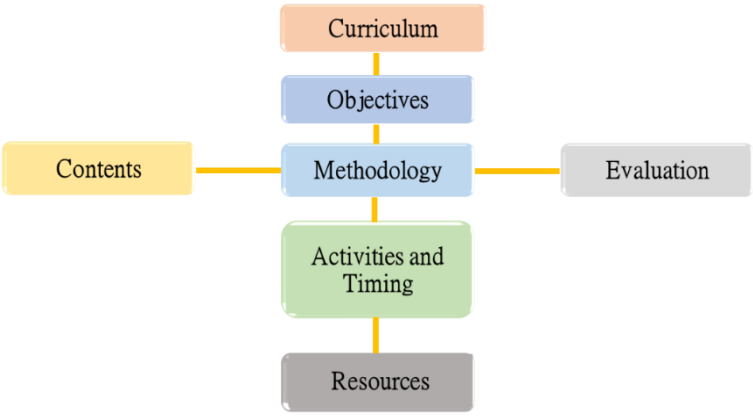
In planning activities appropriate to the different children´s levels of ability and experience, teachers can consider:

- To use a combination of whole-class teaching and group work.

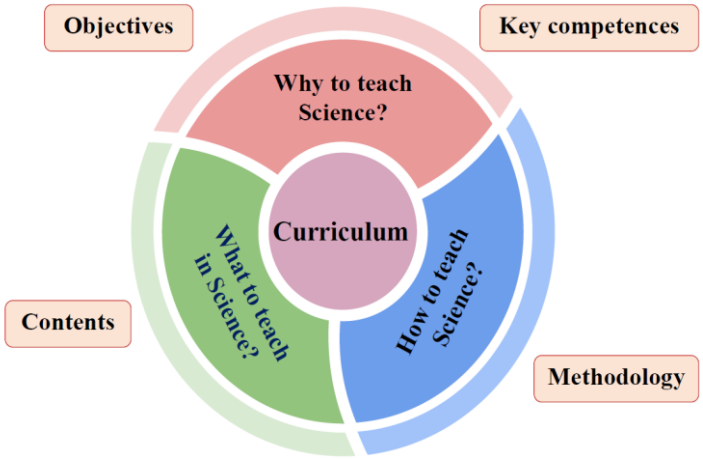
- To provide extra work in response to the necessities of the students.
- To plan teaching units based on especially familiar contexts.
- To provide opportunities for interacting and working with other children in small groups.
- Allow children to work with concrete materials

In definitive, the teaching unit is a set of objectives, competences, contents, methodologies and evaluation criteria of the different areas of knowledge, together with the contribution of these areas to the acquisition of key competences:

A deep relation between all the components of a teaching unit could be:



When we design a teaching unit, we can consider a series of questions such as:



Why to teach Science?

Specifically, it must satisfy the following questions: Why teach science to citizens? Moreover, Is science learning that all must undertake? The answers are the guide to make decisions on the other issues of teaching:

What strategies? | *What capabilities?*

Which activities? | *What contents?*

In definitive, it relates directly to the Aims of Science Education (educational intentions):

Objectives | ***Key Competences***

Objectives

We can define them as:

- They indicate the goals towards which to direct the school activity.
- They facilitate the selection and organisation of the necessary teaching.
- Mark and make possible the criteria and contents of the evaluation.

Key competences

One of the main purposes of primary education is **the acquisition of competences**. In that sense, students will acquire the necessary tools to understand the world around them and become a person capable of actively and critically intervening in society.

What to teach in Science?

It relates to the knowledge and the main aspects worth to be included in the curriculum, namely, the contents. Traditionally, contents were a selection of scientific knowledge, structured in academic disciplines that gave us the ability to offer us an adequate understanding of the world. Currently, contents can be understood more like a selection of knowledge from different fields according to a conception of the school as an agency of cultural transmission and the curriculum.

Within the new curricular approaches, it is the movement on Scientific Literacy of Citizenship that has had the most significant influence since the 1990s. Scientific literacy involves the ability to read and understand the scientific languages of the media. Therefore, from science education, it is necessary to analyse what contents should be taught in school to achieve it.

How to teach Science?

It is related to how to bring to the classroom the contents included in the curriculum, methodology. Three significant factors influence the methodology: the role of the teacher, the role of the student and the learning and context.

Role of the teacher

Usually, the curriculum includes the role of the teacher explicitly or implicitly, which will influence their function in the classroom and degree of autonomy in decision-making. Moreover, as the role of the teacher relates closely to the methodology of a specific curricular proposal (including the planned activities), we can conceive the teacher as:

a) A technician focuses exclusively on teaching what is in the curriculum

b) An autonomous professional who can guide their practice by analysing educational situations and using a wide range of teaching strategies

Role of the student

Not all students are the same, so their learning progress will be different too. Therefore, the teacher should consider the psychological and sociological factors of the students in the classroom when designing a teaching unit.

Learning and context

Currently, the use of everyday contexts to generate learning is a determining factor, especially in science subjects, where we can find specific factors that promote it:

- The emergence of controversy (nuclear power, embryo manipulation…).
- Relevance. Some issues that affect the population, the level of life, the welfare society.
- Commercial interests, when they wish to emphasise quality, novelty… of a product.
- The impact on the attitudes towards science (opinions, beliefs…).

3. Defining goals/purposes/objectives.

Aims and purposes are close concepts. The teacher purpose, when he/she decides to do something, can be considered as equivalent as an aim. Both ideas are related to the result to achieve.

In the same way, teachers usually interchange goals and objectives. The main difference comes in their level of concreteness. Objectives are concrete, whereas goals are less structured. Here is an easy way to remember how they differ:

Goal has the word "**go**" in it. Goals can be indicating going forward in a specific direction.

Objective has the word "**object**" in it. Objects are concrete.

Goals and objectives are tools for accomplishing what the teachers want to achieve. However, goals are long term and objectives are usually performed in the short or medium term. Both describe what students will learn or be able to do after instruction.

In summary, the goals and objectives specify what the teacher will teach and try to evaluate, so they must be clear to students and teacher.