

Chapter 4. Conceptual Contents

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1. Explanation, communication and language

In science education, communication is a crucial aspect. Science teachers have, frequently, to deliver explanations to their students, in order to make clear aspects as, for example:

- a) The sequence of main ideas in a topic, as well as their basic meaning,
- b) Make explicit links between these ideas,
- c) Provide examples that illustrate both ideas and links,
- d) Provide information when needed

Teachers also have to manage to access to their students thinking. The following tables present a sample of ways in which teacher and students can communicate in the science classroom.

Strategies for Teachers to promote communication in the science classroom

STRATEGIES TO KNOW AND CHALLENGE STUDENT THINKING
Ask students about their ideas
Ask questions to challenge student thinking
Engage students in analyzing and interpreting data and observations
Engage students in constructing explanations and arguments
Engage students to make connections synthesizing and summarizing key science ideas

STRATEGIES TO promote the learning of COHERENT SCIENCE CONTENT
Make explicit the initial thinking of the students
Outline how activities are matched to this learning goal
Select the content related to the learning goal and motivate the engagement of students
Sequence key science ideas and activities appropriately
Link science ideas to other science ideas and everyday knowledge

Types of Instruction

Teacher-Directed Instruction

In teacher-directed instruction, the teacher provides explanations to the whole class and individual students respond to the teacher.

The teacher combines saying with showing, supporting oral instruction with pictures, illustrations, realia, graphic organisers, models, demonstrations, video clips, and other visuals.

Teacher-directed instruction clarifies concepts and helps students to build connections that facilitate a greater understanding of science.

Teacher-Assisted Instruction

In teacher-assisted instruction, the teacher guides the brainstorming and discussion among the whole class. He/she emphasises the student–student and teacher-student interactions.

In this mode, the teacher does not lecture and give answers. When a student asks a question, other students can respond rather than the teacher.

Small groups or the whole class agree that an answer is correct, appropriate, or applicable based on the evidence, their reasoning or both.

Teacher-assisted instruction empowers and guides students to think and talk as scientist apprentices.

As students construct meaning from their explorations and text, the teacher may deem it necessary to intervene, by providing further evidence, raw data, or other resources or interactions. By providing a safe environment in which to express ideas, the teacher allows students to accommodate interpretations or test new ideas while continuing to build their scientific knowledge.

Peer-Assisted Instruction

In peer-assisted instruction, small groups of students interact and learn as a team through collaborative activities. Before students begin complex group activities, the teacher may need to model the expected group learning behaviours and establish rules of conduct. Students teach each other and learn together while the teacher monitors and guides as necessary.

Differentiating Instruction

Differentiating instruction means using a variety of instructional strategies that target the diversity of students in the classroom — students with different learning styles, interests, special needs, ...

Differentiation also means planning for collaborative and cooperative learning activities, as some students learn better as members of small groups.

The message of differentiation is to be aware of all the ways students are different and to plan ways to teach that capitalise on those differences.

2. The textbook as a resource

The textbook is a book used as a standard source of information for the formal study of a subject and an instrument for teaching and learning. Although it represents a useful resource for both teachers and learners, it is not the only resource.

Teachers should use a textbook as a guide. By using it this way, they will be free to modify, evaluate, eliminate, or add to the material in the textbook, supplement the textbook with different outside readings, ...

For the learners, the textbook is still one of the most important sources to make contact with the subject. It represents a framework or guide that helps them to organise their learning.

However, the use of a ready-made textbook has its advantages and disadvantages, depending on how they are used and what the contexts for their use are.

Among the most frequently stated advantages of using textbooks are that it provides:

- ❖ A syllabus that fits the official proposals.
- ❖ Security for the students because they have a kind of a road map of the course.
- ❖ A set of visuals, activities, readings,..., and so saves the teacher time in finding or developing such materials.
- ❖ It may include tests or evaluation tools and supporting materials (teacher's guide, worksheets...)

Among the most frequently stated disadvantages of using textbooks are:

- ✓ The textbook does not take the students' previous ideas into account.
- ✓ The content or examples may not reflect the students' needs since textbooks are usually written for the global market.
- ✓ There may not be the right mix of activities.
- ✓ The activities, readings, visuals,..., may be annoying.

3. ICT resources and other resources

Websites are invaluable for providing alternative texts focused on a given concept or topic, and they often have a high ratio of pictures and graphics to text as well as hyperlinks to keywords and related topics. Here are some examples.

The following are samples of top free resources for teaching and learning Science:

Energy Kids: From the U.S. Energy Information Administration, it is full of information about energy; from basics to forms of energy, from using to conserving. Visitors can go on virtual field trips across the country through engaging photo journals, and teachers can find lesson plans, guides, links, and suggested ways of using the website in the classroom.

ScienceBlogs: Is a digital science salon featuring leading bloggers from a wide array of scientific disciplines. Today, ScienceBlogs is the largest online community dedicated to science.

3M Science of Everyday Life: a Web site that provides K-12 science-related curriculum and tools, as well as family activities. The program, which is aligned to national standards, includes activities in the areas of life science, physical science, earth science, and technology and innovation.

Light in Action: Lasers, Cameras & Other Cool Stuff, features kids showing kids aged 9-11 that science can be fun and exciting and that advancements with light are all around them. The free multimedia is from SPIE, the international society for optics and photonics.

The National Science Digital Library is the nation's online library for education and research in science, technology, engineering, and mathematics. It provides free math lessons and activities aligned with the Math Common Core Standards, as well as STEM-related blogs and other free teacher resources and lesson plan ideas. Targeted for K-12 teachers, higher education professionals, and librarians, NSDL also provides literary science maps and iTunes multimedia files.

Untamed Science is a site dedicated to making inspirational videos, and content for the sciences. There are videos for biology, physics, chemistry, earth science and technology, and a series of portals (as seen on the upper right of every page) that serve as guides for students and aids for teachers. These guides are free for everyone.

Discovery Education is also a massive site full of free lesson plans, featured contents in many fields, not only science. Home resources and teacher professional development are also included. *Bookmark:* Top 10 resources from Discovery Education – all free ! by David Andrade

NOAA (NOAA Educational Ocean Service) joins hundreds of organisations and agencies in a celebration of science to make science more accessible, personally meaningful, and locally relevant. Be sure to check their [lesson plan](#) library. Students will be thrilled to engage in activities and games in the [Planet Arcade](#).

The Macaulay Library from Cornell University is the world's largest and oldest scientific archive of biodiversity audio and video recordings.

Smithsonian Wild lets students explore 206,340 camera trap images collected at research sites around the world. Animals are searchable by species name or location in the world. The site puts students up close and personal with animals and the research being done on the animals around the world. Students can view still images, videos, and information about the animal. Also, students can learn more about the research being conducted concerning animals around the world.

Beyond Penguins and Polar Bears consists of 20 thematic issues relating elementary science concepts to the real-world context of the polar region. The online magazine format provides professional development content and instructional resources with a focus on integrating science and literacy. It is for elementary students.

Ask A Biologist: An educational Web site adds new twists to learning by promoting direct conversations between scientists and the public.

Visible Body. Explore high-quality anatomical structures and annotate within the application to explain concepts.

SpongeLab Interactive provides an immersive interactive environment with scientific and medical 3D modelling – a collection of science digital resources including unique images, great animations, and fun games and videos –for **Biology** teaching and learning. Most contents are offered free, but some are not. By interacting with the site users gain credits and experience points that can be used to unlock special features. Credits can also be purchased for minimal cost.

Environmental Science Labs is from Environmental Literacy Council (ELC). For more than a decade, the ELC has been dedicated to helping teachers, students, policymakers, and the public find cross-disciplinary resources on the environment.

Instructables: the How-To and DIY community, germinated from MIT Media Lab **EELink** is from National American Association of Environment Education – a thorough collection of web resources on environment education

The Encyclopedia of Life is less than five years old but is approaching 1 million species pages that include everything from the names of animals to information about their habitats to reproduction habits. This website aims to describe every living creature.

Other resources.

This aspect depends on the creativity of the teacher. A lot of diverse resources can be brought to the primary science classes, such as: JOURNALS, LABS, VISITS, CONFERENCES, SCHOOL CELEBRATIONS, MUSEUMS AND GALLERIES, EXCURSIONS, CULTURAL VISITS, EXPERT PROFESSIONALS...