**PEDAGOGICAL AND INSTRUCTIONAL ANALYSIS**

***For or Against the Implementation of a Nuclear Power Plant***
**By France Garnier, Saut quantique**

| Criteria | Evaluation | | |
|---|---|---|---|
| 1. Development of student autonomy in learning | Passive | 1 2 3 4 **5** | Active |
| 2. Organization of the group | Individual | 1 2 3 4 **5** | Team |
| 3. Degree of interdisciplinarity | Monodiscipl. | 1 2 3 4 **5** | Multidiscipl. |
| 4. Preferred line of reasoning | Deductive | 1 2 **3*** 4 5 | Inductive |
| 5. Systematic approach to problem solving | Minimum | 1 2 3 4 **5** | Maximum |
| 6. Implementation of a method to produce scientific knowledge | Minimum | 1 2 3 **4** 5 | Maximum |
| 7. Development of effective written communication skills | Minimum | 1 2 3 **4** 5 | Maximum |
| 8. Development of effective oral communication skills | Minimum | 1 2 3 4 **5** | Maximum |
| 9. Development of logical reasoning | Minimum | 1 2 3 4 **5** | Maximum |
| 10. Development of critical thinking skills | Minimum | 1 2 3 4 **5** | Maximum |
| 11. Development of attitudes that are useful for scientific work | Minimum | 1 2 3 **4** 5 | Maximum |
| 12. Definition of the students' systems of values | Minimum | 1 2 3 4 **5** | Maximum |
| 13. Use of information technologies | Minimum | 1 2 **3** 4 5 | Maximum |
| 14. Creation of connections between science, technology and social progress | Minimum | 1 2 3 4 **5** | Maximum |
| 15. Familiarization with the context in which scientific concepts are discovered and developed | Minimum | 1 2 3 **4** 5 | Maximum |
| 16. Application of student learnings to new situations | Minimum | 1 2 3 4 **5** | Maximum |

* The line of reasoning used is both inductive and deductive.

**Comments**

This pedagogical activity could involve all learning integration techniques. To achieve their objectives, students must call upon all the intellectual abilities involved in analyzing and solving a complex technoscientific problem in a team. The intrinsic motivation resulting from the teamwork will improve the group's cohesiveness in its quest for the common goal. Moreover, students will be proud to take on, by themselves, the challenge of finding a clear solution to a technoscientific problem with major societal implications.

The pedagogical strategy is typical of problem solving. Team-based learning is the core component rather than lecture-type teaching. One of the major benefits of this strategy is that students acquire new knowledge based on their required contribution in solving a complex problem, what they already know, what they discover in their individual research, and discussions and information shared between them.

The activity illustrates and implements seven key principles of pedagogical action:
**1.** *Meets the needs of students in the classroom;*
**2.** *Provides significance to the learning object for students;*
**3.** *Puts students in action;*
**4.** *Provides adequate representations of the learning object;*
**5.** *Promotes durable learning;*
**6.** *Fosters creativity and the transfer of learnings;*
**7.** *Keeps in line with the natural pace of student development by encouraging student interaction.*

For further information on the key principles of pedagogical action, refer to the article by Guy Archambault entitled "Les nouvelles stratégies pédagogiques ont cent ans" in the introduction of *Trousse 6 : Les Nouvelles stratégies pédagogiques*, Carrefour de la réussite au collégial, Montréal, 2001.

To learn more about these subjects and 47 active pedagogical strategies, refer to: Archambault, Guy (2001), *47 façons pratiques de conjuguer enseigner avec apprendre, Les pratiques spécifiques à la profession enseignante*, Second Edition, Les Presses de l'Université Laval, Sainte-Foy.

**DESCRIPTION OF CRITERIA**

**1. Development of student autonomy in learning**

The activity fosters the development of student autonomy in learning in that students must:

- locate, organize and use pertinent information;
- plan their own learning process, setting realistic goals and choosing appropriate means of attaining them;
- evaluate the effectiveness of their strategies, adapt to different situations and readjust their objectives and behaviour.

**2. Organization of the group**

The activity may require students to work alone or in teams, either in or out of the classroom. If it encourages teamwork, it should bring students to:

- interact with others;
- assume various roles (leadership, collaboration, support) in disciplinary and multidisciplinary teams oriented toward the pursuit of common goals and objectives;
- understand and respect the diversity and interdependence of individuals.

**3. Degree of interdisciplinarity**

The activity is considered as being multidisciplinary if it uses processes, concepts, principles, and factual information derived from various disciplines or fields of knowledge (biology, chemistry, mathematics, sociology, ethics, etc.) to solve a problem or complete a project.

4. **Preferred line of reasoning**

The activity uses a deductive approach if students cover the theoretical aspects in class, and then illustrate these principles or theories through practical activities. On the other hand, the activity uses an inductive approach if experimental results or information retrieval are aimed at making students realize or understand principles or theories.

5. **Systematic approach to problem solving**

We will define synthesis problems as being written problems (e.g. at the end of a chapter), where previously learned rules must be reorganized in a much wider scope than that of proposed exercises to learn techniques or apply algorithms.

The activity brings students to solve synthesis problems systematically if they:

– frame a problem and construct a representation of it;

– analyze a problem, identifying its elements and the relationships among them and their structure and organization to provide a solution.

6. **Implementation of a method to produce scientific knowledge**

Through this activity, students are able to carry out the various steps of the experimental method if they:

– observe and gather data;

– draw inferences from data and construct hypotheses;

– set up experiments, use measuring instruments correctly and carry out experiments;

– summarize their observations, estimate their degree of certainty, draw conclusions from them, and interpret and critique them.

**7. and 8. Development of effective written and/or oral communication skills**

The activity develops communication skills if students are, for instance, required to:

– read scientific or literary texts, as well as texts on current issues;

– write scientific, literary and other types of texts;

– express themselves orally during class presentations, demonstrations or large or small group discussions.

The activity fosters the development of effective communication skills if students are required to:

– correctly use the language of instruction or second language;

– make proper use of the various languages (terminology, symbolism, conventions, etc.) specific to the scientific disciplines covered in the program.

9. **Development of logical reasoning**

The activity develops logical reasoning if students:

– identify a certain number of ideas related to the subject area, and compare, classify and evaluate them;

– organize relevant ideas into a logical sequence;

– construct a coherent argument, a rationale and a proof.

10. **Development of critical thinking skills**

To develop critical thinking skills, the activity should require students to:

– search for information from various sources;

– judge the relevance, adequacy and credibility of this information;

– become aware of knowledge-building processes, and their limits as well as their own biases.

11. **Development of attitudes that are useful for scientific work**

The list of attitudes and qualities science students must demonstrate is long, and no student can be expected to develop them all to a high level.

The activity fosters the development of these attitudes and qualities if students demonstrate, among others:

- a liking for sustained effort;
- perseverance;
- curiosity;
- creativity;
- flexibility;
- a desire to help others;
- a critical spirit.

12. **Definition of the students' systems of values**

Science students should be encouraged to define their own systems of values and to choose the values they will promote as scientists.

To this end, the activity fosters the development of the students' systems of values if they:

- identify and choose personal values;
- refer to ethical considerations and to their systems of values when making decisions and adopting conduct.

Courses in experimental disciplines may address, for example, questions related to pollution, the environment or biotechnology, thereby providing students with the knowledge and skills on which to base the positions they take.

13. **Use of information technologies**

Science students must attain a certain level of competence in the selection and use of available technological tools.

In other words, the activity uses information technologies if students:

- use a computer and its main peripherals;
- use the main types of data processing software: word processing, data processing and graphics programs, specialized software, etc.
- receive an introduction to the programming of algorithms (students headed more specifically toward applied sciences and engineering).

14. **Creation of connections between science, technology and social progress**

The activity fosters the creation of connections between science, technology and social progress if students:

- confront the power and limits of science and technology;
- discuss the influence of society in building scientific knowledge or its implications for social progress.

15. **Familiarization with the context in which scientific concepts are discovered and developed**

The activity fosters the familiarization with the context in which scientific concepts are discovered and developed if students:

- place the emergence and evolution of the concepts taught in the context of the development of human thought;
- recognize how knowledge is constructed and transformed when it is subjected to discussion and the validation of hypotheses through research.

16. **Application of student learnings to new situations**

The activity fosters the application of student learnings to new situations if students:

- see the connections among courses in the same discipline;
- establish links among the various disciplines in the program;
- integrate what they have learned and apply it to solving problems in new situations.