Preparation of guides, on Mechanics of Fluids, for the physic’s teaching based on the Investigatory Methodology

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Abstract. The challenges in the present educational reform emphasize the professional character of the teacher in the planning of classes, execution of activities and evaluation of learning. A set of planned activities is not to a class of science as a pile of thrown bricks is to a house; this is, that if it is not counted on the knowledge of the preconceptions of the students, the daily realities that they face and of the expectations that these have at the time of participating in the science classes, cannot be obtained the proposed objectives.

The well-known investigatory method applied to the education of sciences approaches the conceptual contents from practical activities of easy reproduction that are guided in effective form towards the topics to teach. Guides OPPS (Operation Primary Physics Science), of Louisiana University, are excellent examples of the application of this methodology, as much in the material that corresponds to the students as in the material for the guide of the learning activities (call Leader of the class).

This international experience, within the framework used of the Plans and Programs of the Ministry of Education of Chile (MINEDUC), is the main axis of this work in which the accomplishment of guides with this methodology considers, approaching contained of a unit of the common plan of physics for third grade of high school.

1. Preparation of Guides
All education is framed in a context, geographic, political and social, reason why it is necessary to clarify the minimum contents to teach, the methodology to use and the objectives to fulfil in the science classes. In this point, where the Physic’s Didactics becomes protagonist, the challenge to teach physics, with its laws, definitions, examples and applications, the idea to make these guides is born.

1.1. Plans and Programs MINEDUC.
The plans and programs indicate the vertical main targets (contained of the discipline) and cross-sectional (values and attitudes) of curriculum in Chile. The MINEDUC in the physics subject, for third grade of High School, in the second unit, "Fluids", demands like obligatory minimum contents, hydrostatic and hydrodynamics.
Unit 2: Flowed

1. Hydrostatic
   a) general Description of the fluids
   b) hydrostatic Pressure
   c) Principle of Archimedes
   d) the Capillarity

2. Hydrodynamics
   a) the Bernoulli’s law
   b) Friction and limiting velocity
   c) sanguineous Pressure
   d) the scientists and their contributions

**Contained Second Unit. 3º high school**

In addition, recommendations to the teacher as far as activities occur to make, to concepts to define, works practical to develop.

Between the propose activities we have the calculation of the pressure exerted by a liquid to different depths, the observation of the buoyancy of submerged objects and the description of the movement of objects in flowed different.

The program proposes east pair of activities for such aim, that they were including in the made guides.

1.2. Guides OPPS (Operation Primary Physics Science).
These guides correspond to a project of the University of Louisiana financed by the National Science Foundation of the United States, from 1995 to 1999, applied to children of primary of the United States. They are based on the Investigatory Methodology, they count on a section for the students and another for the “Leader of the Class”.

Project MECIBA (FONDEF D02I 1035) adapted these guides, and constructed new Guides, to improve the understanding that the professors of primary have on concepts of science (physical and chemical)
1.3. Questions Directives.
The activities are sustained in questions to obtain a good learning. As the topics in the plans and
programs are "Fluid in Rest" and "Flowed in Movement", the questions that guided the preparation of
guides were:

Which are the Properties of the Liquids that define them as such?

The activities in this section allow characterizing to the fluids in rest, that is to say, their
macroscopic and microscopic properties, their behaviour, its thermodynamic variables and their
qualities. This section finishes with principle of Archimedes applications.

What happens when a Fluid is in Movement?

In this case the activities focus to the study of the fluids in movement, that is to say, their
characteristic kinematics, the laws that govern their behaviour and the mathematical expressions that
derive from these laws. With a practical example of principle of Bernoulli is concluded.

The guides of this work were made according to the cycle of learning, concluding with a section
called Reflection in which the students make a summary of the learned thing and gather evidences of
their learning, answering the two questions before raised.

1.4. Scheme Activities.
The activities, from the contents demanded in the Plans and Programs, were ordered according to the
cycle of learning and both approaching points to treat. For it the scheme was used that is next.

![Scheme activities](image)

This scheme guided the preparation of the guides, as much the student’s guide as the leader’s guide
of the class, applying the contents handled by the students in later activities.
2. Made Guides.
It is possible to emphasize that this work was motivated by the knowledge of the simpleness, the use of simple materials and the effectiveness in the acquisition of concepts, that guides OPPS characterize, reason by which, the graphical format of the made guides is even similar to the OPPS; nevertheless, we cannot take its name. For that reason to these new guides "Investigatory Methodology in Physics" was called to them, whose abbreviations in spanish language is MIF, and the Contained last name was added to them "Mechanics of Fluids".

3. Student's guides.
Each activity, in the guide is focused to a specific content, which is accompanied as well of definitions, concepts, procedures, or equations.

![Image of student's activities](image1)

Student’s activities.

The student must be able to work independently; it implies responsibility in the handling of laboratory’s material and scientific attitude when developing the activities.

In each activity questions to the students are made to be able to obtain their ideas, concepts and learning, these must consider so that the student gives to excellent information respect to his internal and external processes in which he elaborates his speech and he constructs his learning.

![Image of student's activities](image2)

Student’s activities.
In order to finalize the student’s guide of activities a last called Phase appears Reflection, in which the students, from their experiences in classes, do a concise summary of the learned thing responding the two questions raised in the guide, reinforcing the reflection capacity in the student at the time of allowing that independently it takes control of the learning and makes conscientious of which it does know, of which it does not know, of which learns and of how learns it; in other words the meta cognitive capacity in the student is reinforced.

Reflection activity.

4. Leader’s guides.

The leader of the class is the one who is in charge to guide the learning of the students according to the activities; in this case the teacher is the one who has the handling of the concepts, procedures, laws, and explanations for each situation raised in the guides.

The leader’s guides are a direction for that directs the activities. In these considers, for each activity, the definitions, examples of similar activities, indications to motivate the students, data and the possible results at which the young people in their procedures must arrive.

In addition to the chairs of the subject, so common, one fortifies the learning of procedures, work in laboratory, handling of material, access to scientific bibliography, and own attitudes of a scientific
discipline, like respect by the nature, collaborative work, etc. A meticulous preparation of Student’s Guides on the part of teacher is key to obtain that the instructions of this guide are eloquent and the student can in case single work the activity.

This guide must be the base in the practical work of the student, prepared and planned, so that besides to contain the activities of Student’s Guide she contains a detailed listing of the materials to use in each one of them, and biographies of the most outstanding scientists in the area of Fluid Flow Physics.

The section Annexed of the Leader’s guide contains images and models of the materials to use in the activities, which normally are not in the market.

5. Conclusion
The Didactics is in charge to solve the problems of learning including these from the base of each one of the education components: psychology, sociology, pedagogy, philosophy, etc. To a certain extent the Didactics of science must give the guidelines to improve the educative practices of the teachers of scientific disciplines and to facilitate the teaching-learning process. New models of learning and cognitive theories must be conjugated with the fundamental aspects of the scientific research, attitudes and own values of scientists, like reasoning, to observe, to infer, to verify, thus forming methodologies more effective than allow to solve the problematic ones of the science classes.

The Investigatory Methodology is one of the modern currents that better fit in the science’s teaching. Cradle in a planning of activities whose sequence follows the Cycle of Learning allows that the knowledge in the students is constructed from its experiences in practical activities, simultaneously that returns to the teacher the professional character in the planning and execution of classes designed from specific objectives and contents (concept, procedure, attitude) demanded by the context political, social, and cultural in which is.

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