

## 1. National Research Coordinator's Comments (English)

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General commentary:

This lesson belongs to the German-speaking sample of Swiss lessons. Switzerland is split into three main linguistic parts: a French-speaking part, an Italian-speaking part and a German-speaking part. Switzerland is also split into 26 cantons. Each canton has its own educational system, and therefore its own curriculum, and to some extent its own textbooks. In the majority of the German-speaking cantons there are three tracks on the lower secondary level. The same school usually includes classes from all three tracks, i.e., in most of the schools there are classes from track one (basic demands), track two (extended demands) and track three (advanced, or highest demands). There are some mixed classes in which two tracks are taught. This videotaped lesson shows a track two class.

The teaching of most teachers in German-speaking Switzerland is generally based on a required textbook. Many teachers, however, complement this schoolbook with additional, self-prepared materials such as worksheets, according to the needs of the class. Despite the curricular prescriptions and the textbook, teachers in German-speaking Switzerland are free to organize their lessons as they wish. However, some principles and guidelines of general didactics and didactics of math education have to be considered. These guidelines are found as didactical principles in curricula as well as, in a more concrete form, as didactical suggestions in the teacher edition of the textbooks of each canton. Moreover, because almost every canton has its own curriculum and textbook, in the last few years an attempt to harmonize math teaching has been made. For this purpose, some guidelines for the teaching of math in Switzerland on a national level have been defined (Source: National Council of Directors of Departments of Education, 1998, *Suggestions for Guidelines for School Mathematics Education*, Bern: National Council of Directors of Departments of Education [hereafter 1998 Guidelines]).

Based on these guidelines, and on the main principles included in the curriculum for math education in the canton Bern, we consider the following didactical principles as typical for mathematics instruction in the German-speaking area of Switzerland (Sources: 1998 Guidelines; Department of Education of the canton Bern, 1995, *Curriculum for public schools: Grades 1 to 9*, Bern: Department of Education):

1. **Active discovery learning and problem-solving:** Math should be learned mainly through own activity and experiences and not just by teacher presentation and guided development. Learning is an individual, active process. Challenging tasks, which encourage observation, suppositions, questions, and the search of an own solution method, belong to self-regulated learning.

2. **Cooperative learning, learning through communication:** The cooperation between pupils is important, especially for problem-solving. Teachers should initiate and support statements and argumentation. Different opinions should be confronted and valued.
3. **Varying formats of representation:** Mathematical operations and concepts can be presented as concrete actions, as a graphic representation, or in a formal, symbolical way. In order to develop students' abstraction capacity, the change between these formats of representation is important. Abstract, formal concepts and operations need to be illustrated again and again. Teachers normally don't place formal mathematical representations and processes in the beginning of a new content unit. They first give learners the chance to bring their ideas into their own language and representation. The formal representation is then developed.
4. **"Spiral principle":** Important mathematical ideas, processes and structures cannot be treated exhaustively at once, they need continuous development and elaboration. Learners will come over them repeatedly during their school-time, see them from a new angle in different learning stages and connect them with other knowledge.
5. **Productive practice:** Goals of productive practice are understanding as well as the conscious availability of knowledge. Tasks or problems should be chosen which require further thinking and which lead to new questions. Productive practice in general enhances discovery learning and problem-solving.
6. **Automatization, practice:** A minimal set of basic knowledge and skills must be available at any time. After being developed, these procedures need to be repeated systematically, in order to make them easily applicable to any new problem or situation. Memorizing aids and overviews with rules, formulas and examples can help and support this process.
7. **Positively dealing with mistakes:** Learning to meet the unknown without fear on the one side and making mistakes on the other side, are two important processes in learning mathematics. Mistakes allow a look at the learning process and enable a better understand of it, as well as the possibility to develop it further.
8. Math should be related as much as possible to other school subjects.

In this lesson it is possible to observe how the following didactical principles are realized: principles 2, 3 and 7.

#### **Some examples:**

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(3) **Varying formats of representation:** The introduction in "operating with variables" is illustrated graphically with lengths.

- [00:17:28](#) (7) **Positively dealing with mistakes:** As a mistake happens, it is discussed in detail.
- [00:20:34](#) (7) The same mistake as before occurs again. The teacher makes the class aware of it and points out that he expects a critical judgement of the solution ("Stop, now I expect a reaction from the class!")
- [00:28:49](#) (2), (7) Here again the class is explicitly asked to judge the solution.
- [00:34:16](#) (2) **Cooperative learning, learning through communication:** The pupils are asked to discuss and prepare a problem solution in pairs. The solution will then be presented on the blackboard.
- [00:36:27](#) The class in general, and two students in particular, are asked to give a critical judgement to the solutions presented by the student pairs on the blackboard.
- [00:42:25](#) (3) **Varying formats of representation:** The meaning of "variable" and "term" has been visualized with lengths, it is now illustrated by means of a concrete situation (going to the swimming pool).