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Question 1: How can complementary perspectives contribute to the improvement of mathematics education?

Answer: In my opinion combining complementary perspectives opens interesting perspectives leading to understanding of various phenomena in teaching and learning mathematics as it specifies some of the conditions of their use. It offers new perspectives on answering a number of questions that the previous models failed to solve.

Example (Novotna-Sarrazy, CERME 4, 2005):

As an example, I present two studies originally executed as independent entities; both are dealing with the same topic: problem solving. The first one (J. Novotná) belongs more to the psychological perspective than the purely didactical one, although the didactical concern is not absent. The second one (B. Sarrazy) examines the effects of variability in the formulation of problem assignments on students' flexibility when using taught algorithms in new situations; the research was developed in the framework of the theory of didactical situations starting from various results in the psychological domain.

These two studies although at the beginning carried out separately and on different levels of education, showed themselves to be perfectly complementary.

In one of the studies (Novotná, 1999), we investigated the ways that students are modelling word problem assignments when grasping the problems**'** structure. The individual differences in the form of solvers' models of the assignment structure could be explained by the internal students' cognitive processes (Novotná, 1999). By this approach we were not able to explain the striking difference "spontaneity versus copying" in the **students groups**. *The psychological perspective did not offer any explanation of the* *observed fact. It was necessary to search for it outside the psychological approach.*

In (Sarrazy, 2002) the following question is studied: How could it be explained that certain students show that they are able to use the taught knowledge in new contexts, while others, although "knowing" the taught algorithms, are not able to re-contextualise their knowledge? The central hypothesis of this research is to consider these inter-individual differences of the sensibility on the didactical contract (measured by an index), as an effect of the teachers' didactical variability in the domain of setting arithmetical problems.

In our experiments presented in the first research perspective, the variability of teachers proved to be the variable explaining the significant differences in the number of spontaneously created models by students in some groups in (Novotná, 1999).

References

Novotná, J. (1999). Pictorial representation as a means of grasping word problem structures. *Psychology of Mathematical Education*, 12, http://www.ex.ac.uk/~Pernst/.

Novotná, J. & Sarrazy, B. (2005). Model of a professor's didactical action in mathematics education. Professor's variability and students' algorithmic flexibility in solving arithmetical problem. In Drouhard, Jean-Philippe. *CERME 4*, WG 6. Sant Feliu de Guíxols, Spain, 17.-21.2.2005.
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Sarrazy, B. (2002). Effects of variability on responsiveness to the didactic contract in problem-solving among pupils of 9-10 years, *European Journal of Psychology of education*, XVII. 4, 321-241.

Question 2: In any of the presentations or in your reflections, did you identify an issue for research / for teaching and learning that seems extremely difficult (*and at the same time extremely important*) to deal with?

Answer: In many interesting researches and proposals discussed at the conference, the phenomena treated in detail in the Theory of Didactical Situations in Mathematics (Brousseau, 1997) were not taken into account. The following list presents the phenomena that I regard as most important (Brousseau, Sarrazy, 2002):

- The danger of meta-didactical shift (knowledge is replaced by one of its models described in a meta-language) was clearly present. In several contributions, this danger was not explicitly mentioned.
- The important difference between *"connaissances"* and *"savoirs"* is not applied.

References

Brousseau, G. (1997). *Theory of Didactical situations in mathematics 1970-1990*, [Edited and translated by M. Cooper, N. Balacheff, R. Sutherland & V. Warfield], Dordrecht: Kluwer Academic Publishers. (French version: Brousseau, G. (1998). *Théorie des situations didactiques*. [Textes rassemblés et préparés par N. Balacheff, M. Cooper, R. Sutherland, V. Warfield]. Grenoble: La pensée sauvage.)

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