An instrument for errors' evaluation and decision's prevention in primary school

Francois Kalavassis, Sonia Kafoussi, Chrysanthi Skoumpourdi
University of the Aegean, Greece

The purpose of this workshop is the discussion about the use of an instrument for students' errors' evaluation and teachers' decision's prevention for developing ability for educational planning to primary school teachers.

The meaning and the role of errors in mathematics teaching and learning have been largely discussed among the mathematics educators during the last two decades. As a consequence, nowadays, it is widely accepted that students' errors reveal their own ways of conceptualization of a mathematical concept or procedure (Confrey, 1991). Moreover, it has been acknowledged the positive function of errors during the teaching of mathematics in the classroom (sources of cognitive and socio-cognitive conflicts, opportunity for the development of new mathematical activities, cf. Perret-Clermont, 1980). Furthermore, many educators have mentioned that any change of teachers' beliefs and practices in mathematics education could have their behavior towards students' mathematical errors as a starting point (cf. Wood, Cobb & Yackel, 1991).

Nowadays, mathematics knowledge tends to be identified with information and useful basic tools. Having in mind this situation, we have to change the character of educational process, through classroom mathematics activities that can prepare teachers to prevent their decisions about students' errors. This approach can help students to experience the constructive character of mathematical knowledge.

In this workshop an instrument which can be used by teachers in order to improve their didactical decisions as well as to develop their ability for educational planning is proposed. This instrument was produced by the Laboratory of Learning Technologies and Didactical Engineering of University of the Aegean (Kalavassis, et al., 2002) and it aims to:

- find various solutions to a problem, which is one of the crucial components in the development of creative thinking, since according to Polya (Applebaum & Samovol, 2003, pp. 69) "*it is preferable to solve one problem in a number of different ways rather than solve a number of different problems in the same way*",
- interpret some inborn typical contradictions and deadlocks that students face both in the comprehension and in teaching of school mathematics,
- supply teachers with the theoretical and practical tools in order to enable them to form didactical conditions on which decision making can favor mathematics' learning.

At the beginning, we shall describe the instrument in order to understand its effectiveness and its advantages as well as the way we can use it. Then, all participants will be asked to participate in activities based on the use of this instrument for kindergarten and primary level. At this point it is important to pinpoint that the goal of this particular instrument is not to examine knowledge, but to give the opportunity for a discussion about different ideas and experiences.

This instrument, which looks like a usual research questionnaire with simple structure and use, is described in the following six stages:

I. Several alternative answers on a specific selected subject-problem are presented. These answers are either all of them wrong or all of them correct and they have been systematically observed by different learners on comparable conditions of teaching and learning. The mistaken perceptions including on each particular questionnaire are not individual errors or

arbitrary thoughts. They rather look like being part of a particular thinking process, deeply rooted in many students. They are perceptions that we can find very often in students' answers and they have become subjects of many researches in mathematics education.

II. Participants are requested individually to give a mark to each answer.

III. Participants are requested individually to interpret each answer.

IV. Participants are requested individually to describe their teaching treatment in each case, that is the way they would try to help the students to understand their errors.

V. Participants discuss in small groups of three or four members their grades, their interpretations and their decisions about the ways treating the subject-problem. They chose one representative of the group to present the results of their work.

VI. The representatives of the groups present the particular answers of all the participants by discussing and comparing thoroughly each subject-problem as well as the eventual consequences that each didactical decision of the teacher could have on students' mathematical learning.

VII. At the end of the discussion for each subject-problem, we will present the interpretations of the alternative answers of the students proposed by mathematics researchers. The procedure is completed with the final formulation and listing of the results from the learners' groups as well as with the discussion of the usefulness of this instrument on the development of educational planning ability to aspirant and active teachers.

Below, we present an example based on this instrument, referring to a specific probabilistic problem:

I. The following activities were presented in Fischbein's work (Fischbein & Gazit, 1984; Fischbein & Schnarch, 1997)

A) Ruth prefers, when she participates in a lottery, to choose consecutive numbers like 1, 2, 3, 4, 5, 6. She claims that in this way she increases her chance of winning. On the other hand Jenny claims that the chance of getting six consecutive numbers like 1, 2, 3, 4, 5, 6 is smaller than that of getting a random sequence of numbers. She says that a lottery is something chancy and therefore there is no chance of getting a sequence of consecutive numbers. What is your opinion with regard to the two beliefs, that of Ruth and that of Jenny?

A΄) Children' wrong answer was that "random numbers have a higher probability of winning".

B) In a lotto game, one has to choose 6 numbers from a total of 40. Vered has chosen 1, 2, 3, 4, 5, 6. Ruth has chosen 39, 1, 17, 33, 8, 27. Who has a greater chance of winning?

B΄) Children' wrong answer was that Ruth has a greater chance of winning"

II. Give a mark (0-10) to each answer.

Answer	A΄	B΄
Mark		

III. Which do you think is the origin of each answer?

A´

B´

IV. Describe a didactical treatment for each case.

A´

B´

It is worthwhile to be mentioned that from our experiences gathered up to now, it is impressive the teachers'-learners' divergence when they evaluate or interpret errors, in comparison with their convergence about didactical treatment.

Some questions that we are proposing to discuss in the workshop with the participants are focused on the following:

1. Given that the reform of mathematics education legitimizes students' errors, the question is whether in educational practice we legitimize *equally* all the different answers that students offer as they are engaging in a mathematical problem. Could this equality be developed in the classroom?
2. Could there be a unique method for the evaluation – interpretation – treatment system when we are dealing with a wrong answer? During the educational practice, this system does not seem to be appreciated by the educators in the same way (the subjective evaluation in not sufficient). Under which procedures can we avoid subjectivity during the educational practice?
3. Could we design - invent some kind of educational material that could facilitate or resolve the two above problems?

References

Applebaum, M. & Samovol, P. (2003). Optimized Techniques of Teaching Mathematics at School in Oral Presentation' Abstracts *CIEAEM 55* Poland

Confrey, J. (1991). Learning to listen: A student's Understanding of Powers of ten. In E. von Glasersfeld (Ed.), *Radical Constructivism in Mathematics Education*, (pp.111-138). Kluwer Academic Pubishers.

Fischbein, E. & Gazit, A. (1984). Does the Teaching of Probability Improve Probabilistic Intuitions? *Educational Studies in Mathematics* 15.

Fischbein, E. & Schnarch, D. (1997). The Evolution With Age of Probabilistic, Intuitively Based Misconceptions. *Journal for Research in Mathematics Education* Vol. 28, No 1.

Perret-Clermont, A. N. (1980). *Social interaction and cognitive development in children.* New York, Academic Press

Kalavassis, F., Mitsoulis, C., Orfanos, S., Skoumpourdi, C. & Tzortzakakis, G. (2002). Error and Stigma: error' evaluation in mathematics and school failure prevention. In *Educational, Family, Political Psychopathology* Volume 3 Atrapos Athens

Wood T., Cobb P. & Yackel E.,(1991). Change in Teaching Mathematics: A Case Study, *American Educational Research Journal*, 28(3), 587-616.