# DIALOGUE AMONG IN-SERVICE TEACHERS IN AN INTERNET-BASED MATHEMATICS EDUCATION PROGRAM

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ABSTRACT
This paper describes and analyses an internet-based course in a mathematics education program for in-service teachers. The analysis is focused on the interactions of a small group of teachers around a mathematical activity. Through the analysis we identified interactions that possess the characteristics of a dialogue in terms of Alrø & Skovsmose (2002). It is discussed which design factors are likely to act in favor of the emergency of dialogues supporting the teachers' mathematical and didactical reflection.

## 1. Introduction

The mathematics education program of CICATA-IPN in Mexico is an internet-based program directed to in-service mathematics teachers in Latin American. The program offers Master and Phd studies constituted by a number of different courses. Since the foundation of the program, these courses have been (re)designed based on the experience, intuition and criteria of the different teacher educators in charge of the courses. In spite of this pragmatic design of the courses, we have noticed that in some cases teachers' engagement in group discussions and reflections affects in a positive way their beliefs and attitudes about the teaching and learning of mathematics. The aim of the study reported in this paper is to evaluate, in a more theoretical way, what constitutes these fruitful interactions and which are the design factors that are likely to act in favor of such interaction. The analysis reported here is focused on a special element, which is included in different courses, e.g. *notes of reflection*, but the data presented here it came from the interactions in a group of teachers related to specific activity in one of the internet based courses. The teachers' interactions are analyzed and evaluated using the concept of dialogue as it is developed in Alrø & Skovsmose (2002).

## 2. Theoretical framework

The concept of dialogue is recognized as a key stage in the process of learning (Alrø & Skovsmose, 2002; Chamoso, 2003; McGraw et Al, 2007, Zack & Graves, 2001). An assumption that underlies the concept is that although the learning is personal, the construction of knowledge

is performed through social interactions. In general the concept of dialogue is understood as a sort of interaction in which the participants have a genuine interest on the ideas of their interlocutors, and where they intent to discuss and to build ideas in a collective way. In this paper I used the concept of dialogue, associated to the Inquiry Co-operation Model of Alrø & Skovsmose (2002) in order to pinpoint the dialogical qualities in the teachers' interactions and to identify the important design factors that may encourage productive dialogues among the teachers. In this theoretical approximation it is affirmed that, when an interaction possess specific communicative characteristics as *getting in contact*, *advocating*, *thinking aloud*, *reformulating*, etc, the interaction is considered a dialogue. Although the approach has been developed from analyzing interactions in classroom and face to face small group interactions, the theoretical structure is sufficiently general to be used for analyzing internet mediated interactions among in-service mathematics teachers. The aforementioned elements hold the following characteristics:

> "[*G*]*etting in contact* involves inquiring questions, paying attention, tag questions, mutual confirmation, support and humour. *Locating* has been specified with the clues of inquiring, wondering, widening and clarifying questions, zooming in, check-questions, examining possibilities and hypothetical questions. *Identifying* involves questions of explanation and justification and crystallizing mathematical ideas. *Advocating* is crucial to the particular trying out of possible justifications, and it is closely related to arguing and considering. *Thinking aloud* often occurs as hypothetical questions and expression of thoughts and feelings. *Reformulating* can occur as paraphrasing, completing of utterances and staying in contact. *Challenging* can be made through hypothetical questions, examining new possibilities, clarifying perspectives, and it can be a turning point of investigation. *Evaluating* implies constructive feedback, support and critique" (Alrø & Skovsmose, 2002, p. 110, my emphasis).

We are particularly interested in the study of the dialogue among in-service mathematics teachers because we argue that is important for them to be involved in dialogical interactions. Generally, in-service mathematics teachers possess a collection of experiences, knowledge and beliefs that influence their teaching practice. A positive way to achieve changes in those beliefs, to identify their conceptions and to make them aware of the complexity of the mathematics learning process, is through the expression, comparison, debate and argument of their own ideas and points of view. That is, through dialogical interactions focused in didactical and mathematical topics.

## 3. The course and its components

The analyzed course is called “Analysis of the mathematical school discourse II” (ADME II, the acronym in Spanish). It is part of the master studies and it lasted four weeks. The data came from a course carried out in year 2005 with 27 teachers from three different Latin American countries and working at different educational levels (elementary, upper secondary and university).

The course was focused on the study of different cognitive theories in mathematics education research. The goals of the course were to enable teachers to use cognitive theories to analyze the behaviors of their students and also to b aware of their own mathematical conceptions.

The course was composed of different elements and activities as reading mathematics education research papers; the observation of a video that contains the application of a didactical activity that generates a cognitive conflict; group discussions that were developed on the internet-based forums by means of asynchronous exchange of written messages; and activities called *notes of reflection*. Here I focus on the asynchronous discussions of some teachers, associated to one of these notes of reflection.

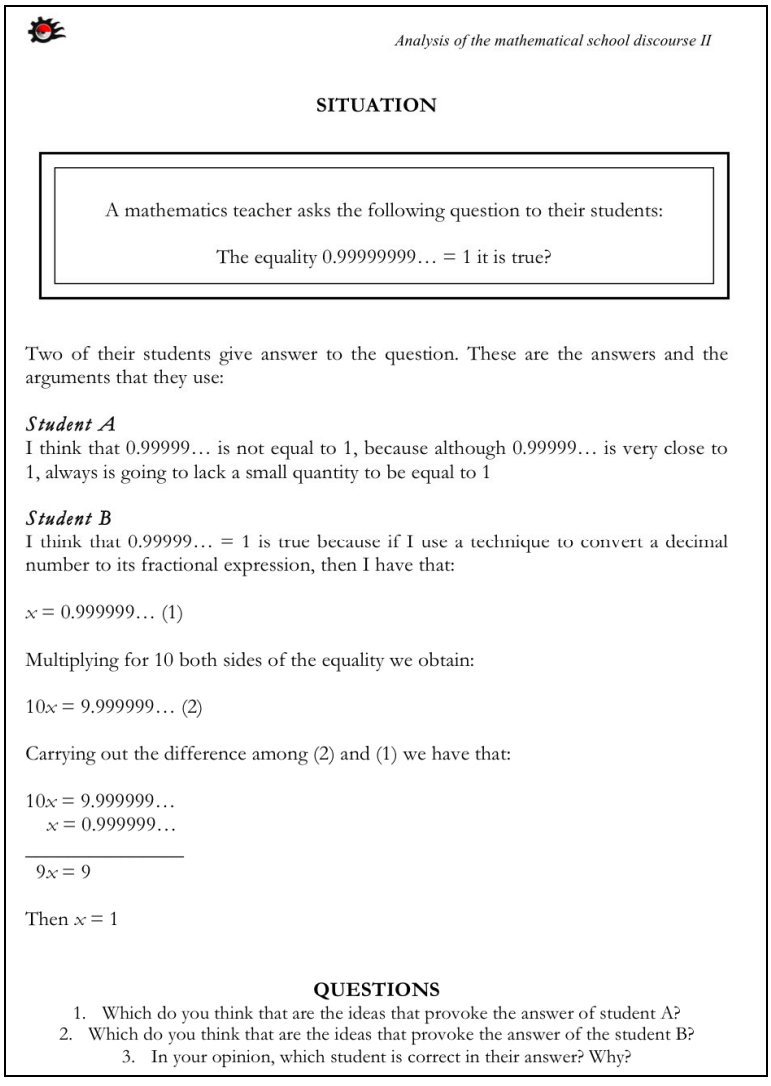
The notes of reflection are activities in which a fictitious school situation designed around a mathematical question or problem is introduced. The situation is developed in an imaginary setting, in which a teacher asks a question to his or her students. Although this is a school episode that has not happened in the reality, the answers that the imaginary students provide (called student A and student B), have been inspired by real teaching experiences or have been taken from experimental data included in some regional research thesis or research reports.

After looking through the situation, teachers are asked to explain the possible causes behind the answers of students A and B. Also, they are asked to decide if they consider the answers to be mathematically correct. The aim of the activity is to stimulate mathematical and didactical reflections in and among the teachers. Figure 1 shows an English translation of the first note of reflection that was presented to the teachers.

## 4. Teachers’ discussion of the first note of reflection

Each note of reflection was answered by the teachers individually and delivered as a file through the internet-based workplace. However, it is an important part of the design that the activity was

discussed in the asynchronous forums. Next is shown an excerpt of an interaction in which this activity is discussed. In the discussion participate Ana and Paula[1]. Ana is Mexican, and Paula come from Argentina. Ana works in secondary level education. She has a bachelor in mathematics and her work is focused on the production of educational videos for distance education through television. Paula studied to become a mathematics teacher and she has three workplaces: She works in an elementary school, in a secondary school and also in an institute of mathematics teacher education in Argentina.



*Analysis of the mathematical school discourse II*

**SITUATION**

A mathematics teacher asks the following question to their students:

The equality 0.99999999… = 1 it is true?

Two of their students give answer to the question. These are the answers and the arguments that they use:

***Student A***
I think that 0.99999… is not equal to 1, because although 0.99999… is very close to 1, always is going to lack a small quantity to be equal to 1

***Student B***
I think that 0.99999… = 1 is true because if I use a technique to convert a decimal number to its fractional expression, then I have that:

$x = 0.999999\ldots$ (1)

Multiplying for 10 both sides of the equality we obtain:

$10x = 9.999999\ldots$ (2)

Carrying out the difference among (2) and (1) we have that:

$$\begin{array}{r} 10x = 9.999999\ldots \\ x = 0.999999\ldots \\ \hline 9x = 9 \end{array}$$

Then $x = 1$

**QUESTIONS**

1. Which do you think that are the ideas that provoke the answer of student A?
2. Which do you think that are the ideas that provoke the answer of the student B?
3. In your opinion, which student is correct in their answer? Why?

*Figure 1*. First note of reflection presented to the teachers

[1] The original names were replaced to protect teachers' identity.

[1] *Date: 17-11-2005 08:55*

*Author: Paula*

*Topic: Question*

I still thinking on 0.9999... and 1. I would like to know how this topic is presented in Mexico. In Argentina we have a very structured and not so visual training. When the first note of reflection was presented I did not doubt about it, the answer was that they are equal. Nevertheless the things that have been said in this forum and in the previous one cause some doubts in me regarding the way you teach this aspect of a decimal representation. Can you tell me how you teach the relationship between fractions and decimals and how you define the number 0.9999... as a real number? Thanks

[2] *Date: 17-11-2005 11:44*

*Author: Ana*

*Topic: Re: Question*

The truth is that I have not tried the topic with students (I do not work in front of a group), but I am an adviser for a didactical guide that will include this topic, for that reason I am interested on the related reflection.

When I studied, I saw it in the two ways (separately, as commonly is studied). For that reason, it seems to me that both are right into the context in which they reply.

If somebody has worked it into the classroom, I hope you can share it with us.

[3] *Date: 17-11-2005 11:46*

*Author: Paula*

*Topic: Re: Question*

I do not understand what do you mean when you say that in one context the first answer is correct. I do not find that context inside the mathematics that I know. Perhaps I don't know it and there is the source of my lack of answers in the discussion on the first forum. In which context A is correct? Can you explain it to me?

Ana is *getting in contact* with Paula in [2]. Ana explains that she does not have experience teaching the topic, but she explicitly states her interest in the discussion. She resorts to her

experience as student to *think aloud* about her idea of the "context-dependent validity" of the equality. This provoke a reaction in Paula, and in [3] an *advocating* process appears, that is, Paula express her skepticism on Ana's idea, but at the same time she is willing to examine her own understandings: "Perhaps I don't know it and there is the source of my lack of answers in the discussion on the first forum". This sort of attitude is one of the clearest indicators that we are facing a dialogue. As Alrø & Skovsmose (2002) affirm: "A dialogue also means *willingness to suspend one's perspectives* – at least for a moment" (p. 121). Ana responds the questioning of Paula, bringing to the discussion the mathematical concept of density:

[4] *Date: 17-11-2005 12:13*
*Author: Ana*
*Topic: Re: Question*
I talk about the idea that is taking the student to give his answer, in this case, the density of the real numbers.

[5] *Date: 17-11-2005 12:18*
*Author: Paula*
*Topic: Re: Question*
The problem that I see is that it does not have to do with density, the problem is that they are the same number, is not that they are two very close numbers. They are the same one. It is there where the student gets confused, that is the way I see it.

[6] *Date: 17-11-2005 12:26*
*Author: Paula*
*Topic: Re: Question*
The problem is that I cannot have two different answers for the same question. In the Janet's video that we saw she finds two different answers, both correct from her point of view. But what finally is concluded is that is not possible, in mathematics, to have two coexisting different answers for the same question. If it were possible, then all would depend on people individual ideas. Definitions exist to avoid that.

## 5. Discussion

Even though the note of reflection showed to be a decisive factor for the apparition of the dialogue, it is not possible to look at it as an element that in an isolated way produces or favors the dialogue among teachers. The note of reflection is an element related to other elements of the course. For example, in [6] Paula uses the content of the video to build an *evaluating* act on Ana's idea of the existence of two different answers for the same mathematical question. Then, it is necessary to further investigate the influence of other elements and characteristics of the internet-based courses in the dialogic acts and in the dynamics of the dialogue.

Besides the note of reflection, we claim that other factors favor the emergency of the dialogue. As de Vries, Lund & Baker (2002) and McGraw et al (2007), we recognize that the emergency of a dialogue is favored among heterogeneous groups as in the case of Ana and Paula (in this case members of a group with different academic background and/or different ideas on the same topic); but is important to point out that heterogeneity is a condition that favors the dialogue but it does not guarantee its occurrence. For example, even though the teachers had different answers to the equality presented in the first note of reflection, and that they were online at the same time as Ana and Paula were interacting, they were not involved in the discussion in an active way. Why Ana and Paula got engage in a dialogue? A theoretical explanation to this question can be found in the concept of intention of Alrø & Skovsmose (2002).

Participation in a dialogue can be determined by the underground and foreground intentions of the participants. Alrø & Skovsmose (2002) affirm: "[W]e must consider how the activities in the classroom relate to their priorities [of the students] that are constructed by their hopes, expectations and frustrations when they face the future…[F]oreground refers to the prospects of the person" (p. 160). Thus, it is clear in [2] that Ana is interested in the discussion because the content is related to her labor responsibilities that will face in the future. We conclude then that in order to achieve the teachers' involvement, the proposed activities not only should be activities that allowing different ways of development or solution, and produce a variety of perspectives as is indicated by de Vries, Lund & Baker (2002). Another important condition is that those activities should be significant for them, that is to say, to be related to their background and foreground intentions.

Our interest in the creation of situations and the identification of the conditions that favor the dialogue among teachers reside in our conception of dialogue as an act intimately connected with reflection. The dialogic acts (such as getting in contact, thinking aloud, etc.) that are present in the interaction between Ana and Paula, allow me to affirm that they were involved in a dialogue; that is to say, a quality interaction in which the teachers express, justify, compare and evaluate their own mathematical and pedagogical ideas. This dialogue is likely to be a reflection source; for instance, at the end of the course, it was asked to Paula if the course had contributed to her educational practice, and she answered:

> "[T]hrough the forums I could know the way of thinking of some of my colleagues and to find the similarities and differences in our ideas. And to understand also that all the different looks on the same reality that we have are reflected in our students."

The previous extract suggests that Paula has understood that the teachers' conceptions and the way in which the contents are presented can influence students' mathematical learning. .

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