PRACTICE-BASED TEACHER EDUCATION FOCUSING ON
MATHEMATICAL DISCUSSIONS

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This paper presents a practice-based teacher education task and reflects on using with
a group of experienced teachers. I begin sketching a rationale for using such tasks,
then I present the context of this activity and conclude referring the value of this
approach for in-service and pre-service teacher education.

EXPLORATORY TASKS IN THE MATHEMATICS CLASSROOM

Classrooms in which the students do some extended work on tasks that require them
to model situations and frame questions and later they present their solutions to the
whole class and discuss other solutions are becoming more common in our country
and perhaps elsewhere. The students usually work in pairs or in small groups.
Sometimes they are asked to write a report with their strategies and solutions, in other
cases they present them orally during the discussion. This requires suitable tasks to
propose to students – exploratory, inquiry, or investigative tasks – that lead them to
do substantial work and from which they can learn new mathematics. It also requires
that teachers support students’ work and conduct productive discussions during
which mathematics ideas are raised, clarified, and formalized. This vision of the
mathematics classroom fits with what many documents such as NCTM (2000) refer
to as “reform mathematics education”.

Worthwhile mathematics tasks are critical in mathematics teaching (NCTM, 1991).
However, tasks appropriate for a class may not be appropriate for another. Thus, the
teacher needs to know what tasks are suitable for his/her students, in terms of
structure (Ponte, 2005), degree of mathematical challenge (Potari & Jaworski, 2002),
context – mathematical or non-mathematical –, and time required to complete it that
may range from a few minutes to some days, weeks, months or even more (Ponte,
2005). The key role of open and challenging tasks in mathematics teaching has been
recognized by mathematics educators such as Sullivan, Bourke and Scott (1997) and
Skovsmose (2001) and has a significant expression in some countries (Boaler, 1998).

However, powerful mathematical tasks do not teach just by themselves. The role of
the teacher in the classroom, presenting them, supporting students, and leading
discussions is critical (Stein & Smith, 1998). In Portugal, a new mathematics
curriculum for basic education – grades 1 to 9 – encourages teachers to propose such
exploratory tasks in mathematics classrooms. It suggests that rich exploratory tasks
and whole class discussions are important elements in the students’ learning
experiences but it leaves to the teacher to decide about the appropriate balance of
classroom working modes. Such exploratory tasks are very demanding on teachers:
Their selection involves a high level of understanding of the mathematics involved as
well as in-depth knowledge about students’ abilities and interests. In supporting

students, teachers have to restrain themselves of saying too much, at the risk of taking away the need for students’ thinking. Discussions, on the other hand, require that teachers orchestrate the classroom discourse, providing opportunities for all students to intervene, stimulating moments of controversy and argumentation as well as moments of systematization and formalization of mathematical ideas.

TEACHER EDUCATION TO TRANSFORM CLASSROOM PRACTICE

Research on teachers’ beliefs, conceptions, and knowledge regarding mathematics and mathematics teaching stand on the implicit assumption that if these can be changed, then teachers’ classroom practice may also change. However, it is becoming clear that if the goal is to have a real impact on teachers’ classroom practice, then classroom practice needs to play a key role in teacher education (Ball & Cohen, 1999; Smith, 2001). This leads to the consideration of practice-based teacher education. One way of achieving this is to regard teacher education as situated in practice. That means that the materials that represent the teaching activity and their results (for example, mathematical tasks, records of students’ work, classroom episodes) are used as opportunities for critique and investigation. Teachers then develop knowledge analyzing real situations that they may use later in their actual teaching practice. Teachers work with material drawn from actual classrooms that may be more or less familiar to them. This is a good choice for a small teacher education activity, when there is not much time for teachers to collect data from their classes, but that provides room to work on issues closely related to classroom events.

THE TEACHER EDUCATION TASK AND CONTEXT

The example that I present here is a task for teachers based on the analysis of a classroom episode from a mathematics task for students (see below). This student task was designed and proposed to a grade 8 class by a mathematics teacher, Idália Pesquita. I found that the work that went on in the classroom is very interesting and could be used as a basis for a teacher education task with the following structure:

Part 1. Solve the task presented to the pupils and consider:
   a) How is the task related to curriculum objectives for mathematics teaching?
   b) How this task may be used in the classroom? How to organize students? What time should they be given to solve it? And for a final discussion?
   c) What difficulties may the students feel in doing it?

Part 2. Observe the video with students discussing this task as well as the transcript.
   a) Identify and analyse then roles assumed by the teacher.
   b) Identify and analyse the interventions of the teacher.
   c) What important decisions the teacher assumes during this segment?
   d) Identify and analyse the roles assumed by students.

Part 3. Final reflection
   a) Discuss if what you saw in this episode is in line with your initial expectations.
   b) Indicate the aspects that you find important that the teacher may have into account in order that this kind of task is successful in class?

Tasks such as this have a high potential in pre-service and in-service teacher education. In fact, the way the teachers participated in the final discussion showed
that they felt learning a lot from it. Doing this task proved to be quite successful in a number of respects, as it was apparent from the high involvement of the teachers during its realization, the frequent number of cases it was referred to in later moments, and the interest that it promoted in the participants to look at classroom situations as teacher education activities. It is more difficult to know in what measure it led these teachers to become more aware of particular issues, for example on algebraic thinking or in leading classroom discussions, but my perception is that at least it was helpful in increasing their interest for these issues.

Some conditions that seemed important for the success of this teacher education task include: (i) its clear relation to a curriculum topic (algebra) and to specific learning objectives (solving problems involving patterns), (ii) the fact that it included detailed elements about the classroom activity on the mathematical task, (iii) the teachers’ perception of ecological validity in terms of the usual teaching conditions (the time available for the students to carry out the task, the number of students in the class, students’ characteristics, etc.), and (iv) and the fact that the issues raised in this task resonate with broader curriculum orientations and existing literature on the topic.

The participating teachers were strongly impressed by seeing and analysing an actual mathematics classroom episode. This is very unusual in mathematics teacher education in our country. The technological apparatus (showing video excerpts of the classroom on a data projector connected to a computer, using sound columns, etc.) was intriguing. But the most important was the fact that the teachers could relate to the actual situation, had the time to discuss it in small groups with a few colleagues and finally had the opportunity to discuss it in the whole group.

This activity was carried out during 3.5 hours as planned. Some participating teachers found the time too short to do everything was asked. Some of them did not conclude working on the mathematics task and thinking about how to use it in the classroom (Part 1), some others said they needed more time to reflect on the episodes and the review the transcripts (beginning of Part 3). However, the way the task was structured, and the review that was made at the beginning of Part 2 and Part 3 helped to maintain all the teachers “on board” and enabled to spend the necessary time on Part 3, the crucial part of the activity.

CONCLUSION

The format of this task was useful to support teachers in reflecting about issues related to exploratory algebraic tasks and classroom discussions. The Portuguese curriculum document was much referred to because it is just being introduced in schools. However, some relation to curriculum documents may assure that the task is related to significant curriculum objectives and mathematics concepts and processes.

Similar activities may be also of much value with beginning teachers and prospective mathematics teachers. Looking at actual mathematics teaching situations, especially at situations that may provide useful models for successful mathematics teaching, may help them to realize that these are not just abstract models or utopian theories
impossible to put into practice in the classroom. However, with prospective mathematics teachers perhaps some more structure or some reading assignments
could be useful to help them to deal with the complexity of the classroom situations.

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