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THE USE OF CLASSROOM VIDEOS AS A CONTEXT FOR RESEARCH ON TEACHERS' PRACTICE AND TEACHER EDUCATION¹

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The present communication comes from a project where we are developing multimedia cases for teacher education that integrate video and other resources from classrooms where an inquiry-based approach to teaching is taking place, combing a perspective of research on classroom practice and teacher education development. This paper concerns one grade 4 lesson taught by an experienced teacher, and intends to analyze how the teacher's reflection about a particular phase of the lesson is used in the multimedia case to potentially stimulate other teachers' analysis of the depicted situations.

Key words: Classroom videos; Inquiry-based approach; Teacher's reflection; Whole-class discussion.

INTRODUCTION

In Portugal, as it happens worldwide, it is not easy for teachers to have access to the observation of meaningful practices, following new curricular orientations, namely those that characterize an inquiry-based approach to teaching. In the last years, in our country the basic education syllabus (grades 1 to 9) has been reformed, creating in teachers an expectation for change. However, this change has been facing difficulties, since reform concerns not only the

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content but, mainly, how mathematics is going to be taught. The role of mathematical challenging tasks and the nature of the subsequent instructional method are hard issues that teachers have to deal with in new ways.

Providing conditions that favor teachers' professional knowledge, in this context of change, has been a challenge for those involved in teacher education. The conception and use of materials that facilitate the analyses of teaching episodes from the classroom, using the knowledge that comes from teachers' practice and the one that comes from the theory in mathematics education, are considered to be important avenues to promote teachers' development.

In the context of the *P3M project (Professional Practices of Teachers of Mathematics)*, we are developing multimedia cases for teacher education that integrate video and other resources from classrooms where an inquiry-based approach to teaching is taking place. The project involves teachers and researchers, and it is, currently, in its first phase: producing the multimedia cases.

The purpose of this communication is to illustrate how the multimedia cases are being developed, combining a perspective of research on classroom practice and teacher education. More specifically, we intend to analyze how the reflection of one videotaped teacher about her practice in a particular phase of the lesson is used in the case to potentially stimulate other teachers' analysis of the depicted situations.

THE CASE FOR MULTIMEDIA CASES IN TEACHER EDUCATION

Video cases in teacher education

Videos have been used for the last decades in the context of teacher education to portrait teachers' practice and to support (future) teachers' reflection on the classroom interactions because video captures much of its richness (van Es & Sherin, 2008). Comparing written to video cases, the latter can provide a more complete, rich, and realistic picture of the classroom because they allow teachers to capture the voices, body language, and class environment (McGraw, Lynch, Koc, Budak & Brown, 2007).

With the accessibility of technology, with many intuitive editing tools and free media sharing sites at our disposal, it has become possible to use videos and multimedia resources in teacher education more widely with teachers (Brunvand, 2010). At the same time, we observe a growing interest for research on the use of classroom videos in teacher education (initial and in-service) that can be attested by the huge amount of publications in this subject, in the last years. One important trend in research concerning the use of multimedia cases in teacher education is the development of the *noticing skill* by teachers (van Es & Sherin, 2008). For these authors *noticing* involves three main aspects: (a) identifying what is important in a teaching situation; (b) using what one knows about the context to reason about a situation; and (c) making connections between specific events and broader principles of teaching and learning. However, considering the vast amount of aspects that can be marked as relevant in one teaching situation, the observer's attention is sometimes directed to specific issues such as student thinking, teacher's role, and classroom discourse (Alsawaie & Alghazo, 2010;

Koc, Peker & Osmaniglu, 2009; MacGraw et al., 2007). In our project we concentrate on the teacher's instructional practices, to promote (future) teachers' learning.

Characteristics of multimedia cases

The general guidelines for constructing each multimedia case in the *P3M project* have resemblance with what Brunvand (2010) refers as “strategies to help novice and expert teacher notice relevant content” (p. 250) in video materials. We will now present them, explaining how they have oriented the multimedia cases' construction in the project.

Establishing perspective and tasks. Classroom videos can be watched from multiple perspectives. Defined the objectives concerning the concepts and topics we want teachers to address with the activity of video analysis, we will have to propose certain tasks that direct them to attend to specific aspects of the situation. In the multimedia cases in the *project P3M*, teachers are asked a set of questions, after watching each video, to guide the analysis of the teaching episode. This is one of the main characteristics of the case: a guided analysis of the intentions and actions of the videotaped teacher. This will help teachers to focus their attention on central concepts and to develop their ability to analyze other teachers' practice.

Explicit prompts. Before analyzing the case, teachers are provided with information about the context where the lesson took place, for instance, the general characteristics of the class, usual options for classroom management, and articulation of the mathematical task proposed in the lesson with the previous work that has been done with the class. This will help (future) teachers to understand the conditions for the development of the videotaped instructional practice. Some theoretical input is also necessary, providing the tools to guarantee that the analysis of the video will promote teachers' learning, namely by presenting key concepts as lenses to read and reflect on the teaching episodes, and supporting the use of specific language for mathematics education, anchored in mathematics curriculum.

Process management. The classroom episodes in the case appear in chronological order so that the teachers are able to make sense of what happened in each phase of the lesson phases. In spite of having particular tasks proposed in the case, as explained above, which are proposed sequentially, it is also important to allow teachers “to make important decisions along the way” (Brunvand, 2010, p. 252), and give them the possibility to view and review the different teaching episodes so that they create a complete portrait of the videotaped teacher's practice.

Teacher's comments. Another important feature of the multimedia cases is the integration of the teacher's comments in relation with the video, because we consider of great relevance to have access to the teacher's thinking. This helps to focus on the instructional decisions of the teacher, and the reasons behind them. As Brunvand (2010) mentions, watching the lesson unfolding in the screen and reading (or hearing) the teacher's comments “is similar to watching a movie with the director's commentary turned on” (p. 251). We agree with van Es and Sherin (2008) that in the context of curriculum reforms, even experienced teachers need to learn how to examine classrooms from different perspectives.

Providing alternating perspectives. Multimedia cases may support (future) teachers to build the bridge between acquired and new perspectives on the teaching and learning of mathematics, namely by presenting multiple perspectives on the situations depicted in the

videos. One important tool for observers is the possibility to access the videotaped teacher's comments, as referred above, which, in some cases, may "completely contradict their perceptions of what took place" (Blunvand, 2010, p. 252). As the cases are tested with different (future) teachers, comments from other teachers may also be included, widening the span of perspectives.

Reflection tools. The opportunity to reflect on the thinking that one develops throughout the multimedia cases analyses is fundamental for the development of new knowledge. Teachers are invited to write their answers to the specific tasks proposed, in an electronic worksheet in the website, and to keep a record of it. These may be revised as they explore other dimensions of the case, namely as they are confronted with the videotaped teacher's perspectives.

THE "CUBES WITH STICKERS" MULTIMEDIA CASE

The use of multimedia cases in the *project P3M* intends to promote the teachers' knowledge about planning and teaching in the context of an inquiry-based approach and their ability to analyze and reflect on teaching and learning situations, using key concepts and topics in mathematics education. Each multimedia case centers on one or two lessons around a mathematical task, documented with video segments from the different phases of the lesson, written worksheets of the students and some teacher's comments on the lessons. These are lodged in a website created by the project team. In this communication we focus on the case "Cubes with Stickers", the name of the mathematical task (appendix 1) that was proposed to grade 4 students by Célia, an experienced teacher who adopts an inquiry-based approach to teaching.

In constructing the cases we adopted a *four phases model* for the structure of the lesson, according to a provisional framework that we are developing for describing the intentions and actions of the teacher in an inquiry-based classroom (appendix 2). This model is an innovation considering the majority of classrooms in Portugal where usually the model of the lesson involves just two steps, or as many teachers refer to as presenting the 'theory' first and then providing the practice of exercises and problems (Ponte, 2011).

METHODOLOGY OF THE STUDY

This study is part of a broader Design Research project where the research on classroom practice and the planning of teacher education courses centered on the use of multimedia resources develop simultaneously. As teacher education courses develop research is carried on, and its results contribute to a reformulation of the teaching education courses, namely of the multimedia resources, giving way to a new cycle of implementation and research (Cobb, Zhao & Dean, 2009). In this communication we focus on the first phase of the project dedicated to multimedia case's construction, using the data collected both in the classroom and individually with the teacher.

The task choice and the overall guidelines for this lesson's planning came from the teacher's initiative, having been initially discussed with one of the researchers (the first author of this communication). Before the lesson, an interview was conducted with the teacher, with the purpose of recording her main options and justifications regarding the task, the methodological orientations and the anticipation of strategies and difficulties. Our goal was the collection of material to integrate the teacher's thoughts in the multimedia case.

The data collection in the classroom involved the use of two video cameras to record the working moments with the whole class, as well as some interaction episodes between the teacher and the students when the latter work autonomously in carrying out the task. From that video collection, we select the segments that are subject to further analysis and which will become classroom episodes in the multimedia case (video or written ones) and/or the questions to ask the teacher in the post class interview.

After the class, a new interview took place, aiming at fostering the teacher's reflection about the lesson. In this interview the questions focus on the confrontation between the planned and the implemented; explanation and justification of certain actions and decisions during the lesson; and the global evaluation of the purposes of the lesson. With this purpose, some teaching episodes are watched in order to help the teacher focus on particular events of the lesson and not refer only to superficial ideas or general guideline principles. This second interview is based on the framework about the *intentions and actions of the teacher* (appendix 2), concerning the four phases of the lesson: Introduction of the task; Development of the task, Discussion of the task, and Systematization of the mathematical learning. In the present communication, we center our analysis in the explanation and justification of the teacher's decisions concerning the phase of discussion of task with the class. It is from this material that we are going to illustrate the way the case has been developed.

THE TEACHER'S REFLECTION ABOUT THE TASK'S DISCUSSION WITH THE STUDENTS

The orchestration of the discussion of the students' work on the task is one of the most challenging aspects for the teacher practice, since it is not possible to anticipate exhaustively which strategies and representations they will adopt, the difficulties they will face in communicating their mathematical ideas or the doubts and questions that will appear. Therefore, this is a topic that allows multiple points for analyses, surfacing several perspectives about the teacher's options.

From the analysis of the teacher's instructional practices in the lesson and the two interviews carried on with her, we have highlighted three issues, as instances, concerning the orchestration of the students' work discussion and its preparation. The first one (I1) has to do with the teacher's perspective about the meaning and importance of that lesson phase. The decision about the choice of the students who are going to present their work and the sequence of the different presentations depends on the objective the teacher establishes for that phase. Célia considers that it is, still, a moment for students to learn by analyzing the different solutions and representations:

That is the idea, to have confrontation. It is not a presentation, it is a learning moment, therefore it can't be a presentation, neither a correction, because it's not that (...) the moment is to confront, to think together about the different solutions, different representations that have to appear from there, from the presentation... it is a goal. (I1)

The second issue (I2) concerns the teacher's specific choice of the group who presents their work, in the first place. According to Célia, she chose this group because they expressed visually the structure of the sequence in a clear way, which could influence positively other students' understandings about the task. The group expresses clearly in words the general law

for obtaining the number of stickers for any number of cubes, and at the same time, exemplifies it drawing one sequence of cubes. Célia attributes great importance to the visual representation of the mathematical situation as a support for thinking about the task:

To have chosen this one as the first [to be presented] has to do with the visualization questions (...) it was the clearest for them to understand the constructions and the rule. This one was really [selected] due to the image and the way that they represented. They were very clear: $1+1+1$... so, there were eight cubes, representing the different, than what was the 4, right? (...) This was one of the clearest representations concerning the visualization issue, how they visualized the constructions, that I thought (...) if there were still some doubts or if there were still some problems, this would be another attempt to solve different problems ... (I2)

The third issue (I3) concerns Célia's reflection about her role when students are presenting and discussing their work. She assumes a non-directive posture, and sometimes stands down, staying at the level of the students that are seated and gives time to students to explain their ideas and to their colleagues questioning. As she explains, that is something she has been working with the class:

In that phase I try that my intervention is not much [directive]... letting that the group who is explaining and justifying is the one who explains again [if necessary]. It is something that sometimes is difficult because our tendency is to jump and do, but that is something that I increasingly try to do, offering them that moment of the lesson. (I3)

THE USE OF THE TEACHER'S REFLECTION IN THE MULTIMEDIA CASE

In the section of the multimedia case dedicated to the phase of the discussion of students' work on the task, we present several classroom episodes, where it is possible to watch the presentations of some groups of students, the interaction among the students, and the teacher's action in those moments. One of the selected classroom episodes regards precisely the first group to present their work, as documented above. In this section we will illustrate, partially, how the classroom instructional practice of Célia and the associated reflection is used in the multimedia case to promote the teachers' analyses of this phase of the lesson.

The teacher's preparation for the task's discussion

Teachers have access to the lesson plan, and are asked to comment on Célia's thought strategies for this phase of the lesson. There are questions, such as: How does the teacher guarantees the conditions for the students' presentations? What criteria does she establishes for selecting the solutions to be presented? What kind of difficulties is the teacher anticipating for this phase of the lesson? Then they have access to the students' work and are asked to chose and sequence the groups according to some criteria. After that, they are confronted with the teacher's comments regarding that phase of the lesson and the choices she effectively made, and required to compare them with their own. The above mentioned issues, I1 and I2, are discussed.

Analysis of one classroom episode

The classroom episode shows the first group presenting its work in a video with three minutes. One element of the group explains how they solved the task, using the overhead projector. Several students question his explanation, trying to understand the different aspects of the representation they did, and the student presenting tries to clarify it. The teacher

intervenes in some instances, mainly giving indications to help the student to make a better use of the resources at his disposal and sometimes to guarantee an orderly intervention of the students who question him. Students exhibit great autonomy in explaining and questioning.

As we construct the multimedia case taking into account the reflection made by the teacher, this helps us to focus the analysis of this classroom episode in certain aspects mentioned by the teacher. Taking into account the previous analysis proposed about Célia's intentions for this phase of lesson (I1) and the reasons for choosing that group to present in the first place (I2), the analyses of the videotaped classroom episode centers now on the teacher's instructional practices according to the framework for the teacher's intentions and actions (appendix 2), namely on the promotion of the presentation's mathematical quality and management of relationships among students.

Post-lesson reflection by the teacher

The use of the teacher's post-lesson reflection about the depicted lesson represents an important analysis dimension concerning the multimedia case: the thinking of the teacher targeted in the video about her practice. This dimension adds to the previous two (analysis of the teacher's preparation and of the videotaped classroom episodes) the possibility to understand the teacher's decisions in that specific context. In connection with the previous two, it encourages teachers to review their perspectives about Célia's practice.

Using the framework on the teacher's practice, teachers focus now on Célia's post-lesson reflection concerning the phase Discussion of the task. The two issues (I1; I2) mentioned before, may be revisited and connected to the third one (I3), taking into account the analyses they have made of the teacher's practices in the classroom episode above.

Concerning I1 and I2, teachers revisit Célia's intentions for that phase of the lesson ("a learning situation and not a presentation"), and now that they may connect those intentions with the specific teacher's actions depicted in the classroom episode. Beginning with simple and clear solutions, guarantying a common starting point for everyone, and emphasizing the importance of representation of the mathematical situation, are aspects that are present in the episode which have to do with Célia's intention of promoting students' mathematical learning through the discussion of the work they have done on the proposed mathematical task.

When analyzing this teacher's reflection about her role in the discussion of the students' work (I3) it is possible to establish connections with those two issues (I1 and I2) in respect to the classroom episode above but also with others in the multimedia case. Célia explains that she assumes a non-directive role, letting the students to assume the responsibility for explaining and justifying their ideas. The students' autonomy on the depicted video episode, which is assumed by the teacher ("offering them that moment of the lesson"), is the result of a continuous inquiry-based practice with the class, as she contends.

FINAL REMARKS

The construction of the multimedia case under study takes into account several aspects that the literature has indicated to be advantageous in the context of teacher education (Brunvand, 2010). One of those aspects, which we tried to illustrate in this communication, is the use of the comments and reflections of the teacher in the videotaped lesson. The teacher's reflection about the analyzed lesson allows not only to know the actor's point of view about the events,

but it goes further by giving us the sense of putting ourselves in her shoes, as if we could assume her role and see the class through her eyes. This is particularly important in this multimedia case since the depicted teacher's practice is not common to the majority of teachers in our national context.

The phase of discussion of students' work on the task assumes great relevance in an inquiry-based classroom. In the study by Leikin and Rota (2006) one of the considered indicators of teacher proficiency, in that kind of context, was exactly the quality of teachers' discussion actions. However, these are challenging practices that most (future) teachers have never watched. In the particular example presented, teachers have the opportunity to watch a classroom episode and understand how that moment was prepared by the teacher, the choices she had to do, the reasons behind them, and also how she reflects about her role in conducting that phase of the lesson. These aspects are intended to stimulate teacher's understanding of the characteristics of this kind of approach, and that its success depends on the continuous development of an inquiry-based classroom culture with students. This contributes to regard the lesson as realistic, an aspect that is considered to be critical in order teacher to attribute credibility to the resources used in teacher education.

Considering the framework about the teacher's practice in an inquiry-based classroom, used as synthesis of several aspects that were analyzed in the multimedia case, the option to collect data about the teacher's decisions and consequent justifications may contribute to:

- regard the represented items of the framework as an authentic practice and not just as theory, stimulating the connection between theory and practice;
- better conceive the articulation between research and development, allowing the refinement of the framework, integrating new aspects and establishing new connections.

With this communication we intended to illustrate, in one particular aspect, how the multimedia cases in the *project P3M* are being developed combining research on classroom practice and teacher education development. It assumes the perspective that teachers may learn from observing and reflecting on challenging practices, namely inquiry-based approaches, where the discussion of the students' work has great relevance. As the project unfolds we expect to develop new knowledge about the fruitful relationship between research on teacher's classroom practice and teacher professional development.

We would like to thank Célia Mestre, the teacher in the video, for her precious collaboration in our study, and Ana Paula Gil for the work done in editing the videos and supporting us with the website for the multimedia cases.

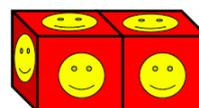
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Appendix 1. Cubes with Stickers

Joana is building a game with cubes and stickers. She connects the cubes through one of its faces and forms a queue of cubes. Then she glues a sticker in each of the cube's faces. The figure shows the construction that Joana did with 2 cubes. In that construction she used 10 stickers.



1. Find out how many stickers Joana used in a construction with:
 - 1.1. Three cubes;
 - 1.2. Four cubes;
 - 1.3. Ten cubes;
 - 1.4. Fifty two cubes.
2. Can you find out what is the rule that allows you to know how many stickers Joana used in a construction with any given number of cubes? Explain how you thought.

¹Adapted from Moss, J., Beaty, R., McNab, S. L., & Eisenband, J. (2005). *The potential of geometric sequences to foster young students' ability to generalize in Mathematics*. <http://www.brookings.edu/gs/brown/algebraicreasoning.htm>

Appendix 2. A framework for mathematics inquiry based classroom practice: intentions and actions of the teacher

	Promotion of mathematics learning	Classroom management
Introduction of the task	<p><i>To guarantee the appropriation of the task by the students:</i></p> <ul style="list-style-type: none"> - Helping students to get familiar with the task's context - Clarifying the interpretation of the task - Mobilizing necessary prior knowledge - Setting goals <p><i>To promote students' engagement in the task:</i></p> <ul style="list-style-type: none"> - Establishing connections to students' prior experiences - Challenging students for work - Requesting for expected results 	<p><i>To organize students' work:</i></p> <ul style="list-style-type: none"> - Establishing time for the work to be developed in each phase of the lesson - Setting forms of work organization (individual, pairs, small groups, whole-class) - Organizing the lesson resources
Development of the task	<p><i>To support students' autonomous work on the task:</i></p> <ul style="list-style-type: none"> - Making questions and giving clues - Suggesting representations - Focusing productive ideas - Requesting clarifications and justifications - Challenging to deepen and extend the task <p><i>To keep the cognitive challenge</i></p> <ul style="list-style-type: none"> - Promoting the students' reasoning - Trying not to validate the mathematical correctness of the students' answers 	<p><i>To promote the work of the pairs/groups:</i></p> <ul style="list-style-type: none"> - Setting interactions between students - Providing resources for the group <p><i>To guarantee the production of materials for the students' presentations:</i></p> <ul style="list-style-type: none"> - Requesting writing records - Providing appropriate resources - Providing time to prepare the presentation <p><i>To organize the discussion:</i></p> <ul style="list-style-type: none"> - Identifying and selecting varied solutions (with common errors, less or more complete, and with relevant representations to explore) - Sequencing the selected solutions
Discussion of the task	<p><i>To promote the mathematical quality of the students' presentations:</i></p> <ul style="list-style-type: none"> - Asking for clear explanations of the solutions - Asking for justifications of the outcomes and the representations used - Discussing the difference and mathematical efficacy of the presented solutions <p><i>To promote interactions among students in the discussion:</i></p> <ul style="list-style-type: none"> - Encouraging questioning for the clarification of presented ideas and comparison between solutions - Encouraging analysis, debate and comparison between solutions - Discussing mathematical errors identified in the solutions 	<p><i>To create a favorable environment for presentation and discussion:</i></p> <ul style="list-style-type: none"> - Putting an end to the autonomous work of students - Providing the reorganization of the places/space - Promoting an attitude of respect and genuine interest on different presentations <p><i>To manage relationships among students:</i></p> <ul style="list-style-type: none"> - Setting the order of presentations - Explaining why the work of some students is not presented (for instance, to avoid repetition,...) - Promoting and managing the participation of students in the discussion
Systematization of the mathematical learning	<p><i>To institutionalize concepts or procedures on mathematical topics raised by the task's exploration:</i></p> <ul style="list-style-type: none"> - Identifying key mathematical concept(s), clarifying their definition and exploring multiple representations - Identifying key mathematical procedure(s) from the task, clarifying the conditions of their implementation and review their use <p><i>To institutionalize ideas or procedures concerning the development of transversal capabilities raised by the task's exploration:</i></p> <ul style="list-style-type: none"> - Identifying and connecting dimensions of the transversal capabilities in presence - Enhancing the key factors for their development <p><i>To establish connections with prior learning:</i></p> <ul style="list-style-type: none"> - Highlighting links with the targeted mathematical concepts, procedures or transversal capabilities 	<p><i>To create an appropriate environment for the systematization:</i></p> <ul style="list-style-type: none"> - Focusing students at the collective systematization - Promoting students' recognition of the importance of this phase of the lesson for learning <p><i>To guarantee written record of the ideas that result from systematization:</i></p> <ul style="list-style-type: none"> - Recording in computer or physical resources (boards, interactive boards, transparencies, posters ...) by students or teacher - Requesting written records in student notebooks