TEACHING PRACTICES TO ENHANCE STUDENTS' SELF-ASSESSMENT IN MATHEMATICS: PLANNING A FOCUSED INTERVENTION

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This paper focus the planning process of a teaching intervention aimed at promoting students' self-assessment in mathematics. We present an interpretative case study of a collaborative group, planning assessment practices addressed to students' appropriation of assessment criteria in mathematics. The study allow us to: describe the main focus and factors considered in the planning processes; identify the key practices/strategies planned; and understand their foundations. It also highlights the importance of planning formative assessment practices in mathematics and gives some insight into that process.

Keywords: formative assessment practices, planning, self-assessment, assessment criteria, mathematics

INTRODUCTION

Self-assessment is a privileged form of formative assessment (Nunziati, 1990; Santos, 2008) that helps students to take greater responsibility for their own learning (Sadler, 1989) and leads to significant improvements in their achievement, particularly in mathematics (Fontana & Fernandes, 1994). However, the development of self-assessment isn't easy and requires several conditions, which should be promoted by teachers, through formative assessment practices (Wiliam, 2011). To be effective, these practices should be carefully planned.

This study is part of a broader research [1], trying to understand assessment practices of teachers, aimed at promoting students' self-assessment in mathematics. These practices are addressed to: (i) an intentional oral communication during whole-class mathematical discussions; (ii) the appropriation of assessment criteria by students; (iii) the development of students' written self-assessments. They are integrated into a teaching intervention planned in a context of collaborative work involving the first author of this paper (researcher) and four mathematics teachers (grades 7 to 9). In this paper, we focus on the planning process of the teaching intervention, especially with regard to assessment practices addressed to appropriation of assessment criteria, during an initial period of 9 months. We consider the following research questions: (i) What were the main features of the planning process (level of planning, influencing factors and focus)? (ii) What planning decisions were made by the group regarding the definition and implementation of classroom practices? (iii) What reasons have substantiated such planning decisions?

Although it is widely recognized the importance of teachers' practices in the context of formative assessment, very few research has been presented in the particular context of mathematics, namely at previous CERME conferences.

THEORETICAL FRAMEWORK

Teachers' practices can be viewed as the activities that they regularly conduct, with certain meanings and intentions, in their working context (Ponte & Chapman, 2006). When teachers develop assessment practices intended to enhance students' learning, we may speak of formative assessment. Formative assessment "accommodate[s] all the ways in which assessment can shape instruction" (Wiliam, 2011, p. 40), it involves elicitation, interpretation and use of evidence about students' learning to make founded decisions about teaching and learning (Wiliam, 2011).

There are some key strategies that are associated to the territory of formative assessment: (i) clarifying and sharing learning intentions and criteria for success; (ii) engineering effective classroom discussions, questions and learning tasks; (iii) providing feedback that moves learning forward; (iv) activating students as the owners of their own learning; (v) activating students as instructional resources for one another (Leahy, Lyon, Thompson & Wiliam, 2005). However, there isn't a *one-size-fits-all package* (Leahy *et al.*, 2005), so it is not enough for teachers to know these strategies. They need to study, and possibly discuss with others, how to implement these strategies in their own classrooms. Otherwise, "without this space for teachers' voices, it seems likely that formative assessment will be enacted more as a set of techniques rather than as a step towards a more dialogic form of teaching" (Hodgen, 2007, p. 1893).

Self-assessment is an internal process of regulation of own thinking and learning (Nunziati, 1990) that is vital for learning (Black & Wiliam, 1998). It includes monitoring and action: the student confronts what he/she did with what he/she was expected to do, acknowledging the differences between these two situations, and acts to reduce or eliminate them (Sadler, 1989; Santos, 2008). Therefore, assessment criteria are a reference and a needed condition to self-assessment, but they are just its starting point. They must be legitimate for students and allow them to understand what is expected of them (Hadji, 1994), they must be *appropriated* by students. However, this is quite rare and difficult since the meaning given by students to the criteria may be different from the one given by the teacher (Black & William, 1998; Sadler 1989). Moreover, one must take into account the didactic tension: "the more clearly the teacher indicates the behaviour sought, the easier it is for students to display that behaviour without generating it from understanding" (Mason, 1998, p.2). So, it is necessary to create opportunities for students to really understand the criteria in the context of their work (Black & William, 1998) and to develop ways of promoting a state of *working-on*, instead of *working-through*, in mathematics classroom (Mason, 1998).

Classroom discussions are excellent opportunities for the development of formative assessment practices. In particular, teachers should engage students in discursive

practices, encouraging them to develop, explain, justify and assess their ideas and those of colleagues (NCTM, 2000); promote the establishment and respect for rules of interaction; and direct the focus of discussion, cautioning the development of important mathematical aspects (Chazan & Ball, 1995).

Given the complexity of effective formative assessment practices, teacher collaboration might be especially useful (Boavida & Ponte, 2002; Hargreaves, 1998). Besides that, careful planning is essential. In fact, planning processes are central in teachers' practices, but they are typically undervalued (Calderhead, 1996; Clark & Peterson, 1986; Shavelson & Stern, 1981).

Teacher planning is both a psychological process – in which teachers visualizes the future, inventories means and ends, and constructs a framework to guide their action – and a practical activity – the things that teachers do when they say that they are planning (Clark & Peterson, 1986). Planning include three phases: preactive (before teaching), interactive (during teaching) and postactive (after teaching) (Milner, 2001). Calderhead (1996) presents the main features of planning processes: (i) planning occurs at different and interconnected levels, from yearly and long-term plans to lesson plans, and may be seen as "a continuous process of re-examining, refining and adding to previous decisions" (p. 714); (ii) planning is mostly informal, teachers plan by mentality focusing on aspects that need their attention (iii) planning is creative, it does not follow a linear process from specified objectives to activities planned to accomplish them, it has a problem-finding and a problem-solving phase; (iv) planning is knowledge-based, teachers base their planning on different kinds of knowledge (for example, knowledge of subject matter and of students); (v) planning must allow flexibility, to adapt planned activities accordingly to the situations that might emerge; and 6) planning occurs within a practical and ideological context, since there are various factors that influence teachers' planning as policy expectations, textbooks or other materials being used, teachers' experiences and conceptions of mathematics teaching and learning.

METHODOLOGY

This is an interpretative case study (Yin, 2009). Special attention is given to questions of "how" and "why", especially concerning the planning, by the collaborative group, of the teaching intervention aimed at promoting students' self-assessment in mathematics. The collaborative group was constituted to the broad research purpose. The four teachers were chosen to take part in the group, based on the following criteria: to evidence sensitivity concerning issues related to the research aim and openness to consider them in their professional practices; to have different professional experience.

In this study, collaboration is characterized by joint work, in order to provide mutual support and the achievement of goals (not necessarily the same) that benefit all and deepen their knowledge (Boavida & Ponte, 2002). Participants must feel comfortable in their roles (not necessarily the same) and be attentive to the needs of others and

open to negotiate understandings emerging from the collaborative effort (Hargreaves, 1998). Collaborative group meetings included the planning of the teaching intervention, planning processes and assessment of the practices/strategies after implementation in classrooms. The planning process took as starting point the development of a shared understanding regarding the objectives and guidelines that frame the intervention, based on the discussion of various documents, especially associated with formative assessment, oral communication and collective discussions in mathematics classroom. Initially, the researcher played a key role in the collaborative group, being responsible for: (i) negotiate the general goals of the teaching intervention to be planned, (ii) propose documents and materials as basis for discussion and work, (iii) propose points for the agenda of the meetings. Over time, these roles were shared with teachers, eventually having them the lead.

Data collection includes participant observation of 15 meetings of the collaborative group (meetings were audio recorded; the following code was used to identify each meeting: M1 to M15), supported by document collection of teachers planning materials. We used ideas of critical discourse analysis (Luke, 1995), since the process of data analysis included: the transcription of the meetings recorders; the selection of relevant parts of the texts, keeping the coherence of discourse; the interpretation of the texts reduced, taking into account who talks and his/her intention, social context, identities and power relations involved. This interpretation involved the identification of perspectives, ways of being and acting presented in the participants' speech, which led to the identification of themes. In this paper, in particular, is not explicitly compared or contrasted the speech of each participant, but considered the speech of all participants in the construction of a collective discourse of the collaborative group. The transcripts presented in the following section were translated from Portuguese.

ANALYSIS AND RESULTS

Defining assessment criteria in mathematics

The assessment criteria are recognized, by the group, as essential to clarify what is expected of students in mathematics classroom and help them to self-assess accordingly:

Valter: It has to be very clear to them what they're supposed to do.

Researcher: Yeah.

Valter: Because that is what allows them the self-regulation. (...)

Filipa: We have to give him the assessment criteria (...) for him to know how he will be assessed (…) isn't it? (M5).

In particular with regard to the students' self-assessment, the group agreed that they tend to be not criteria-based (or use criteria different from the ones of the teacher):

I think they have many difficulties ... when I ask them a self-assessment, they are not (...) being more criteria-based when a person asks them: (…) What do you think you can do to improve your learning? It is where ... I think they have difficulties (Filipa, M2).

The group have agreed that the assessment criteria should reveal the expectations concerning the role of students in collective mathematical discussions, in particular as regards to aspects diagnosed as source of resistance and difficulties for students:

[Example 1]

Researcher: I think that if this is a problem in your students [do not value the collective discussion], in the assessment criteria (...) it should be evident that one of the things that they are expected to do is (…) comment or ... whatever ... but ...

Filipa: Yeah, know how to assess...

Joana: Know how to justify his option. (...)

Filipa: ... criticize the other, criticize the speech of the other (M4)

[Example 2]

Filipa: I think it's very important [that they compare, analyse, relate ...]. Because I think that it is what they have more difficulties. (...)

Valter: The ability ... to be able to argue on the basis of the argument presented by another, counter-argue, I find it an asset. To seek to understand the other's perspective (M5).

Furthermore, the group stressed the need for the criteria to put a focus on mathematics:

It's important that there is debate among students, but I have to emphasize that he [student] has… there must be mathematics, if not he will not realize, "Well, I participated a lot" (Valter, M4).

Thus, the group defined assessment criteria in three domains of mathematics: Concepts and procedures; Strategies and processes of reasoning; Communication.

Working assessment criteria with students

For presenting the criteria, the collaborative group first use a table of descriptors for various levels of performance. But this table was considered too complex for students: "will they understand all this text? The 7th graders? I have some [students] of the 9th grade who will lose themselves (Filipa, M7)". So it was created a simplified assessment grid, presenting a description of what is expected of students for each criterion. To prepare this grid, the group sought to use a language accessible to students:

Valter: They have a restricted code of language. (…)

Filipa: If you put "I make good oral statements", they understand. (…)

Valter: The student must know to what he is answering. (M8)

Aware of the difficulties that some terms could still cause (particularly *systematic solving strategy*), the group considered the importance of negotiating its meaning with students, using concrete examples: "Or give an example (...) They [students] have to realize (...) I think that with an example is better" (Valter, M8).

Following the same assumptions, for a first approach to the assessment criteria in the classroom, the collaborative group decided to involve students in an assessment experience of work samples, using the assessment grid. Strengths and weaknesses should be identified in light of the criteria and a negotiation process should be developed, allowing students to propose changes, but without jeopardizing the key ideas considered by the group:

Researcher: ... the idea was also to leave (...) students, isn't it? ... if necessary, change something. Let them even...

Joana: ... suggest…

Researcher: "So you think that here, perhaps, would be more clear to you this?".

Joana: Sure. (...)

Researcher: Without removing what we consider essential, isn't it?

Joana: I think so. (M7)

In addition, the group realized the need to invest systematically in the appropriation of the criteria, as a whole, in the context for which they were planned – collective mathematical discussions with presentation of students' work. To operationalize this idea, the group planned a first cyclical model of lessons, comprising: (i) performing the task in small groups; (ii) groups' presentations and collective discussion; (iii) students' self-assessment; and (iv) confrontation between students' assessment and the one performed by the teacher, followed by whole-class discussion. In this model, self-assessment is developed by filling the assessment grid, aiming to reinforce the criteria by which students must guide and assess their performance. Self-assessment is asked to groups of students, rather than individually, to encourage discussion and simultaneously not expose individual cases of students who may eventually feel more constrained. The whole-class discussion about teacher and students assessments, including teacher feedback, was specially planned to open doors to the negotiation of meanings regarding the criteria and the clarification of what is expected of students, using concrete examples of effectiveness in the classroom, but without constraining students:

Researcher: I think the advantage (...) is that it only speaks...

Sofia: ... who wants, isn't it?

Researcher: ... who feels comfortable to present his case (…) So, we defend cases of students who do not want to expose themselves...

Filipa: Sure.

Researcher: So, they don't feel obligated to do it, but nevertheless they are being confronted with the assessment that the teacher did, and with the examples of others they can... (M9).

Assessing and rethinking practices

To assess the effectiveness of the model and rethink future steps, the group considered to stop/close the corresponding cycle, at proper moments, asking individual written reflections to students as self-assessment.

Filipa: … what do you think about (…) putting this [model] in all lessons of a [mathematical topic]? (...)

Valter: And, maybe, taking off occasionally to see what is already achieved....

Joana: Yeah. (...)

Researcher: (...) the idea is, later, as Valter said, that they no longer need it [the assessment grid] (...) Maybe it should be interesting (...) after the end of the topic, to ask for a written reflection, for example, no longer...

Valter: ... without the grid in front. (...)

Researcher: And then through these reflections we can also see if it is necessary (...) to continue or not. (M9)

The group defined a new cyclical model of lessons, similar to the previous one but more flexible, for application when students show a reasonable understanding of the criteria. In this model, self-assessment of students is developed through a written reflection, which may be open or oriented depending on its main purpose:

Researcher: [We want that students] are able to reflect, self-assess their work, also to find strategies to improve (...) maybe in order to a reflection (…) be more useful to them (…) some guidelines may be provided (...)

Valter: This can go through (...) at some point ask for a reflection with some indications (...) And then, later, give again a reflection that is open (...) to see if things meanwhile were being internalized. (M14)

This phase of self-assessment and the next one (whole-class discussion of the assessments) might not happen every time, so they don't become routine procedures that don't raise reflection:

Filipa: … they [students] do a written reflection for each task and it ends the conversation! (…) is for their own good! (...)

Researcher: It depends (…) Because it may become a tedious process and they always writing the same thing, you know? Instead of evoking reflection, be...

Filipa: Yes.

Sofia: It becomes routine. (M5)

DISCUSSION AND CONCLUSIONS

In this study, planning has gathered characteristics, mainly, of a long-term planning – a structure of what to do was defined – but also of other levels of planning – how to operationalize some practices/strategies was considered in some detail (Shavelson & Stern, 1981). Thus, different levels of planning were contemplated and have informed each other (Milner, 2001). Nevertheless, since the teaching intervention presupposed the introduction of innovative elements in teachers' practices, long-term planning emerged as the most significant in a first stage (Milner, 2001).

Planning was developed based on different types of knowledge and was influenced by several factors (Calderhead, 1996), in particular: (i) knowledge of mathematics curriculum, literature and teachers' conceptions about teaching and learning mathematics, in order to define the assessment criteria and the expected roles of teacher and students in the intervention lessons; (ii) teachers' previous experiences and knowledge about their students to inform about challenges and difficulties; (iii) research recommendations, namely about formative assessment, and teachers' conceptions and previous experiences to outline practices/strategies and ways of operationalizing them in mathematics classroom.

Regarding classroom practices planned by the collaborative group, they reveal some formative key-strategies (Leahy *et al.,* 2005) and are the result of the collaborative group work, trying to find a suitable way of implementing those broad strategies in the mathematics classroom. The planning process of these practices focus on three main areas: defining assessment criteria in mathematics; working assessment criteria with students; assessing and rethinking practices. Assessment criteria were defined as a powerful resource both to clarify what is expected of students (and indirectly of teacher) in intervention lessons, and to support students' self-assessment (Hadji, 1994). The definition of such criteria was, itself, guided by some criteria, namely: to take into account critical points (in relation to particular difficulties diagnosed) and to put a significant focus on mathematics. This led to criteria that meet mathematical skills and understandings recognized as essential in mathematics learning (NCTM, 2000): Concepts and procedures, Strategies and processes of reasoning; Communication.

Planning how to *work on* assessment criteria with students (instead of *work through*) has raised new challenges and concerns to the group (Mason, 1998). First, a simplified grid of assessment was prepared to become criteria accessible to students. Then, a process of negotiation was conceived, engaging students in the assessment of work samples, with discussion about the strong and weak aspects of each one. Recommendations of several authors were, thereby, considered and combined (Sadler, 1989; Santos, 2008; Wiliam, 2011). For students to understand the criteria in context (Black & William, 1998), a cycle model of practices/strategies was also planned, including students' self-assessment, using the grid, and whole-class discussion about teacher and students' assessments. Later on, to assess the effectiveness of previous practices in promoting students' appropriation of

assessment criteria, the group has planned to ask written reflections to students. Ultimately, written reflections were integrated in a new model for intervention lessons, as a way to promote and regulate students' self-assessment, which takes into account the didactic tension and the importance of students *working-on* in mathematics classroom (Mason, 1998).

Practices planned by the collaborative group show potential to meet the conditions, identified by Sadler (1989), as supporters of the improvement of students' learning: sharing an idea of quality similar to the one of the teacher, continuous monitoring of work and access to a repertoire of alternative strategies that can be implemented to improve. Naturally, planning should continue, through a cycle of preactive, interactive, and postactive planning (Milner, 2001), readjusting the practices toward the promotion of students' self-assessment in mathematics.

This study presents an innovative character by placing the focus of teacher planning on formative assessment in mathematics and on ways of operationalize such assessment in the classroom, giving some insight into that process. It highlights the importance of, on the one hand, valuing formative assessment in mathematics teachers' planning and, on the other hand, developing a focused and intentional planning of teachers' assessment practices so that they effectively contribute to students' learning in mathematics.

NOTES

1. Research funded by FCT (Fundação para a Ciência e a Tecnologia) - SFRH / BD / 74620/2010

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