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The development of self-regulation through assessment criteria

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Abstract

Self-regulation is essential for learning, but it is neither innate, nor spontaneous. It is imperative for the subject to clear up the reference in order to have an effective auto-regulation. The teacher has the responsibility to create opportunities for students to construct this reference, in order to permit the appropriation of the learning objectives' meaning.
This study seeks to understand the contribution of using assessment criteria to the development of self-regulation. In particular, this article looks to answer the following questions: How can the construction and the use of assessment criteria in an interaction process contribute to the development of self-regulation of primary students? Which difficulties arise for the students in this process?
This paper reports a meta-analysis of two studies of six and eleven-year-old students using an interpretive approach. Data collection was based on student interviews, participant observation of classes and documental evidence. The analysis considered three phases of self-regulation: understanding what we did, comparing with what is expected to do and planning what needs to be accomplished and the difficulties arisen by the process.
The final results show that the criteria are gradually starting to be considered as a guide. When reflecting on what they did (supported by the criteria), the perception that they are not punished for their mistakes facilitates the clarification of their difficulties and the request for help to the teacher. The participative construction of the assessment criteria contributes to the understanding of what is expected of them.
Self-regulation is a socially constructed process. The progressive work with the assessment criteria contributes to the development of self-regulation. In primary education, the establishment of strategies to pursue, which is the phase of self-regulation least achieved by students of these ages, depends mainly on the support provided by teacher´s action.

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Keywords: assessment criteria, self-regulation, primary education

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1. Introduction

The subject is the author of his own learning and, as such, needs to establish a dialogue on this process with himself (Vygotsky, 1987) in order to realize if he is on course to achieve the learning objectives. This dialogue corresponds to what we call self-regulation. It is imperative for the subject to clear up the reference in order to have an effective auto-regulation. However, although self-regulation is essential for the learning (Black & Wiliam, 2009), it is neither innate, nor spontaneous. In this perspective, the teacher has the responsibility to create opportunities for students to make this reference, in order to permit the appropriation of the learning objectives' meanings. A promising way to do it is through the negotiation of the assessment criteria. This study seeks to understand the contribution of using assessment criteria for the development of self-regulation. To this end, the following questions were formulated:

- How can the construction and the use of assessment criteria in an interaction process contribute to the development of self-regulation of primary students?
- What difficulties arise for the students in this process?

2. Self-regulation and assessment criteria

Self-assessment is a privileged form of formative assessment (Nunziati, 1990; Santos, 2008) which helps students to take greater responsibilities for their own learning (Sadler, 1989) and leads to significant improvements in their achievement, particularly in mathematics (Brookhart *et al*., 2004). One model that has led to more research studies is the social cognitive model of self-regulation (Zimmerman, 2000). It includes three phases: the preparatory or providence, where the students outline specific goals for themselves and plan the strategies that they will use to achieve them; the execution, where students control their own performance; and the self-reflection, where the students do a self-assessment of their methods, the knowledge they have acquired and the attempt to perceive the usefulness and importance of the processes used to solve the task. This model has a cyclical nature because the internal feedback obtained from the previous learning experience is used to make adjustments at several levels: the delineation of the objectives, the choice of strategies and other processes that will be used during the development of subsequent tasks (Zimmerman, 1995).

The development of self-assessment is not simple. It requires several conditions which should be promoted by teachers through formative assessment practices (Wiliam, 2011). Self-regulation is essential for learning but raises many questions, namely regarding the learning environments and learning situations to be considered(Tardif, 2007).

The assessment criteria are a reference and an essential condition for self-assessment, but they are just its starting point. We understand that evaluation criteria are not only a statement that spells out just what is important at a given moment, but they are also an instrument of dialogue between the different actors (Vial, 2001). So, considering that they are not static or normative, they may develop over time and become the main instruments of self-regulation (Vial, 2012). Considering the objective that addresses the assessment criteria, several authors categorize them as *achievement criteria* and *success criteria* (Nunziati, 1990; Bonniol & Vial, 1997). The achievement criteria, or procedural, are related with procedures; the concrete acts that we expect the students to do from what we asked them to do. The success criteria are directed to the final results, defining levels of acceptance. However, it should be noted that the criteria for success can turn into achievement criteria when used in a perspective of improvement and not of measurement and if also used by the person who performed or has to perform the task (Bonniol & Vial, 1997). Thus, the combination of these two types of criteria can be an important way to the development of student self-regulation. Some of them favor the involvement and student engagement during action (achievement criteria), others help each person to distance himself and to appreciate critically what is being done (success criteria). In other words, the combination of these two types of criteria allows the action of understanding by the student.

The better the students understand what is expected of them, the more they will be predisposed to learn (Elshout-Mohr, Oostdam & Overmaat, 2002). But, since the logic of the learner and the logic of a subject or teacher, are not guaranteed to perfectly match (Nunziati, 1990) and also due to the fact that students´ conceptions and their self-imposed standards regulate their activities (Black & Wiliam, 1998; Santos & Pinto, 2011), continued investment is required by the teacher. The assessment criteria should be negotiated between the teacher and the students. The teacher should also involve the students in direct experiences of assessment (Sadler, 1989) as well as request the students to discuss between each other and with the teacher (Torrance & Pryor, 2001; Wiliam, 2007).

The appropriation of the assessment criteria is a slow process that requires investment and intentionality by the teacher. But this is imperative, if we accept that in those classes where the students are challenged to develop a high level of self-regulation, students are enable to engage in complex and open learning situations (Perry & VanderKamp, 2000). Moreover, the richer the task, the more balanced the intervention of the teacher's focus can be: process, products and self-regulation (Santos & Semana, 2012).

3. Methodology

This paper reports a meta-analysis of two studies of six and eleven-year-old students using an interpretive approach. The two studies were carried out over one academic year, 2011/2012, in Portugal, supervised by the first author of this paper. They were developed by two teachers, Andreia Peres (Peres, 2012), a primary school teacher, and Emília Beirão (Beirão, 2012), a teacher of mathematics. The participants of the studies were, respectively, 20 six year old students, belonging to a primary class, and 22 students from ten to fourteen years of age (mean age of eleven). In the first study, four students were chosen as case studies for a more developed understanding.

In Andreia's class, the learning objective was the development of solving solutions to a certain problem whilst working individually. The students solved eight problems over a period of five months. In Emília's class, the students solved, in groups, five mathematical tasks to develop their mathematical reasoning, which covered different mathematics topics. Problem solving and mathematical reasoning are important high level capacities and help with learning mathematics (NCTM; 2000). To solve problems, students use several interdependent factors, such as the acquisition and utilization of knowledge, control, affects and several representation modes (Lester & Kehle, 2003). Mathematical reasoning and sense making must be present and emphasized in all areas of any high school mathematics curriculum (NCTM, 2009).

Data collection was based on student interviews (both with audio recording and its total transcription), participant observation of classes and analysis of the documents produced by the students. The analysis considered the three phases of self-regulation: to understand what we did; to compare to what is expected to do and to plan what needs to be accomplished; and then the difficulties arisen in the process. The transcripts presented in the following section were translated from Portuguese.

4. Results

4.1 To understand what we did

Assessment criteria were constructed by the teacher with the students and have several versions until the final one. In both studies, the construction of an assessment criteria grid starts with the resolution of a task. From there, the teacher makes the students relate what they did with the different stages. While this relation in the 1st year of school was made by the students themselves, in the 6th grade, this is proposed by the teacher, being set for their different levels of achievement or acceptance.

In Andreia's class, students begun to select three aspects: "to select the main information of the problem", "to do" and "to answer". In a second problem, they add: "to think how to do", because they felt that this aspect was missing. The final grid of the assessment criteria is shown in appendix A. In the last problems, the teacher presented their statements in their own grid in order to make the assessment criteria more accessible to the students.

In Emília's class, the assessment criteria presented (appendix B) were very well accepted and recognized as being important by the students. A student expressed: "These tasks do not have questions, so we need a guide to know what we will do first". Over time, as the resolution of other open tasks of an investigative nature, the grid has suffered several reformulations, either in steps initially set by the teacher or the descriptions of the different levels of acceptance. The final grid of the assessment criteria is shown in appendix B.

This reformulation process, in the sense of successive improvements, allowed the students to consciously realise the increasing significance of what they have done. For example, during the construction process, one of Emily's students criticized the terms "few", "some" and "many" justifications, claiming that the mattered was not the quantity but the quality: "Teacher, we can find a few, but they are quality, and many that are basic, simple".

4.2. To compare to what is expected to do

With the filling of the grid, it was possible to detect difficulties experienced by students in the resolution of tasks and in the clarification of what was asked to do. For example, a student from Andreia's class, Francisco, successfully solved the fourth problem, but had difficulties in representing the second step "how to think", marking in the option "I did something". This cross gave rise to the following dialog:

> Teacher: Here you will write what you thought, or you will write on the paper what crossed your mind. If you think you'll have to join or to take. Joining is an account of...
> Francisco: Plus
> Teacher: And taking is an account of...
> Francisco: Minus.

With no more questions, the student cleared the cross that he had marked and concluded that he was correct. The use of the criteria enabled the rapid diagnosis of a doubt and his clarification. In the following problems, this process was repeated. Every time Francisco had a doubt, he pointed it in the grid of the assessment criteria, leading to a teacher-student interaction. In his opinion, the criteria are important "because we have to tell the truth and if we cannot do, we place the cross and the teacher gets to know of our difficulty".

The teacher Emilia used the grid of the assessment criteria to help the students become aware of what they were being asked, for example within a task of exploration in which the goal was to reach the general term of a sequence, finding its mathematical expression:

> Duarte: It is always the triple of figure number plus one.
> Teacher: Very well. Now if I ask for the figure 100, how many little squares are? And for figure 1000?
> (...)
> Teacher: When we begin to make hypotheses, suspicions, what are we doing? Look at the grid of the assessment criteria.
> Duarte: I know! Conjetures.
> Teacher: That its! Then continue!

A few moments later, the students were verbalizing some examples for the general expression. The teacher writes on blackboard "3x?+1" and ask to the class:

> Teacher: This question mark corresponds to what? Will it correspond to what?
> João: To the figure number, teacher.

Teacher: Very well. To this expression 3xn+1 we call general term in symbolic mathematics language. Does this expression translate your thought?
Raquel: Yes.
Teacher: So it seems that we have reached the general term or generalization. If we look at the assessment criteria grid, check if we had already used justifications, conjecture, general term. It is missing us to verify whether there are relationships in this task or from the table that we built. Let's see if we can find some?

As evidenced, the use of the grid, whether done independently by students or by the teacher's suggestion, allowed students to realize their doubts and gives the opportunity to the teacher to know them, as in the case of teacher Emilia's students, to realize what the next step for carrying out the task is.

4.3. To plan what needs to be accomplished

In the two studies under analysis, the teachers developed some work around the assessment criteria in a context of intellectually challenging tasks for students, problem solving and exploratory or research tasks, that allow different levels of achievement and development. The discussion around the different levels of achievement told the students what to do next in the direction of its improvement.

In the case of the teacher Andreia, the students have been encouraged over time to examine and to put in one of the levels of achievement considered in the grid (appendix A). In many cases at this age, pupils tend to point to the highest level of achievement, even if this does not happen. But by developing an environment of trust and discussing the grid with the students, it was possible for them to have greater awareness of what they did and thus to identify what they needed to improve:

Teacher: Rui, look: I was here looking at your problem that we've been doing, and I noticed that you said you could always do everything right, you never have difficulties, is that correct?
Rui: Yes.
(...)
Teacher: Do you think that this part with the little faces is important? If the face is smiling or is more or less or if it is ... or if you did not do it well? Do you think this part is important?
Rui: Yes.
Teacher: Why is it important?
Rui: Because if we do ... if all we have made wrong we have to put one ... a cross on the wrong, and if we did more or less, we draw a cross on the more or less, and if we did it right, we draw a cross on the right.
Teacher: Very well Rui. I was wondering if you had put that ran well without thinking or you thought about it and if you knew to solve the problem. Did you really know it?
Rui: Yes.

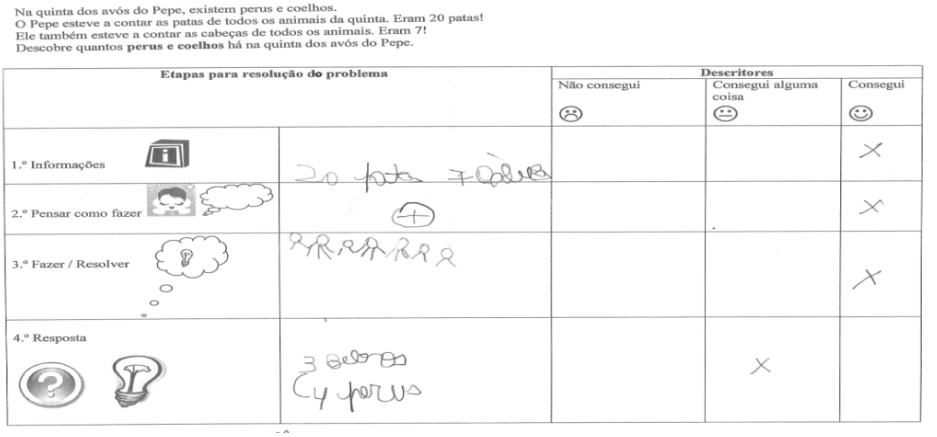
In the case of teacher Emília, the discussion of levels of achievement allows to identify ways to continue the improvement and development of the task:

Luís: 19+1=20; 18+2=20, 17+3=20 and is always like that...
Cátia: Ah! That's it... good! It is half the perimeter.
Duarte: If we had thought of just 20, it was only to find two numbers whose sum is 20.
Class: That's right.
Duarte: Teacher, this was already level 3?
Teacher: What do you think? What's written in Level 3 refers to formulate conjectures? Let's all read.
Class: Formulates a general conjecture.
Teacher: Let's think if this happens with other measures perimeters. For example, in case 36.

So the work around the assessment criteria allows students to assign meaning to what is expected of them and to guide them to improve their work.

4.4. Difficulties in the process

Throughout the process, weaknesses were found in many types and taking into account the specific age of the students and the type of tasks performed. The younger students showed to have weaknesses in writing their answers in a formal type because they still can't mastered this skill. For example, the fourth problem was about a farm with turkeys and rabbits, in a total of 7 animals and a total of 20 legs. Rui was able to solve it, but wrote the answer using a iconic representation. The strategy used by this student was different from the first one he had intention to use, as we can confirm by his registers:


Na quinta dos avós do Pepe, existem perus e coelhos.
O Pepe esteve a contar as patas de todos os animais da quinta. Eram 20 patas!
Ele também esteve a contar as cabeças de todos os animais. Eram 7!
Descobre quantos **perus e coelhos** há na quinta dos avós do Pepe.

Etapas para resolução do problema		Descritores: Não consegui ☹	Consegui alguma coisa 😐	Consegui ☺
1.º Informações	20 patas 7 cabeças			X
2.º Pensar como fazer	4			X
3.º Fazer / Resolver	RRRRRRR			X
4.º Resposta	3 coelhos 4 perus		X	

Figure 1. Rui registers of the fourth problem

In the first problems, students seemed to have an overrating success, regardless of whether this was or was not fully achieved. Only with a continued use of assessment criteria, the students used the different levels to make honest self-assessment of their work, entirely because they understood that there was no punishment if they fail.

For older students, the appropriation of mathematical vocabulary and achievement of agreement in groups according to the level of achievement weaknesses were more evident. The following dialogue exemplifies the second weakness mentioned:

> Teacher: What's going on? Why are you bored?
> João: I think it is level 3.
> Duarte: No, I think it's level 2, because they have not showed for all cases yet.
> Rute: Teacher, I also think it is level 2, Duarte is right.

5. Conclusions

The assessment criteria and their effects on the development of students' capacity to self-regulation are possible, regardless of the age of the students, although the way to do it may be diverse. Thus, this essential dimension of formative assessment is not something to be made just from a certain age, but must be included in the agenda of any teacher (Santos & Pinto, 2011).

When the criteria are negotiated from family tasks, they constitute themselves as guides for producing these same tasks (Wegmuller, 2007). The criteria gradually come to be seen as a guide. When reflecting on what they did (supported by the criteria), the perception that they are not punished for mistakes facilitates the clarification of their weaknesses and also the request for help from the teacher. The participative construction of the

assessment criteria contributes to the understanding of what is expected of them. In other words, when criteria of achievement and success criteria are worked together, they contribute to the development of self-regulation of students (Bonniol & Vial, 1997), making them an essential instrument of self-regulation (Vial, 2012).

Self-regulation is a socially constructed process. The progressive work with the assessment criteria contributes to the development of self-regulation. In primary education, the establishment of strategies to pursue, which is the phase of self-regulation least achieved by students of these ages (Pinto & Santos, 2012), depends mainly on the support provided by teacher's action. But this social context presents certain weaknesses, such as the need to build agreements or shared meanings. However, overcoming those constraints will generate a learning environment with potential.

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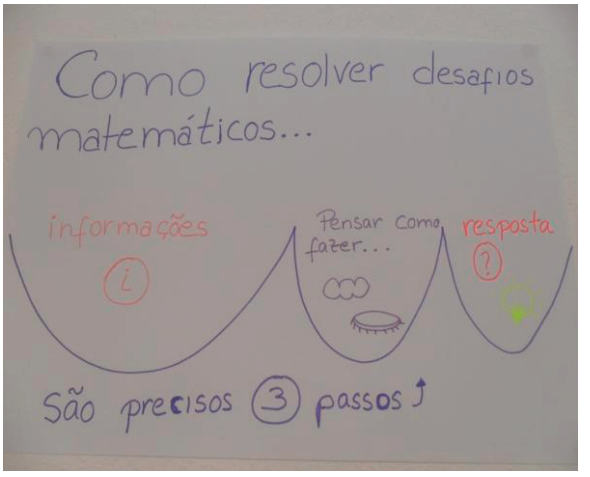
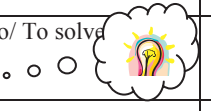
Appendix A.

A.1. First version



A.2. Final version

Phases to solve a problem		Out coming		
		I was not able ☹	I did something 😐	I was successful ☺
1.º Information 				
2.º To think how to do 				
3.º To do/ To solve 				
4.º To answer 				

Appendix B.

B.1. First version

Phases of mathematical reasoning	Level 1	Level 2	Level 3
Find relations between number			
Formulate conjectures (what happens if…)			
Show contra-examples			
Justify the validity of the conjectures			
Argumentation			

B.2. Final version

Phases of mathematical reasoning	Level 1	Level 2	Level 3
Find relations between number or mathematical objects	Increase/Decrease Even/Odd Double/Triple	Dividers/Multiples Prime/Composite Regularity or simple patterns	Generalize a regularity
Formulate conjectures (what happens if…)	Looks for some particular cases	Looks for some particular cases with persistence	Formulate a general conjecture (generalization)
Justify the validity of the conjectures	Test for some cases and justify without rigor	Test for some cases Indicates contra-examples	Use appropriate mathematical language in a natural or symbolic representation