This article focuses on the evolution of students’ ability for self-assessment. Although the student studied shown an evolution, knowledge of the assessment criteria is not enough to contribute to improve her performance. Self-representations of the criteria led to gaps between what the student did and what was aimed by the criteria. The conflict required to change the representations depends on a continuous investment by the teacher.

INTRODUCTION

Over the years, the emphasis on understanding assessment as part of the learning process has gained strength (Crockcroft, 1982; NCTM, 1989; NCTM, 1995; NCTM, 2000). The monitoring and self-monitoring dimensions of assessment have especially singled out. In essence, every individual performs self-assessment (Nunziati, 1990) and this ability may contribute to the self-construction of a trajectory that allows him/her to overcome obstacles. Self-assessment is associated to the comparison between what one achieves and what one thinks should be achieved. However, the valued criteria, though explicit, do not necessarily have the same meaning for all those to whom they are presented (Morgan, 2003). Meanings may depend of each one’s perspectives, namely as regards assessment, the subject and its teaching. So it is important to understand how students mobilize assessment criteria, the difficulties they encounter in constructing their meanings, and how the discrepancy between different interpretations can be minimized.

This paper concerns a larger study whose main aim was to understand how students’ ability for self-assessment develops when the teacher invests in the appropriation of assessment criteria, in the context of the classroom. In this context, where students engaged in problem-solving, in research activities and in writing up reports about their work, we sought to understand (i) in what way students use the assessment criteria adopted throughout their activity, and (ii) the difficulties students have in their appropriation.

THEORETICAL FRAMEWORK

Viewing mathematics as a creative activity must be accentuated in school mathematics. Students should engage in problem-solving, in research activities and in the construction of mathematical argumentation (NCTM, 200, 2003). But these tasks, per se, are not enough for students to develop their own knowledge about thinking mathematically. Students need to develop a conscious, reflective practice, of which the development of self-assessment is a part. To do so, they must establish a
comparison between what they do and the criteria that are valued. For instance, students should know what is sufficient to correspond to a proposal and understand what is meant by a plausible mathematical justification (Yackel & Cobb, 1996).

According to the NCTM (2003), self-assessment methods comprise teaching students to understand the objectives of learning and the assessment criteria, as well as resorting to tasks that allow them to assess their own learning processes. Involving students in self-assessment requires that they know and understand the assessment criteria (Jorro, 2000; NCTM, 2003; Perrenoud, 1998; Santos, 2002). Fully clarifying the criteria does not imply appropriating the assessment language (Morgan; 2003). The appropriation of assessment criteria, even though clearly defined, varies from individual to individual. This appropriation specifically implies a shared construction of meanings between teacher and students that promotes an alignment between the interpretation of the students and those of the teacher. For this to occur, the teacher should consider other, complementary strategies besides the clarification of criteria (Santos, 2002). Also, the use of criteria depends partly on the individual’s level of acceptance and internalization of objectives, standards or criteria.

Self-assessment is a competency that is worth constructing, for moving from a spontaneous assessment to an intentional control system regarding one’s performances results from a learning process (Nunziati, 1990). To Hadji (1997), self-assessment is an activity of reflected self-control over actions and behaviour on behalf of the individual who is learning. Santos (2002) stresses that self-assessment implies that one becomes aware of the different moments and aspects of his/her cognitive activity, therefore it is a meta-cognitive process. A non-conscious self-control action is a tacit, spontaneous activity that is natural in the activity of any individual (Nunziati, 1990), and in this sense all human beings self-assess themselves. Meta-cognition goes beyond non-conscious self-control, for it is conscious and reflective (Nunziati, 1990).

**METHODS**

The methodology used was qualitative and interpretative in nature (Goetz & LeCompte, 1984), because of its adequacy to understand these problems within teaching and the fact that the features of this kind of methodology were in keeping with those of the options in the present study (Bogdan & Biklen, 1982). The research design followed was the case study1.

The tools for collecting data were participant observation, interviews and the documental analysis of the written productions of students (reports and self-assessments). 23 lessons of a 7th grade class (12-year-old students) were monitored during the 2003/2004 school year. In the first class the study was explained to the students, as were the general criteria of assessment. Six classes were devoted to

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1 Although two case studies were developed in this study, in this paper only one will be addressed.
getting them used to the presence of the researcher and to getting to know the
students better. Finally, what had been agreed between the researcher and the class
teacher was developed over 16 classes, with a view to developing the students’ self-
assessment ability. These classes were audio and video-taped and fully transcribed.
Four semi-structured interviews took place with each case student and were also fully
transcribed. The students did reports about the activity that was developed and their
respective self-assessments. The data were subjected to several levels of analysis that
took place periodically (Miles & Huberman, 1994), based on categories defined a
posteriori that arose from the data gathered and keeping in mind the theoretical
framework and the questions of the study.

Throughout the whole year the researcher and class teacher developed collaborative
work that included working sessions for planning classes, defining tasks for the
students (three problems and two tasks of mathematics research), the creation and
reformulation of assessment criteria, analysis of the students’ reports and self-
assessments and the definition of strategies to facilitate the students’ appropriation
of the criteria. The assessment criteria considered were: Presentation of the report; Task
solving strategies; Explanation of the way you thought; Reflection about strategies
and solutions; Mathematical language. The facilitating strategies for appropriating
assessment criteria included their full clarification, confronting the students with
these criteria, the opportunity to improve work, the adoption of a group work
methodology (co-assessment between peers), the request of students self-assessments
(self-assessment and co-assessment) and writing up feedbacks.

THE CASE OF VANDA

Vanda is a 12-year-old student who participates in class, but usually she is not one of
the first to intervene. She communicates well and generally takes care with the
language she uses. She attributes the fact that she had a 52 in Mathematics the
previous year to her effort: “because I think I worked hard to deserve it”. She
associates Mathematics to numbers and arithmetic above all, and states that
Mathematics helps “our daily life when we’re dealing with bills, even when we go to
the shops to know what we have to pay”. Vanda declares that she likes Mathematics
because “it’s... interesting, it’s different, it’s novel”. Vanda studies Mathematics by
solving exercises in various books, although she also studies the notes she takes in
classes: “I solve a few exercises (...) I also study with my notes, sometimes even with
the textbooks, but more with activity books”. This student relates assessment to
teachers’ objectives and the final mark to those of the tests. As for self-assessment,
Vanda strongly connects it to the end-of-term mark. She is used to self-assessing,
especially at the end of term. She does so expressing herself in terms of levels.

In the first task developed within this study, Vanda’s self-assessment was very
different from the teacher’s. The improved version of her report, though carefully and

\[2\] In a scale of 1 to 5, where 5 is the maximum level of performance.
creatively presented, resorting to an A3 card, simply includes one successful attempt and one lost, for each list of numbers, with very superficial reflections. In the first interview, Vanda finds the following aspects those that teachers most value: “presentation, the words used, the expressions, (...) where we provided that information, which topics we addressed”. So, at the start of the study, she values the report presentation and development most of all because she feels that is where the solution of the task is, that is, the answers to the questions posed.

In the second task, the teacher once again stresses the need for the students to record what they discuss. Although the discussion between Vanda and the colleague sitting beside her took a whole class and involved calling the teacher several times to validate their reasoning, in the report they only present their conclusions without explaining them more thoroughly. The aesthetic side of their work is still the most favored aspect. In fact, these students even wrote titles on the computer to then paste on their work, despite the teacher having explained that embellishing it was not important (“what we want here isn’t pretty work”), and that Vanda had replied: “Well-organized work”. Vanda emphasized the “well-organized” of her comment and the teacher had continued to explain: “It can have things that are crossed out. As if this was the road we were taking and we gave up because we felt it wasn’t the best way”. But Vanda continues to associate this aspect to the appearance, “it’s lovely with the colors”, and to the sequence of ideas that show the answer, but not necessarily to its mathematical grounding. Neither student writes anything down as to the difficulties they felt. In the part of the conclusion and reflection of the report they write: “We enjoyed developing this task because it helped us to develop knowledge and work better in group”.

As the different learning experiences progress, Vanda begins to question her explanation of the reasoning she develops and to distinguish the strategies she used for the calculations. In the interview that took place after the fourth task, when commenting on the criterion Explanation of the way you thought, Vanda states: “I think there are things we could have put better because there were parts that perhaps we could have explained more (...) the explanations could have been clearer”. The Reflection about strategies, to Vanda, is “reaching a conclusion and explaining with my way of thinking. Now that’s what I think is showing we reflect”. Thus this student now sees reflecting about the task as one of the parts to include at the end of the report, as the synthesis of the entire work, and associates to it a reflection about everything they did.

In the last task, Vanda starts with the introduction, moves on to the development, and then the conclusion. She does the cover after finishing the work. Also, she does no previous draft, nor does she make a fuss about crossing out what she wants to annul. This time, she does not eliminate part of her research from the report just because she decided to go another way. Despite not having commented on her first approach, her intention was to show the route she took.
In the first criterion she feels she respected much of the proposed structure and explains that, as regards the *Presentation of the report*, “it’s really everything, cover and all, I think the whole report’s important, every single sheet, not just the cover, but the presentation of the cover’s also important and so is presenting the whole report”. So although Vanda still favours the development, and then the conclusion of the task, she refers that she must present every part of the structure. She also finally stops investing mainly in the aesthetic appearance of the report.

As for the *Solving strategies*, she states she presented these fully. She feels she explained the way she thought. For Vanda, presenting solving strategies for a problem and explaining the way she thought are not one and the same:

> Well, you can just stick a strategy there, can’t you? If you can use an expression, but how does it get there, right? There’s got to be an explanation as to how it got there, that I did it, I reached that conclusion.

Vanda still seems to think that if she presents the calculations, or a table, for example, the strategy is there. But she knows she has to include the intention and the connection to what she intends to do, and what she makes of it. She explains that she chose the implementation level 3 for the criterion *Task solving strategies* precisely because she thinks that although she tried to meet its requisites, she could have presented her strategies in a “more complete” way. And she clarifies this statement: “I think I could have a more complete explanation of how it got there, how I did that”. As such, she considers she only reached the implementation level 3 for the criterion *Explanation of the way you thought*.

In the following criterion she claims to have reflected about strategies and solutions. For her, in Mathematics it is important to reflect about the strategies used and solutions reached, but she still focuses her justification on her reflection about strategies: “yes, because we’ve got to put a strategy there, and the strategy might be wrong, and we have to reflect, see which conclusion we draw”. So Vanda reflects about the strategy to see which conclusion she reaches and to see if the former is wrong. However, she continues not to regard cases where the strategy was right and the answer would have to be in clear consistency with her analysis. Vanda states that the teacher can verify a student’s reflection about strategies and solutions, in the report, precisely from the explanations and the “steps” the student took: “ah..., because of the explanations that are there, see, the steps we took”. But in her final interview she justifies having chose implementation level 3 in the criterion *Reflecting about strategies* and solutions with the fact that she did not manage to explain why her conjecture (solution) turned up.

To this student, the adequate use of mathematical language, showing a sound knowledge of the relations between expressions and knowledge, implementation level 4 of the last assessment criterion, is “to use the expressions as well, see, to use

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3 In a scale of 1 to 4, where 4 is the maximum level of performance.
the content with the right expressions”, that is, to resort to the content and mobilize the right expressions in her explanations and definition of her “steps”. Vanda chose level 3 in the criterion Mathematical language because she feels she did not mobilize her knowledge well enough: “I didn’t find a justification, the evidence, probably because I didn’t mobilize the content or the knowledge”.

Finally, it should be noted that Vanda attributes implementation level 3 for the first time to all the assessment criteria in the only task she solved individually. The fact that she worked on it alone may have left her more insecure as to the quality of her performance, an aspect that may have influenced her judgments about the quality of her work. However, given that Vanda effectively integrates more aspects of the criteria than she did initially, choosing this level seems to be related to a more critical look at her report.

CONCLUSIONS

While solving tasks, Vanda mobilizes self-representations of the criteria and other standards that steer her activity; in other words, she resorts to a spontaneous form of assessment (Nunziati, 1990). Initially her stance towards her activity is almost as if the expressed assessment criteria did not exist. She is used to self-assessing herself but only in the final balance performed at the end of each term which, according to Abretch (1991), does not have the desired effects in a formative assessment. As Vanda realizes the importance of the criteria in her assessment, she seeks ways to try and correspond to her understanding of each criterion. In the second task Vanda actually does put down more than the calculations so as to respond to the proposal, but the explanations of certain choices and of one of the conclusions remain only implicit, and one of the conclusions is not clear. She maintains her own personal idea of what she thinks is valued (“well-organized work”), continuing to place aesthetic appearance above a good part of the rest, until she does the third task, in which there is a direct interaction with the teacher about this matter. Up until the fourth task she develops no justifications beyond a few examples, calculations or the adoption of forms of representing data.

From the start of the study, Vanda associates the thing that allows her to reach conclusions to the criterion Task solving strategies, which in practical terms means calculations or a table. At the end of the study, she has not totally modified this perspective, but shows she is aware that it is not enough to present only calculations or a table – she must associate to these an “explanation” for the reason they appear in her work, for how it was conducted and for drawing a conclusion from this. Vanda first understood the Explanation of the way you thought as the presentation of calculations and opinions. By the end, she actually considers more justifications than those she carries out and grounds one of her conclusions mathematically. As for the criterion Reflection about strategies and solutions, Vanda simply related it to strategies. The explanations she elaborated in her solutions assume some relevance in light of this criterion and this evolution is clear in her self-assessment regarding the
final task. But ultimately it seems that the main thing that keeps marking this criterion for Vanda is that reflecting about the strategy is all it takes for solutions to arise naturally. Initially, Vanda associated the criterion *Mathematical language* to the knowledge of the content involved. At the end of the study, she relates this criterion to both knowledge and the expressions used.

Vanda’s main difficulties in appropriating assessment criteria are related, first and foremost, to not being used to working with them. At the beginning she is directed by an impression she creates of the work before her, based on self-imposed standards. Later, when developing her learning, Vanda becomes aware of the aspects that are really valued. The interpretation she develops in light of the criteria is influenced by the importance of what she considers to be a correct answer and of what she thinks is a plausible justification. However, this student keeps seeking forms of trying to correspond to the criteria. And despite not changing some of her perspectives, Vanda realizes what she must present in order to draw closer to what the teacher values. As regards self-assessment (final balance) of the report, it also becomes increasingly self-critical.

**Figure 1. Interrelations between factors intervening in students’ activity**

In short, self-imposed standards that derive from their experience of assessment may be said to mediate students’ actions towards the criteria and the activity under development (see fig. 1). In this study, the conflict required to change representation or to control the standards created by students was motivated by the teacher’s investment in appropriating criteria. Standards are questioned through this investment. From this conflict new representations or the self-control of initial standards arise. In other words, the relationship between assessment criteria and self-imposed standards changes, both through adjustments and through the management of what is done, controlling that which is self-valued. This has reflections on students’ activity.

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