

LIGHTS AND SHADOWS OF FEEDBACK IN MATHEMATICS LEARNING

Leonor Santos, University of Lisbon

Jorge Pinto, School of Education of Setúbal

Feedback as an assessment practice for learning, specially in Mathematics, has been studied over the past decades. Based on the evidences gathered from several previous research studies we aimed to study how the “form” and “dimension” of feedback can influence students’ learning. Four interpretative research studies were carried out, over a three year period. The participants, students aged between twelve to fourteen years old, show that the trends studied can be determinant to find out how effective feedback is in connection to the students’ school achievement and to their conceptions of the tasks given.

INTRODUCTION

Formative assessment is a type of assessment that currently has a key relevance considering the school crises. This relevance is due to four key reasons: (i) a general concern of the OECD countries to end failure and drop out (Field; Kuczera & Pont, 2007), where it is recognized that the modes of assessment centred in retention don’t contribute to learning; (ii) the need for assessment to be a tool serving teaching practices in order for them to be closer to the students difficulties; (iii) the fact that formative assessment needs to be recognized as key by the assessment guidelines and the curricular orientations for mathematics teaching (NCTM, 1995; 2000), and (iv) the fact that the teachers are favourable to using a formative assessment but their practices are still poor and little effective (Black & Wiliam, 1998; Torrance & Pryor, 2001). This facts lead to the development of project AREA¹. This project aimed to understand how formative assessment can become a real learning tool. In this perspective we assume that all learning is complex and created by the individual through its activity and the use of mediator processes of re-interpretation of its own actions. Thus, the formative assessment is a relationship process between the student and the teacher aiming to do a certain task, that is, an assessment for learning. The products of this relationship and of the mediation process in connection to the purposed tasks and objectives are shared between teacher and student. The reflection that the participants do about this information can strongly improve its use. Thus, the key objective of this research study is to study deeply one type of interaction – written feedback. Having as starting point the results of previous research studies about feedback (Black & Wiliam, 1998; Clarke, 1996; Wiliam, 2007), we aimed to understand what the potential of feedback to mathematics learning is and what should be the conditions present in order to maximize its learning potential.

THEORETICAL FRAMEWORK

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A new approach to learning and consequently to teaching lead to new culture and assessment forms (Dierick & Dochy, 2001). With the evolution of the times, we can state that an assessment for learning is not circumscribed to the formal moments of assessment but essentially present in every day moments in the classroom, in the moments where learning tasks are being performed as well as on those where reflection is being done. In this perspective intentionality is another aspect that deserves special attention. It is the intention of understanding and students support that provides assessment with a formative nature (Pinto & Santos, 2006). Assessment goes through gathering evidences, followed by its interpretation and finally in an action based on the hypothesis reached (William & Black, 1996). However, this type of assessment will only be truly a formative assessment if there are implications to the learning.

A key element to an assessment for learning is feedback. Feedback is perceived as the information that shows how apart is the “performed” to the “expected” trying to minimize that difference (Sadler, 1989). The revision of literature done by Black and William (1998) gives some contribution to distinguish feedback regarding its nature. Referring to another revision of literature done by Kluger and DeNisi, they identified three levels of linked processes in the regulation of tasks performance: *meta-task processes*, involving the self; *task-motivation processes*, involving the focal task; and *task learning processes*, involving the details of the focal task. The results gathered from previous studies point out that when feedback is aiming mainly to the task its effect tend to be positive, favouring the improvement of the student’s product.

Also Gipps (1999) makes a distinction between two types of feedback: the *evaluative* and the *descriptive feedback*. The first is seen as a judgment of value with an implicit and explicit use of norms. Given its nature it has little effects on learning. This author still divides the descriptive feedback in two other types: the feedback that specifies the progress and the feedback that constructs a way forward. The first sub-type of feedback is the only responsibility of the teacher. It is the teacher that has a control, power and authority to say to the student what he should do in order to improve its production. The second sub-type of feedback is developed in collaboration with the student. Therefore, the responsibility and power over a certain production is shared promoting a deeper understanding about the tasks given and encourages the student to access and to reflect on what they have done.

Tunstall and Gipps (1996) have developed a new type of feedback as a result of a study carried out about oral and written feedback. Assuming that feedback is a socialization tool and as such it is directly connected to values, attitudes and classroom processes, the authors defined two subcategories of evaluative feedback with opposite ends are, respectively: *Rewarding versus punishing; approving versus disapproving*. As subcategories to descriptive feedback they have considered *specifying attainment versus specifying improvement and constructing achievement versus constructing the way forward*. The authors argue that the use of this categorization suggests that feedback can change according to the style, purpose, meaning and processes. Nevertheless, it is important to stand out that these

subcategories, as they are stated, are not necessarily separated. Furthermore, the same teacher can use, in different moments, different types of feedback. Also Jorro (2000) makes a distinction between two types of assessment writing. Making *notes to convey information* that can be translated by vague statements with little contribute to learning; and making *notes as a dialogue* that aims to question, to provide clues and to encourage reflection from the student (Veslin & Veslin, 1992).

In summary, feedback can contribute to improve students' performance when is focused on what is needed to be done in order to improve performance, and when more detailed information on how to proceed is given (William, 1999). We still have to consider how much information should be provided and the appropriate moment to do it. To state that the more feedback the better is not necessarily true (William, 1999). It is the quality and not just the quantity of feedback provided that deserves our attention (Sadler, 1998). The amount of information provided should only be the necessary for the student to move forward and not too much in order to provide the answer (Santos 2004; 2008). Strategies that are favourable to long castings learning include allowing for the student to identify and correct its own mistakes and to reach the correct answers (Nunziati, 1990; Jorro, 2000). To know what is the correct moment to provide written feedback also seems to be crucial. Several studies point out that feedback should never be provided before the student is given the chance to think and work on the given task and a grade given (William, 1999).

The assessment practices that we have mentioned constitute a big challenge to the teachers. To perfect the practices of an assessment for learning does not follow a linear process. There is no facilitating process that can be adapted to existing practices that can guarantee fast results (William *et al.*, 2004). Nevertheless, evidence show that we can obtain gains to student learning through an assessment for learning practices and that the teaching of high level objectives is compatible with success even when this is measured using limited instruments such as external assessment test (Black *et al.*, 2003; William, 2007)

METHODOLOGY

This study is based on four research studies about feedback in a mathematics classroom. The studies were carried out over a three year period in Portugal (from the academic year of 2005/2006 to 2007/2008). These research studies were carried out under the scope of project AREA and were developed by two teachers, Sónia e Sílvia, that teach in two different school in different areas of Portugal. One of the teachers carried out one research study per year (a total of three) and the other just one on the final year. The participants of the studies were classes of middle school level with students aged between twelve and fourteen years old.

All of the research studies carried out an interpretative research methodology and used a case study design. The selection of the participant students aimed to gather students with different levels of school achievement in mathematics. The data was gathered through classroom observation, students' interviews (both with audio

recording and its total transcription) and analyses of the documents produced by the students. All of the students' productions included two versions. The first version, not yet graded, had received some written feedback by the teacher. The feedback provided always aimed to be focused on the task and not on the students' specific trends (Black & William, 1998) and to be mainly of a descriptive nature (Gipps, 1999).

For the purpose of this research the feedback provided was analysed according to the following categories: form (symbolic/descriptive, this one could be affirmative/interrogative/mixed) and the length of the feedback (short/long).

RESULTS AND ANALYSES

The feedback provided to the student and its effectiveness concerning learning will be analysed considering its form and length.

Form

Analysing the feedback provided to the students throughout this research project we can state that there was progress made regarding the form of the feedback provided by the teacher. The teacher went through a frequent use of symbols to mark a mistake or something incomplete (underline, a cross, a question mark) that gradually started to disappear being then replaced, at the start of the second year of research, by a descriptive feedback as we noticed that the first form of feedback used was only useful to certain students. All of the students perceived feedback through symbols as something that was wrong. However, to the students that had a good achievement in mathematics the symbols were sufficient. They were interpreted as a call for awareness that would make them go over what they had done and use their knowledge to improve the second version of their product. For the students that had an average or weak achievement in mathematics the symbols were not enough for them to change the incorrect information. The students argued that the teacher should say what she wanted: "If the teacher would explain what it was. It could have a note explaining what was wrong, instead of a cross" (student with medium achievement, Sónia, 05/06).

Descriptive feedback can present several statement forms: affirmative, interrogative and mixed. The interrogative form intention is for the student to reflect on their answer, to clarify it and to use their knowledge. In order to do this we associate several clues that will help with the progression of the task such as, "How did you come up with these values?", "What did you conclude?", "How can you convince me that this statement is true?", "Is it always true?". The affirmative form appears to be more often used when it is necessary to explicit a mathematical concept in order to solve a task or to identify a concept that it is clearly not correct, such as "You understood the task very well and your results are presented very well. However, you forgot one thing. The box where you had your little 'cubes' is itself a 'cube' and it was full of your little cubes" (Sónia, 08/09). The mixed form has very similar intentions in connection to the interrogative form to which we add an 'anchor point'

in a way that establishes a certainty on the student: “This paragraph does seem to be very clear. Are you sure you understood all the information provided?” (Sónia, 08/09).

When we compare several feedback forms, the interrogative or mixed forms seem to be clearer to the students regardless of their achievement: “I have the questions. It is easier” (student with medium achievement, Sílvia, 08/09), “The overall comments are important but I understand the questions better than the overall comments. When we have questions we try to answer them. It is easier”, so the student try to address the questions first: “We think it is best to answer the questions that the teacher poses us” (student with high achievement, Sílvia, 08/09).

An interrogative or mixed feedback that is contextualized by the task and that aims to provide more detail about what it is asked to do can help the student with the task given. It is the case of the following comment: “How can the cube A be formed by 23 little cubes? And B by 18? And C by 10?” or “Where the two brothers born with the same weight? Or was one heavier than the other? Did they maintain the same weight difference forever?” (Sónia, 08/09). Or still by specifying the question connected to the students’ contribution to the group work: “Did I help the group with the work? Have I participated and gave my opinion? In what way? Did I listen and respected others opinions?” (Sílvia, 08/09). Nevertheless, not all comments that include questions are effective to all students, specially for those that have a low achievement in mathematics. When the comments given are more abstract, not centred on the task or require the connection between concepts the feedback is not always understood. For example, “Start by saying one result that we learned and that connects elements of the triangle with elements of the square. What does CD^2 represent? And DE^2 ? Why do we divide the area of square Q by 4? We have represented in the picture triangles and squares...” (Sónia, 08/09). This fact was confirmed by the teacher: “When I used symbols from the task on my comment or a specific mathematical language the student did not understood” (Sónia, 08/09).

In this analyses we still have to consider that certain feedbacks have been ineffective not due to its form as such but due to the students perception of the task itself. That is, for example, the case of a student, with low achievement, that values more reaching a correct answer rather than the explanation of the process use to reach that answer. Faced with the following comment: “You were looking for values that would solve the problem and you were successful because you found them. Now I want you to present other possibilities and to explain why they cannot be solutions to the problem” (Sónia, 08/09), this student added nothing to what he had already done. The other teacher found the same problem regarding the final conclusions of the finalized work. Faced with the feedback comment stating: “You mention that the task was difficult but well done. What brings you to say that? Do not forget to justify your comments” (Sílvia, 08/09), the student states that he added nothing on the second stage because “I don’t think that the conclusion is very important. If it was the

conclusion of the task it would be important. But it wasn't so I don't worry about it. I just do it because the teacher asks me to" (student with medium/high achievement, Sílvia, 08/09). When it is a student with high achievement, and even when the teacher states that on the first stage the task was correctly solved and performed, the student commits to the second stage where he tries to perfect all aspects of the product, even the smallest details.

Length

The comments have a tendency to be short. However its length seems to be connected with the length of the task itself. If the tasks are open the comments tend to be longer. However, this type of comments, as the students themselves admit, are the ones that are more difficult to understand: "I had to gather all the information from the first stage of the task plus the comments to do the second stage. I had to read, look back on the comments, do the second stage. There was a point when I was really confused. The notes should be smaller" (student with a low achievement, Sónia, 08/09); "I think that the teacher should just write 'you need to explain yourself better...' because with all this text we read and start thinking about something more" (student with medium achievement, Sónia, 08/09).

These comments do not seem to help when it comes to re-writing the tasks. The students are lead to several strategies such as: (i) to remove or not what it is wrong; (ii) disregard the comments that they do not understand or ask the teacher for clarification; and (iii) hierarchies the information that they understand giving priority to the aspects related to mathematics and then the ones connected to the formal aspects of the task. Faced with the awareness that it is wrong, but without knowing how to correct it, some students chose to remove the information in order to avoid leaving mistakes on their products. Others chose to leave it as it is as they fear, that by changing it, it will lose coherence or that it would become worst: "We read but we didn't understand what was wrong. We decided to include it again. If we took it out something could be missing. If we change it, it could be worst" (group of two students, one with low achievement the other with medium, Sónia, 05/06). We are then facing different attitudes towards a mistake.

One other aspect stands out in all the studies that relates to other type of behaviour facing a not understood feedback comment. The students with a lower general achievement disregard the comment while students with a high achievement question the teacher regarding the feedback given. This questioning is often related to the fact that they want to present a product directly connected with the requests of the teacher. This fact leads to the presence of oral feedback as an important complement of the written feedback. Oral feedback can be dynamic, constantly adjusted and developed which can be seen as an upgrade of the initial written feedback.

Finally, when the comment is long, and as such withholds a lot of information, students tend to manage their time by delaying other aspects related to the final product, such as the front cover: "We were more concerned with looking for the

information. So, in order to be able to do everything, we left the front cover to the end” (group of students, Sónia, 08/09).

SUMMARY AND IMPLICATIONS

The research that served us as a starting point shows that feedback of a descriptive nature (Gipps, 1999), such as notes as dialogue (Jorro, 2000), contextualized by the task and with detailed directions as to how to proceed (William, 1999) is potentially more favourable to learning. However, our study point out that not all feedback with these characteristics has the same positive effects regarding learning. The form of the comments as well its length, the type of student and its perceptions are factors that can influence the effectiveness of this assessment practice. The interrogative or mixed form in comparison to the affirmative form seems to facilitate the students understanding of the feedback and to get them involved in the following stages of the task. Short feedback comments seem to be more effective than the long ones, helping the students to focus in certain specific aspects of the task. Nevertheless, we need to stand out that there seems to be a connection between the length of feedback and the nature of the mathematical task in hand. More open tasks tend to require a longer feedback which can constitute a difficulty for the teacher. Following Tunstall and Gipps (1996) research, feedback as a mediation instrument for the learning and teaching relations, can be appropriate to students in a diversity of ways. The students with a lower achievement in mathematics reveal more difficulties in understanding feedback when it relates or uses mathematical concepts or refers to more abstract ideas. When the understanding of what is requested from the task is not what the teacher intended to be can constitute another difficulty for the effectiveness of feedback. Nevertheless, when the students reveal a high achievement in mathematics, if the feedback is not understood, they tend to question the teacher aiming for some new feedback, this time orally, and thus creating a new learning opportunity. Summarizing, this research study reveals that we cannot mention of totally good or bad feedbacks. Giving feedback can constitute a task of extreme complexity, where the intentionality of the teacher and its ability to reflect on and about its own action are determinate factors to a real assessment for learning practice.

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