ON PRIMARY TEACHERS’ ASSESSMENT OF PUPILS’ WRITTEN WORK IN MATHEMATICS

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The study reported here aims at examining the resources which Greek primary teachers draw on and the positions they adopt within the pedagogical discourse of assessment. 553 primary school teachers were asked to assign a grade to four authentic solutions to a word problem and to justify their grades in writing. The results indicate that in assessing students’ written work, teachers tended to resort to a rather limited variety of resources, mainly from an unofficial, personally constructed and rather traditional pedagogic discourse, while the way they were positioned within this discourse did not allow them to offer varied evaluations.

INTRODUCTION

Assessment in mathematics is often seen to be equivalent to an evaluation of the level of understanding achieved by pupils. This approach to assessment is based on the assumption that pupils have certain characteristics such as skills, abilities and knowledge, which can be measured. However, this emphasis on the measurement of children’s achievements is very limited, as it does not allow for the complexity of the assessment process to be acknowledged. That is, it does not allow for their work to be understood in relation to power structures developed in the classroom, the school and the wider society. This suggests that, in looking at how pupils’ work is judged by teachers, the social nature of mathematical behavior, theories of pedagogical discourse and communication, as well as a sociological analysis of the role of education, mathematics and assessment all need to be taken into account (Morgan, 2000).

Teachers’ assessment practices in mathematics are shaped by a number of factors, internal (e.g., their conception of mathematics, its learning and teaching, their feeling and expectations of students) and external (e.g., parents, examining boards) to them. Thus, there can be important differences in both the assessments teachers make and the approach they adopt in assessing. These differences can be interpreted on the basis of an epistemology according to which there is not necessarily a relation between a student’s ‘text’ and the meanings the teacher, as a reader of the text, constructs (Kress, 1989). On the contrary, these meanings depend on the features that the reader identifies in the text. These features vary according to the pedagogical discourse utilized, and the positionings adopted by the teacher-reader within it along with his/her previous experience (Morgan, 1998).

In the light of the above considerations, it becomes apparent that teachers proceed to assessments subjectively. Moreover, they do not have the same subjective judgement in all cases and in all school subjects. As a result, assessment seems at times to be an
informal function and at others a formal, well-defined operation, which has been probably pointed out (Morgan, 2002).

Recognizing the interpretive nature of assessment, the relevant research in mathematics education has turned its attention to the processes adopted by teachers when interpreting students’ performance. The still limited work towards this direction indicates that when judging students’ mathematical attainments, teachers read their texts in an interpretative and contextualized way, relying not only on “their knowledge of the current circumstances but also on the resources they bring to bear as they ‘read’ the students’ mathematical performance from these texts. These (resources) … arise from the teachers’ personal, social, and cultural history and from their current positioning within a particular discourse” (Morgan & Watson, 2002). In a series of studies, Morgan and her colleagues, attempting to identify resources utilized and positions adopted by teachers when assessing pupils’ texts, came to suggesting the following categories: (a) Resources: ‘teachers’ personal knowledge of mathematics’, ‘their beliefs about the nature of the subject matter’, ‘their expectations of how mathematical knowledge can be communicated’, ‘their experience and expectations of students and classrooms in general and of individual students in particular’, ‘their linguistic skills and cultural background’ (Morgan & Watson, 2002) and (b) Positions: ‘teacher-examiner, using externally determined criteria’, teacher-examiner, using own criteria’, ‘teacher- advocate, seeking opportunities to give credits to students’, ‘teacher-adviser, suggesting ways of meeting the criteria’. The positions adopted by teachers-assessors and the resources available to these positions signal “different relationships to students and to external authorities as well as different orientations towards the texts and the task of assessment” (Morgan et al, 2002).

A rather small number of studies attempted to study teachers’ assessment practices in mathematics within the perspective described above, revealing certain interesting and important aspects of these practices, some of which are summarized below:

- Teachers can easily identify and value the ‘correct’ elements in their students’ productions in mathematics texts, but they find it difficult to coherently describe the features of these productions, which influence their assessment practices.

- In assessing, teachers exploit either individual or collective resources, which might come from different and even contradictory discourses. The way teachers are positioned within them may lead to different assessment of a student by a particular teacher in different times and contexts (Evans, 2000, Morgan et al, 2002).

- Teachers’ knowledge and beliefs about mathematics and its teaching and learning are among the central resources teachers draw on to assess pupils, and are mainly located in the pedagogical discourse. This is because these conceptions contribute to and predetermine how mathematics is taught, play a
part in definitions of achievement and inform criteria of attainment (Thomson, 1992). Thus, despite the limited research in this area, there is some recognition that teachers’ judgements about pupils’ achievements are influenced by teachers’ values of mathematics. For example, problem-solving skills, memory for rules and ability to adapt skills may be valued differently by different teachers or even by teachers with similar views of mathematics, because of their idea of how mathematics should be represented. Believing in a transmission model of teaching or in a constructivist model of learning in mathematics is likely to mean valuing different assessment tasks and outcomes and interpreting pupils’ achievements differently compared to favouring other models of teaching and learning (see, for example, Kahn, 2000). A teacher with a utilitarian view of mathematics may see successful use as indicative of understanding, whereas one with a logistic view might demand a full explanation of meaning (Ernest, 1990). Or, favouring a particular teaching or learning approach, for example, considering application as the ultimate demonstration of understanding, or valuing and encouraging investigative or practical work, is likely to affect teachers’ assessment conceptions as well as their assessing practices, and hence to possibly disadvantage certain groups of students (Walkerdine, 1988).

The argumentation developed above indicates the importance of examining the features that characterize teachers’ practices when assessing their students’ productions in conjunction with the differentiated answers provided by the latter in given contexts. The research described in the following is an effort to contribute to this direction.

THE STUDY

The study reported here was carried out in the context of a larger research project, which aimed at examining the resources which Greek primary teachers draw on and the positions they adopt within the pedagogical discourse of assessment. In the present paper, the focus is narrowed down to an examination of the pedagogical discourse of assessment employed by primary teachers, when reading pupils’ written answers to a word problem requiring operations with whole numbers. In particular, an attempt is made to address the following research questions: (a) What are the main features of these pupils’ texts that teachers value and how do they affect the grade they assign to the students? (b) What are the resources teachers draw on and the positions they adopt in assessing these texts?

The data exploited here come from 553 Greek primary teachers (328 female and 225 male) with 6 to 20 years of teaching experience. The teachers were asked to assign a grade to the authentic solutions to the above mentioned word problem provided by four 10 years old students and also justify in writing their grades. Students’ answers differed with respect to the linguistic and the symbolic features of the mathematical text produced (all the solutions were correct). More specifically, the answers provided by the four students were as follows:
Student A: the necessary operations are correctly performed and the series of operations is simply described in words.

Student B: the necessary operations are correctly performed and a written answer for each of the questions set is provided.

Student C: the necessary operations are analytically and correctly performed and a written answer for each of the questions set is provided.

Student D: the necessary operations are correctly carried out.

DATA ANALYSIS AND RESULTS

The analysis of the data predominately aimed at identifying the resources which the teachers of the sample draw on and the positions they adopt in the context of the discourse they develop in trying to justify the grades they allocated to each of the four answers. To this purpose, the categories suggested by Morgan and her colleagues were exploited, following an interpretive process: for each category, identifying and coding of the relevant content of the teachers’ written answers; enrichment of the exemplification as more answers were read; noticing compatibility and dominant orientation(s) in the data.

Before launching into presenting the results of the above analysis, we discuss the way the teachers of the sample graded the four answers.

Table 1. The grades allocated by the teachers to the four students’ answers.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Student A</th>
<th>Student B</th>
<th>Student C</th>
<th>Student D</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>(75.9%)</td>
<td>(48.3%)</td>
<td>(32.7%)</td>
<td>(12.1%)</td>
</tr>
<tr>
<td>9.5</td>
<td>(1.3%)</td>
<td>(4.7%)</td>
<td>(3.6%)</td>
<td>(2.4%)</td>
</tr>
<tr>
<td>9</td>
<td>(8.7%)</td>
<td>(30.2%)</td>
<td>(26.9%)</td>
<td>(22.4%)</td>
</tr>
<tr>
<td>8.5</td>
<td>(0.2%)</td>
<td>(0.7%)</td>
<td>(1.3%)</td>
<td>(2.7%)</td>
</tr>
<tr>
<td>8</td>
<td>(5.1%)</td>
<td>(7.4%)</td>
<td>(17.9%)</td>
<td>(28%)</td>
</tr>
<tr>
<td>Lower than 8</td>
<td>(8.8%)</td>
<td>(8.7%)</td>
<td>(17.6%)</td>
<td>(67.6%)</td>
</tr>
</tbody>
</table>

Note: Students’ work in Greek primary schools is graded from 0 – 10.

The results in the above table show that the teachers of the sample valued fairly highly all four answers, their grades being more unanimous for students’ A and D answers than for the remaining two. About three quarters of the teachers graded student A’s answer as excellent and almost two thirds of them student’s D response as the least satisfactory. For students’ B and C, about 83% and 63% of the sample’s grades respectively are split between 10 and 9, with the former grade being a little more popular. These results indicate that, despite the fact that none of the four answers incorporated any serious attempt to provide any justification for the operations chosen, teachers tended to value them highly. This was particularly the case when the answer included operations performed in the commonly taught way and some writing, especially if this writing was related to operations, even if it was simply naming them.
Tables 2 and 3 below present the resources utilized by the teachers of the sample and the positions adopted by them respectively, as identified in the written discourse they developed in justifying their grading of the four students’ answers, following the categorization of Morgan and her colleagues.

Table 2. Resources exploited by teachers in assessing the four students’ responses

<table>
<thead>
<tr>
<th>Resources</th>
<th>Student A</th>
<th>Student B</th>
<th>Student C</th>
<th>Student D</th>
</tr>
</thead>
<tbody>
<tr>
<td>PK</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>BM</td>
<td>18 (3.2%)</td>
<td>29 (5.3%)</td>
<td>15 (2.7%)</td>
<td>17 (3.1%)</td>
</tr>
<tr>
<td>EMC</td>
<td>243 (43.94%)</td>
<td>211 (38.1%)</td>
<td>256 (46.3%)</td>
<td>270 (48.8%)</td>
</tr>
<tr>
<td>BM+EMC</td>
<td>167 (30.2%)</td>
<td>165 (29.8%)</td>
<td>136 (24.6%)</td>
<td>126 (22.8%)</td>
</tr>
<tr>
<td>O/I</td>
<td>21 (3.8%)</td>
<td>16 (2.9%)</td>
<td>9 (1.6%)</td>
<td>12 (2.1%)</td>
</tr>
<tr>
<td>N/A</td>
<td>104 (18.9%)</td>
<td>132 (23.9%)</td>
<td>137 (24.8%)</td>
<td>128 (23.2%)</td>
</tr>
</tbody>
</table>

Note: PK: Teachers personal knowledge & experiences of mathematics, BM: Teacher’s beliefs about the nature of mathematics, EMC: Teacher’s expectations of how mathematical knowledge is communicated, O/I: Other or impossible to identify, N/A: No answer.

From this table, it becomes obvious that in all cases, the teachers of the sample resorted predominately to resources related to their expectations of how mathematical knowledge should be communicated and secondarily to also resources concerning their beliefs about the nature of mathematics. These results highlight a) the dominance of the individually constructed rather than of the officially determined resources of assessment in mathematics, b) the overwhelming predominance of resources related to the way mathematics should be communicated (almost 7 in 10 teachers exploited somehow this type of resource) and c) the relatively high degree of stability of the resources utilized by the teachers across the four students answers. Furthermore, the fact that almost 1 in 4 to 5 teachers refused to justify their grades can be taken as an indication of the difficulty or uneasiness these teachers experience when having to specify their assessment criteria.

Below, some examples of teachers’ grade justifications are presented, in order to help the reader formulate a sense of the way in which the data were analyzed.

Teachers’ beliefs about the nature of mathematics: “Correct result, mathematics is the route to the result”, “the student’s thought is mathematically logical”, “the student solves the problem with a slightly more complicated manner, cannot think of the easiest/shortest route”, “mathematics is being economical”, “the student uses the shortest route and this shows intelligence and correct mathematical thinking”.

Teachers’ expectations of how mathematical knowledge is communicated: “the sequence of the ideas and operations is apparent”, “he explains the solving procedure step-by-step...however, he does not provide an answer to the questions asked”, “its disadvantage is that there is no thinking expressed”, “lengthy answers are not necessary... because they constitute an obstacle for students who are not
good at language and take more time to think of how they should express their thoughts rather than of how to solve the problem”. “She formulated coherently her answer, so that anyone who reads it, can understand the problem... I think that this is important”.

In order to acquire a better understanding of the above results, we proceeded to a detailed analysis of the sub-categories constituting each of the resource categories. This analysis led to the identification of four sub-categories for the most frequent resource utilized (EMC): (a) ‘thinking carried out analyzed’, (b) ‘actions taken justified’, (c) ‘actions taken explained’ and (d) ‘work presented clearly/in detail/precisely or not’. Among them, sub-category (d), particularly for students’ C and D answers, and then category (a), specifically for students’ A response, were located in far more than 60% of the relevant teachers’ responses to all four cases. Thus, it appears that for the majority of the teachers of the sample who drew on this particular resource, the conventionally and correctly performed mathematical manipulations (mainly of symbolic character) are good enough indicators of pupils’ attainments in mathematics (given that the verbal part of the four students’ answers hardly described any genuine thinking). That is, these teachers drew mainly on an unofficial discourse (calculations are seen as explanations or justifications, communication is taken to simply mean transmission of meaning) and not on any official one (where the terms ‘communication’, ‘explanation’, ‘justification’ in mathematics are fairly well-defined features).

Table 3. Positions adopted by the teachers in assessing the four students’ answers

<table>
<thead>
<tr>
<th>Positioning</th>
<th>Student A</th>
<th>Student B</th>
<th>Student C</th>
<th>Student D</th>
</tr>
</thead>
<tbody>
<tr>
<td>EEC</td>
<td>23 (4,2%)</td>
<td>41 (7,4%)</td>
<td>21 (3,8%)</td>
<td>14 (2,5%)</td>
</tr>
<tr>
<td>EOC</td>
<td>250 (45,2%)</td>
<td>234 (42,4%)</td>
<td>261 (47,2%)</td>
<td>271 (49%)</td>
</tr>
<tr>
<td>EEC+EOC</td>
<td>138 (24,9%)</td>
<td>127 (22,9%)</td>
<td>121 (21,8%)</td>
<td>114 (20,7%)</td>
</tr>
<tr>
<td>ADVO</td>
<td>21 (3,8 %)</td>
<td>9 (1,6%)</td>
<td>2 (0,4%)</td>
<td>9 (1,6%)</td>
</tr>
<tr>
<td>ADVI</td>
<td>14 (2,5%)</td>
<td>4 (0,7%)</td>
<td>2 (0,4%)</td>
<td>5 (1%)</td>
</tr>
<tr>
<td>O</td>
<td>3 (0,5%)</td>
<td>6 (1,1%)</td>
<td>9 (1,6%)</td>
<td>12 (2%)</td>
</tr>
<tr>
<td>N/A</td>
<td>104 (18,9%)</td>
<td>132 (23,9%)</td>
<td>137 (24,8%)</td>
<td>128 (23,2%)</td>
</tr>
</tbody>
</table>

Note: EEC: Examiner (externally determined criteria), EOC: Examiner (own criteria), ADVO: Advocate, ADVI: Adviser, O: Other, N/A: Not answered.

The results recorded in Table 3 show that the dominant positioning adopted by the teachers of the sample in their discourse of assessment is that of an examiner using his/her own criteria and, in some cases, in addition, that of an examiner using externally determined criteria of assessment. The fact that this picture remains stable across the four cases underlines the prevalence of this type of positioning. This indicates that these teachers tended to ignore, reject or resist to official discourses (e.g., evaluation discourse, professional discourse, academic discourse), resorting to
their own professional values or even to common sense notions concerning assessment (see also examples below).

Some examples, which exemplify the two main position categories are as follows: (a) Teacher-assessor as an examiner, using his/her own criteria: “this student thinks like an adult, in a mature and carefully way”, “I think that this child has understood better the way of solving a problem...It might be that my opinion is wrong, because the child solved the problem in the way I would solve it”, “for me personally, his answer is satisfactory”, “he either does not externalize his thought or he is very secure”.

(b) Teacher-assessor as an examiner, using external criteria: “each problem requires not only lining up of the mathematical operations, but also the formulation of the answers”, “In mathematics, only accurate answers are acceptable”, “Each problem requires a specific answer expressed in certain units”.

CONCLUDING REMARKS

The preceding analysis allows for a number of points concerning the participating teachers’ assessment practices of pupils’ written productions to be raised. To start with, these teachers could easily identify what was ‘correct’ in the four students’ answers, but found it difficult to differentiate between them (hence the high grading). This might be due to the fact that these answers are similar with respect to the correctness of the solution and the performance of the operations. However, they differ in relation to the number of operations carried out (student C) and the content of their verbal component and / or the familiarity of the teachers with it. In particular, with reference to the latter, student’s A linguistic part of the response adds nothing to its value, but is often seen in Greek students’ work and is not discouraged by teachers; in students’ B and C answers, the solution is simply spelt out, also a common practice in Greek mathematics classrooms, whereas there is no verbal part in student’s D response. This might also explain the moderate diffusion noticed for students’ B, C and D answers in the first two tables above, agreeing with Morgan and Watson (2002), who argue that “when a student text diverges from the usual to the extent that it is not covered by the established common expectations, each teacher must resort to his or her personal resources, thus creating the possibility of divergence in the narratives they compose”.

With respect to the resources utilized and the positions adopted, the above analysis reveals that these teachers tended to draw on a rather limited variety of resources, more or less the same for all four cases, mainly from an unofficial, personally constructed discourse. This is compatible with the positions they adopted within this discourse. Both these resources and positionings underpin performance oriented assessment practices which predominately value procedural than relational aspects of mathematics and lead to similar evaluations of students’ texts. An explanation of this could be sought in these teachers’ limited mathematics education, which makes problematic their access to official discourses related to it. This is reinforced by an educational system, still very centralised and conservative, which offers very limited
opportunities for genuine in-service training, innovative initiatives and experimentation. Primary mathematics teaching is almost solely based on textbooks distributed to every single student of the country free of charge by the Ministry of Education. Thus, the teachers of the sample, being educated and functioning within a downgraded educational environment, with a conservative mathematics education policy in force, were gradually led to develop and consolidate discourses which were compatible to this retrogressive reality and personal in character.

The above findings underline the importance of this particular way of looking at teachers’ functioning as assessors and points out to the need for further research in this direction, which will permit the identification of the resources teachers draw on and the various ways they are positioned in the relevant discourse when judging students’ work in various context.

REFERENCES