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VALIDITY OF ASSESSMENTS IN MATHEMATICAL TEXTBOOKS: A STUDY OF BEGINNING OF PRIMARY SCHOOL LEVEL TEXTBOOK ASSESSMENTS

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This paper proposes an analysis of how mathematical textbooks address the question of assessment and how formal assessment is prescribed to teachers, using a didactical framework. The prescribed teaching in textbooks can be considered as one step of the didactical transposition and the analysis of the mathematical content of assessments enables us to better understand teaching practices and to better interpret students' performance. The present analysis is based on didactical criteria of validity and on a methodology for studying textbooks. A comparison of ten Grade 1 (beginning of primary school) textbooks on the mathematical domain of numbers, reveals significant differences between collections in terms of the specified rhythm and administration of formal assessments, types and complexity of tasks, indications for grading and interpreting students' answers, etc. However, most share one common feature: the description they provide for teachers and the content of their assessments are not adequate to ensure their validity and teachers therefore need to take initiatives of their own to adapt these assessments if they wish to use them effectively.

INTRODUCTION AND CONTEXT

In France, as in many other countries, primary school teachers are encouraged to develop assessments of learning in their classes, and they are free to design these assessments themselves. It is interesting to examine what kind of tools are proposed to teachers to help them in this task. Examples of general assessment tasks are made available by the French Ministry of Education, but the specific focus of this paper is assessments set out in mathematical textbooks. Indeed, textbooks and teacher manuals are widely used among teachers, thus these resources likely influence their assessment practices. There are many mathematical textbooks available to teachers in France (Mounier and Priolet (2015) found more than one hundred titles in collections for primary schools alone).

This paper focuses on formal assessments, although an overview of how other assessments are treated in textbooks is presented herein. A recent study (Sayac, 2018) of teacher assessment practices indicates that, while formal paper-and-pencil assessment tasks proposed by teachers at primary school take various forms, they are low-level in complexity and some are even redundant. This same phenomenon has previously been demonstrated for national large-scale assessment content for end of primary school assessments in France (Grapin, 2015). It is therefore interesting to further investigate whether the same low-level complexity can be observed in any of the prescribed content of assessments in primary school textbooks.

In reference to the steps of the process of didactic transposition (Chevallard 1991, Bosch & Gascon, 2006), Kang & Kilpatrick (1992) state that “the mathematical textbook is an essential reference along

the route of didactic transpositions in school mathematics”. In this epistemological model, analyzing mathematical assessments in textbooks can enable us to better understand teaching practices (knowledge taught) and to better interpret students’ performance in external assessments (knowledge learned). Using a didactic model for designing tasks, we can explore both what kinds of assessment supports are *available* to teachers in textbooks, and better identify what kinds of resources or training programs they *need*, to help them in the design and implementation of assessments for both summative and formative evaluations.

First of all, it is necessary to specify the focus of the present study on assessments in mathematical textbooks and to define the study design. As set out above, the focus herein is on formal assessments, mainly completed in France at the end of teaching modules in a paper-and-pencil format. This paper first explores what is prescribed in textbooks for this kind of assessment: types of tasks, administration, grading, feedback, etc. Before outlining the approach and methodology employed, it is important to note that results pertain to grade 1 assessments (beginning of primary school in France) for a specific mathematical domain: whole numbers, which also incorporates calculation and arithmetic problem solving. This choice was made because learning numbers (writing and reading numbers, solving problems and calculating) plays an important role at this educational level and teachers must therefore regularly assess these skills in order to regulate their teaching.

DIDACTICAL APPROACH FOR STUDYING ASSESSMENTS IN TEXTBOOKS

Didactical framework and methodology for studying validity

Teacher assessment practices can be characterized according to both assessment processes (validity of tasks, aims of the assessment, administration of the assessment) and by assessment logic, enabling human factors to be taken into account (Sayac 2018). As the present research is centered on textbooks and not directly on practices, the focus herein is on assessment processes, especially validity.

Validity is an important subject of educational debate and it has been studied in many papers about educational testing. This concept is also central to any assessment: in a general sense, a test is valid if it assesses what it is intended to assess, and only that. To study the validity of external assessments, an anthropological approach (Chevallard 1991) was used to develop a methodology (Gravin 2015), defining an epistemological model of reference (Bosch & Gascon 2006) for the mathematical domain of whole numbers as taught at the beginning of primary school. Such reference enables us to study each step of the process of the didactic transposition, and for the purpose of this study, enables us to provide guarantees of the validity of the assessment content. This paper structures the domain of numbers into several mathematical organizations (local, regional and global) and describes types of tasks in terms of techniques and technology (“technique” is the official word for ‘way of doing’; by “technology”, Chevallard (1991) refers to the discourse used to explain and justify techniques (Bosch & Gascon 2006)).

Validity is studied on two levels: first, question by question, with an *a priori* analysis of each assessment task. For this, each is described regarding type of task, techniques required to solve it (both possible techniques and attempted techniques), technologies, complexity of tasks and several didactic variables, which are specific to the type of task at hand. Then, on a global level, all assessment tasks on the subject are analyzed: whether all the types of tasks are represented (is anything not covered? Is anything redundant?), whether the level of complexity varies (are all tasks low- or high-level

complexity?), and whether there is progression in terms of techniques and technologies. Regarding internal assessment, the link between mathematical organizations covered during the learning module (discovery learning exercises, institutionalization, application and synthesis exercises) and those assessed at the end of the module are analyzed.

The study of validity is not limited to the study of mathematical organizations; it also includes analysis of the administration of assessments according to didactical organizations, as well as anything involved in the grading and interpretation of students' answers. Indeed, this study observes what is prescribed to support students' learning: providing appropriate feedback about students' responses or implementing differentiation, for example.

Methodology for analyzing textbooks

The methodology used for this research is based on previous research on textbooks conducted by the present author (Grapin & Mounier 2018). To investigate how textbook authors have designed assessments, in a first step and on a global level, the introductions of teacher's guides are studied and how authors perceive the notion of assessment is explored: for example, is there a general discourse about assessments? What do assessments contain? When and how should assessments be administered? Is any guidance or are any specific tools provided for teachers? etc.

In a second step, assessments prescribed in the mathematical domain of whole numbers were analyzed, with this paper focusing solely on formal assessments. The validity of tasks was studied on both local and global levels, as set out above, according to mathematical and didactical organizations prescribed at specified stages of the teaching process. At the end of this step, each textbook, along with its specificities, could be described, and they could be compared on several criteria: the rhythm of formal assessments throughout the school year, the distribution of types of tasks across assessments, and the extent to which the mathematical domain is covered, the complexity of tasks, the instructions for teachers for using these formal assessments in formative ways, etc.

RESULTS

Ten Grade 1 mathematical textbooks and their teacher's guide were analyzed. During our presentation, general results will be first presented, then developed and illustrated using examples of assessment tasks and comparative tables. First of all, we can observe that most textbooks offer formal assessment in paper-and-pencil format, but the organization and rhythm thereof are very different from one textbook to another. This of course depends on the general organization of the textbook, but the number of tests recommended can vary from five per year (one per period) to fourteen (one at the end of each learning module). The number of tasks per assessment is thus very different from one test to another and can vary from four to more than fifty tasks (if we consider tasks and not exercises).

A significant difference between collections regarding types of tasks prescribed was revealed: in a first textbook, the authors explain that the assessment of mental calculation is for teachers to carry out independently and thus no such tasks are set out in their assessment. In a second textbook, no assessment tasks were found pertaining to writing or reading numbers (for example, "write forty-four" or "read 45") whereas these skills are regularly taught. In a third textbook, all assessments begin with five questions which pupils have to answer orally. Where textbooks do provide assessment tasks for each theme, the distribution of types of task per theme differs widely, some focusing more on

calculation while others offer more tasks on numbers. Even if concrete materials for numeration are often used during the learning module, only two textbook collections prescribe individual student assessments using such materials.

Nine of the ten textbooks studied do not give any instructions for teachers on how to interpret the answers given by students; there is no instruction regarding techniques (ways of doing) for answering, types of errors nor types of feedback teachers should provide in order to help their students to progress.

DISCUSSION AND CONCLUSION

Resources for formally assessing pupils in mathematical textbooks (which include tasks, indications for administration, interpretation of results, feedback, etc.) vary from one collection to another, but, in all cases, there are gaps which require the teacher to use their initiative in order to overcome these. These gaps are both numerous and varied: for example, many types of tasks may not be assessed (sometimes authors indicate this fact, but often they do not), there may be no instructions for interpreting students' answers, for grading or for providing feedback (the aims of the assessment tasks may not be clearly described, or techniques for providing the answer not clearly explained...). So, teachers need solid mathematical and pedagogical knowledge in order to be able to critically evaluate and implement what is proposed in textbooks, identifying and addressing the various gaps therein.

Mathematical textbooks cannot fulfil the role of a trainer for enhancing and strengthening teachers' assessment skills. Although other resources are available for French teachers, especially those created by the Ministry of Education or on the internet, we can nevertheless conclude that, in order to support teachers in the design of valid assessments to be used in a formative way in their own classes, more training should be proposed and more assessment support materials should be developed, such as valid assessment tasks specifying criteria for grading, including techniques and feedback, and specific tools for keeping track of the progress and needs of each student.

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