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A CROSS-CULTURAL ANALYSIS OF THE VOICE OF CURRICULUM MATERIALS

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Abstract

This paper presents a cross-cultural analysis of how authors of elementary mathematics curriculum programs communicate with teachers and what they communicate about, focusing on teacher's guides for six programs from three distinct school systems, U.S., Flanders and Sweden. Findings revealed distinct differences between approaches common to each cultural context that relate to different educational traditions. These findings point to differing assumptions about the knowledge needed by teachers to enact instruction. Further research is needed to explore these patterns qualitatively and consider teachers' use of these materials when planning and enacting instruction.

INTRODUCTION

Mathematics curriculum programs are used by elementary teachers around the world¹. They are commonly viewed as a primary tool for teachers' instructional design and as "the links between the ideas presented in the intended curriculum and the very different world of the classroom" (Valverde et al., 2002, p. 55). Designed for use by teachers, these materials represent assumptions about what mathematics instruction should look like and how teachers might be supported to enact instructional designs. As such, they stand as cultural artifacts (Pepin, Gueudet, Trouche, 2013). Because of their consistent use across school systems, cross-cultural analyses of curriculum materials can provide insight into differences in opportunities to learn within and across cultural contexts.

This paper presents a cross-cultural analysis of curriculum materials, focusing on the teacher's guide, in three distinct school systems: the United States; Flanders, the Dutch speaking part of Belgium; and Sweden. The focus of our analysis was on the *voice* of the text, defined as the ways curriculum program authors communicate with teachers and what they communicate about (Remillard, 2005, 2012). Our analysis focused on what different approaches to communicating with teachers revealed about: a) how the teacher's guide support teachers; b) assumptions about what teachers need to know to enact instruction; and c) differences in cultural traditions and educational practices. We also wondered about patterns that cut across cultural boundaries and their implications for future research.

BACKGROUND AND FRAMEWORK

Our analysis rests on an adaptive view of curriculum material use, which holds that teachers actively interpret and construct curriculum in the classroom with their students (c.f. Ben-Peretz, 1990; Remillard, 2005). This perspective raises questions about the type of guidance curriculum programs might provide. Ball and Cohen (1996) argue that, rather than simply scripting instruction, curriculum programs "could contribute to professional practices if they were created with closer attention to processes of *curriculum enactment*" (p. 7). Building on this idea, Davis and Kajcik (2005) propose that curriculum programs designed to be *educative* for teachers in this way might

¹ We use 'curriculum programs' to refer to the whole package of materials that authors design to guide and support classroom instruction. This package can consist of student textbooks, a teacher's guide and additional materials. This study focuses mainly on the teacher's guide. We also use the term "curriculum material" to refer to curriculum resources more generally.

help teachers a) attend to student thinking, b) engage the content and make connections within the discipline, c) understand designers' rationale for pedagogical choices, and d) mobilize curricular materials within a specific classroom context.

METHODS

We analysed a sample of lessons from teacher's guides from six curriculum programs, two distinct programs selected from each cultural context. In order to examine how the authors communicate with the teacher, we coded each unit (sentence, phrase, figure and icon) in a sample of 72 lesson, using a coding scheme designed to study how mathematics teacher's guides support teachers (Remillard, 2013; Van Steenbrugge & Bergqvist, 2014). The 72 lessons (24 from each country) were randomly drawn from the strands on numbers, operations and fractions and were evenly distributed among grades 3, 4, and 5 and the two programs for each country.

Table 1 lists the six curriculum programs that are included in the study. Descriptive details and relevant development information are provided in the findings section.

Table 1: Curriculum Programs Analysed

Abbreviation	Country	Curriculum Title	Current Publisher
EM	U.S.	Everyday Mathematics	Wright Group/ McGraw-Hil
MiF	U.S.	Math in Focus	Houghton Mifflin Harcourt
NT	Belgium	Nieuwe Tal-rijk	Plantyn
KP	Belgium	Kompas	die Keure
MD	Sweden	Matte Direkt	Sanoma Utbildning
ME	Sweden	Matte Eldorado	Natur & Kultur

Table 2 provides a brief overview of the coding scheme, adopted from the ICUBiT study in the U.S. and based on Davis and Krajcik's (2005) design principles (Remillard, 2013). Codes 2-4 are viewed as potentially educative. Using Atlas ti, we applied codes to units in the teacher's guides to indicate the focus of the message to the teacher. With the exception of code 0, we allowed for multiple codes to be applied to a sentence (hybrids). For example, some sentences direct teacher action and provide educative support. Code D was defined as a secondary code and could not be applied independently.

In addition, we used structural codes to indicate where in the lesson each sentence was: Introductory and orienting material, main body of the lesson, and beyond the main body of the lesson. Introductory material is intended to orient the teacher to the lesson's goals, objectives, materials, vocabulary, activities, practice problems, homework, and assessment resources. The main body of the lesson is material intended for the primary focus of the lesson. It includes guidance for the lesson as well as teaching notes associated with this guidance. We coded material as beyond the

main body of the lesson if it was material teachers had the option to use or omit to customize or extend the lesson. Use or omission of this material did not significantly alter the main objectives of the lesson. The intent of the structural codes was to provide a mechanism for sorting between guidance designed to support the primary instructional activities of the lesson, guidance intended to provide orienting information, and guidance that was not core to the lesson.

Table 2: Overview of Coding Scheme

Code	Short Title	Abbreviated Description
0	Providing Referential Information	Information about the lesson without simultaneously accomplishing aims specified in other categories
1	Directing Actions	Indicates what teachers and students should do or say during or in preparation for lesson
2	Design Transparency	Communicates author's intent behind design decisions
3	Anticipating Student Thinking	Indicates intended student understanding or likely misconceptions and how to respond
4	Explaining Mathematical Ideas	Describes key mathematical concepts, relationships, definitions, or properties or their importance
D	Decision Making	Indicates that teacher should make a decision

Results of coding analysis were compiled and are presented in Table 3. Within and across country comparisons are discussed in the following four sections.

Table 3: Variations in Types of Guidance for Teachers across Six Curriculum Programs
Percent of total number of units devoted to...

	Mean units per lesson	Referential Information	Directing Action only	Tot. Directing action ^a	Design Transparency ^b	Student Thinking ^b	Explaining Math Ideas ^b	Tot. Educative Support ^{c, d}	Decision Making
EM (US)	180	28	27	42	23	19	15	45	5
MiF(US)	109	22	27	55	21	28	21	52	5
NT (FI)	97	26	35	52	19	18	14	39	4
KP (FI)	121	16	43	66	18	19	18	41	17
MD (Sw)	21	10	36	51	38	11	11	54	15
ME (Sw)	32	15	18	42	29	32	23	68	20

Note. ^a Total percent of units coded as directing action, including those also coded as containing educative support; ^b Educative supports; ^c Total percent of units coded as educative supports, excluding multiple codes (e.g., if a unit was coded as a 3/4 hybrid, it was only counted once).

HOW THE U.S. CURRICULA COMMUNICATE WITH TEACHERS

The two U.S. curriculum programs, *Everyday Mathematics (EM)* and *Math in Focus (MiF)*, represent two different instructional traditions. At the same time, they share structural and visual design features that are common to many elementary programs in the U.S..

Development and Program Philosophy

EM was one of several programs developed with funding from the National Science Foundation to reflect the vision presented in the NCTM *Standards*. The aim is to build conceptual understanding by gradually building on students' informal knowledge. It introduces a number of unique visual representations and developmental algorithms to support this process. The curriculum promotes student generation of ideas and encourages students the use and articulation of multiple strategies and solution paths.

MiF was adapted from one of the primary mathematics programs developed and used in Singapore. The original program was developed by Marshall Cavendish International in collaboration with the Singapore Ministry of Education. The curriculum was then adapted for the U.S. market by a U.S. publishing company. *MiF* also emphasizes conceptual understanding, but takes a more directive pedagogical approach, directing the teacher to introduce key mathematical ideas to the students directly through visual representations characteristic of the Singapore curriculum and teacher directed instruction.

Similarities in Structure

Both programs are representative of many in the U.S. in sheer quantity of material provided. The teacher's guide is the main component of an extensive package of resources, which includes print and electronic material for assessment, enrichment, or additional practice. Both guides are sectioned into topic-specific chapters. Each lesson, which lays out 1-2 days of instruction, includes considerable detail. The mean number of sentences per lesson is among the highest in our sample (*EM*=180; *MiF*=109). Lessons begin with an introductory section, which accounts for 14% (*EM*) and 6% (*MiF*) of the sentences, and include a number of optional items (*EM*=13%; *MiF*=9%). Throughout the main body of the lesson, both programs guide the teacher in setting up and facilitating the activities of the lesson. Both programs include supplemental notes about math concepts or student errors, for example, in boxes or in the margins, but *EM* does so more extensively.

Differences in how the Programs Guide the Teacher

When it comes to communicating with and guiding the teacher, the two curricula are comparable in the proportion of sentences written to direct teacher actions (27%). A notable difference between the two curricula is evident when examining the use of two types of educative features, particularly features designed to communicate about mathematics concepts and student thinking. Proportionally, *MiF* devotes about 50% more attention to communicating with the teacher about student thinking

and mathematics concepts. These differences can be accounted for when examining the proportion of directing-action sentences also coded as hybrids ($EM=42\%$; $MiF=55\%$). In addition to communicating to the teacher what to do or say, these sentences communicate details about the design of the curriculum, student thinking, or the mathematics. In other words, MiF is more likely to intertwine guidance that directs teachers' instructional actions with educative messages.

HOW THE FLANDERS CURRICULA COMMUNICATE WITH TEACHERS

Both *Nieuwe Tal-rijk (NT)* and *Kompas (KP)* are frequently used in Flanders and are representative for the spectrum of curriculum programs. They share several common features and at the same time contain some distinct features.

Development and Program Philosophy

Both NT and KP were developed in response of the launch of the Attainment targets in 1998, which specify goals to be met at the end of 6th grade, but not how to reach these goals during elementary school. Schools are assured by the authors of NT and KP that, if they carefully follow the program throughout the six grades, they will meet the attainment targets.

In line with the philosophy of the attainment targets, both NT and KP stress the importance of conceptual understanding, realistic contexts, and communication. They differ in their specific approach toward communication. Throughout the lessons, KP recurrently stresses the importance of correct use of mathematical language. NT promotes discussion of mathematical ideas and strategies through student collaboration.

Structure

Both programs consist of student texts and a teacher's guide. The teacher's guide includes lesson plans and print material for assessment and differentiation. KP also includes electronic material for additional practice. Lessons in both guides are grouped in units that address several domains. Each unit in NT and KP always addresses the domains of number, calculations, measurement, and geometry. Units in KP also include the problem solving domain.

Lessons in NT and KP contain considerable detail; they have a rather high mean number of sentences per lesson ($NT=97$; $KP=121$). Besides the main body of the lesson, which contains the detailed guidance for enacting the lesson ($NT=71\%$; $KP=93\%$), both programs also include an introductory section ($NT=23\%$; $KP=7\%$). Lessons in NT contain a number of optional items (7%). Whereas the main body of the lesson in KP has a fixed structured for all lessons, the structure of the main body of lessons in NT varies.

Differences in how the Programs Guide the Teacher

Both NT and KP contain a high proportion of directive guidelines. Whereas the proportion of directive guidelines in NT and KP is among the highest in our sample ($NT=52\%$; $KP=66\%$), the proportion of educative guidelines is among the lowest ($NT=39\%$; $KP=41\%$). Both programs contain among the highest proportion in our sample of guidelines that are merely directive, containing no educative supports ($NT=35\%$; $KP=43\%$). Compared to NT , KP is more directive, both in number of sentences that are merely directive and in the sentences that intertwine directive and

educative guidance. *KP* also includes a higher proportion of instances that indicate that the teacher should make a decision (*NT*=4%; *KP*=17%).

HOW THE SWEDISH CURRICULA COMMUNICATE WITH TEACHERS

Development and Program Philosophy

Matte Direkt (MD) is a traditional curriculum program (in the Swedish system), with a new issue adapted for the new national curriculum in 2011. In *MD*, students work alone or in pairs for most of the lesson. The role of the teacher is to introduce the lesson and get the students working. The goals of the lesson are presented in a box on the first page for each chapter in the teacher's guide and in the student textbook.

Matte Eldorado (ME) is a new curriculum program that builds directly on the 2011 national curriculum. The teacher's guide starts with a 30-page introduction, including what it means to teach mathematics and where each goal from the national curriculum is addressed in the program. Each chapter begins with two pages that contain the unit goals, the authors' interpretation of the goals, the pre-knowledge the students should have, and a discussion of how each goal is met in the chapter.

Similarities in Structure

The two Swedish curriculum programs share several common traits even if they differ in some important aspects. Both programs give information on each page in the student textbook, and both have a system for differentiating instruction using optional tracks. Both programs also present goals in the beginning of each chapter, although in rather different ways. Compared to the programs from the other countries in this study, the two Swedish teacher's guides are very short, on average 21 (*MD*) and 32 (*ME*) units per lesson.

Differences in how the Programs Guide the Teacher

MD has a much higher proportion of units (sentences or images) that direct teachers' actions, whereas *ME* devotes more communication to the mathematical content and student thinking. Of all six programs in our analysis, *ME* had the smallest percentage of units coded as merely *directing action*. *ME* also had the highest proportion of units coded as educative support and the highest proportion of units indicating the teacher should make a decision.

Both programs contain a high proportion of sentences that communicate design transparency, where the teacher is told what the students are supposed to do and learn (*MD* more than *ME*). A distinct feature of *ME* is that it asks the teacher questions concerning the students' work (e.g., "Are the students' own expressions correct and on what level of difficulty are they?") These questions are clearly rhetorical and used in a supportive way to raise the teachers' awareness of certain aspects of student learning.

DISCUSSION AND CONCLUSION

Our cross-cultural analysis has revealed a number of differences, both across as within the cultural contexts. They also point to fruitful areas for future research.

One difference is the amount of guidance offered in the lessons of the teacher's guide. In contrast to lessons in the U.S. or Flanders teacher's guides, lessons in the Swedish guides contain rather limited detail. For instance, *EM (US)* contains nearly 9 times as many units per lesson than *MD (Sw)*. Another difference relates to the balance between directive and educative guidance. The Flanders lessons are much more directive than educative. The US lessons and *MD (Sw)* are quite balanced, and lessons in *ME (Sw)* are more educative than directive. These differences may reflect and relate to differences in educational traditions. In Swedish elementary math education, student texts have a central position. The teacher's role is to facilitate the student-text interaction. The teacher's guide indicates what the teacher might look for and expect. In Flanders and the U.S., teachers play a directive role, leading instruction. The teacher's guides, in turn, offer directive guidance for this role. In the U.S., there is also strong commitment to student-student collaboration and some of the educative features in U.S. guides may be aimed supporting this less directive role. It is worth noting that the dominant instructional mode in each culture is reflected in the mode by which text authors communicate with teachers.

These observations raise a number of questions about assumptions about the knowledge teachers need to enact instruction. Might it be that the Swedish curriculum authors assume teachers know how to engage students with the content, whereas the U.S. and Flanders curriculum authors assume teachers need more prescription? What does it mean when a teacher's guide contains little support in anticipating student thinking or in communicating mathematical ideas? Do curriculum authors assume that teachers do not need that kind of information in order to craft instruction? Do they assume that teachers master this kind of knowledge and, thus, don't need that additional information?

It is interesting to notice that, although the proportion of indications to make a decision differs across the curriculum programs, excepts for *KP (Fl)*, the number of decisions to be made per lesson is quite equal (an average between 3 and 8 decisions per lessons). Deeper analysis is needed on how the curriculum programs indicate that the teacher should make a decision. A combination of educative guidelines with indications to make decisions could indicate that these educative guidelines are considered as a support for decision making.

Another interesting issue to analyse more deeply is the difference in guidance that is merely directive and guidance that combines directive guidance with educative guidance. Regardless of how directive or educative the programs are, the difference in proportion between both is rather large (between 15–29%). This hybrid approach appears to assume that teachers benefit from directive guidance when it is accompanied by educative explanations.

This cross-cultural analysis has pointed out within and cross-cultural differences that appear to reflect educational contexts and values in each culture. Further research might explore these differences more qualitatively and consider differences in how teachers use the guidance their curriculum guides provide.

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