

MATHEMATICS LEARNING DIFFICULTIES

AN ANALYSIS OF PRIMARY TEACHERS' PERCEPTIONS

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In this contribution, we report findings on a questionnaire used to measure mathematics learning difficulties in primary education. This study especially centres on the commercially available learning packages (CALP: manuals and exercise books used in classroom) that have been implemented in primary education, since there is no research evidence available as to the efficacy and efficiency of these CALPs (manuals and exercise books used in classroom) in the Flemish context. A large and representative opportunity sample of 734 teachers from 190 primary schools participated in the study.

OBJECTIVES

This study is situated within the field of learning problems in primary education. According to Dumont (1994) two types of problems can be distinguished: a *learning disability* is situated in the child's own cognitive development whereas the cause of a *learning difficulty* is situated outside the child or in another problem in the child.

Although the prevalence of reading problems on the one hand and mathematics learning problems on the other hand seems to be equal (Desoete, Roeyers, & De Clercq, 2004; Dowker, 2005; Ruijsenaars, van Luit, & van Lieshout, 2006), the amount of research in both fields does not reflect this finding (Ginsburg, 1997; Mazzocco & Myers, 2003). Far more research is conducted in the field of reading, while the field of mathematics remains underexposed. Therefore, this study tries to tackle this shortcoming and focuses on mathematics learning difficulties.

Taken into account that interventions should take place at an early stage (Dowker, 2004, Kroesbergen & Van Luit, 2003; Van Luit & Schopman, 2000), we focus on primary education. Moreover, since schools and teachers – in the Flemish (Belgian) context – receive a high level of autonomy (Standaert, 2001) and teachers are seen as the most important actor in educational contexts (Gravemeijer et al., 1993; Jitendra et al., 2005; Sood & Jitendra, 2007), we specifically focus on mathematics teachers. More precisely, the study focuses on instructional and didactical processes as an exogenous variable that might explain the emergence of children's learning difficulties in mathematics.

The central problem statement in our research project is to analyze the relationship between *a*) didactics of mathematics, *b*) mathematics performance results, and *c*) mathematics learning difficulties. With regard to didactics of mathematics, a distinction is made between a teacher's performance in the classroom and the CALP

used in classroom. Considering the performance of teachers, different studies point at the importance of teacher beliefs or related concepts like perceptions (Askew, Brown, Rhodes, Wiliam, & Johnson, 1997; Carnine & Jitendra, 1997, Beijaard, Meijer, & Verloop, 2004; Richardson, Andres, Tidwell, & Lloyd, 1991; Staub & Stern, 2002). As such, in this paper, we focus on the perceptions of primary school teachers concerning mathematics learning difficulties.

THEORETICAL FRAMEWORK: MATHEMATICS LEARNING DIFFICULTIES – TEACHER’S PERCEPTIONS

Mathematics learning difficulties

As pointed out above, a learning disability is situated in the child’s own cognitive development whereas the cause of a learning difficulty is situated outside the child or in another problem in the child (for example: bad sight). The former is often referred to as a primary cause while the latter is referred to as a secondary cause. In this study, we focus on the secondary causes and more specifically on the instructional and didactical processes. Or as cited by Carnine & Jitendra (1997, p.3), “Individuals who exhibit learning difficulties may not be intellectually impaired; rather, their learning problems may be the result of an inadequate design of instruction in curricular materials”.

Whereas *disabilities* require an orthodidactic intervention *outside* the classroom, the approach to tackle *difficulties* should remain a didactical responsibility of those involved *inside* the classroom. The prevalence of mathematics learning disabilities is estimated at about 2-8% (Desoete, 2007a; 2008; Geary, 2004; Ruijssenaars et al., 2006; Stock, Desoete, & Roeyers, 2006). For those children – in the Flemish educational context – a two-year intervention program is available. In contrast to children with learning disabilities, no systematic evidence-based approaches have been developed yet for pupils with learning difficulties. The results of the present study present a concrete starting point to develop such specific interventions.

Teacher’s perceptions

Research stresses the importance of understanding teacher’s practices and the determinants of those practices and put this as a priority in view of future research (Artigue, see this volume; Chevallard, 1999; Margolinas, 2002;). According to McLeod (1992), research in mathematics education should be more extensively focussed on the integration of cognitive and affective factors and more attention should be paid to teacher affect in stead of to student affect.

Kept those recommendations in mind, in this study we will focus on teacher’s perceptions or teacher’s beliefs as part of the affective determinant of a teacher’s practice. Moreover, given the fact that “Experiences and reflection are two basic sources of influence that are considered to be important in the formation, development and change of beliefs” (Oliveira & Hannula, 2007, p.14) we especially

consider teacher's reflections and experiences with manuals and exercise books used in mathematics lessons.

Teacher's beliefs about the efficacy of their mathematics teaching are one of the less researched dimensions of the affective domain (Philippou & Christou, 2002). Nonetheless, the importance of teacher's beliefs is highlighted when formulating that a teacher's belief can be seen as a filter through which a teacher's knowledge is translated into practice (Swafford, 1995). Other research demonstrated a clear relationship between teacher's beliefs, instructional practices and student learning (Richardson, Andres, Tidwell, & Lloyd, 1991; Staub & Stern, 2002).

It is also found that the affective system isn't a spin-off of cognition anymore (e.g., Goldin, 2002; McLeod, 1992; Op't Eynde et. al, 2002). An illustration of this is given by Thompson (1992), who poses that when dealing with changing teacher's performance, one must consider what teachers know as well as what teachers believe. Research also indicates that the construct belief is of great importance for the understanding of mathematics teaching and learning (e.g. Philipp, 2007).

Llinares (2002) formulates that "Knowledge and beliefs, as they affect participation and reification, can be seen to be essential aspects in the development of an identity as an elementary teacher." (p.206). Philipp (2007) holds the position that

A conception is a belief for an individual if he or she could respect a position that is in disagreement with the conception as reasonable and intelligent, and it is knowledge for that individual if he or she could not respect a disagreeing position with the conception as reasonable or intelligent (p.267)

According to many educators, the difference between knowledge and beliefs should not be the primary concern. Instead, what is important to them is how beliefs and knowledge influence teacher's experiences (e.g. Thompson, 1992).

Thompson (1992) describes four important topics when considering teacher's conceptions and mathematics:

Teacher's conceptions on the nature of mathematics

Teacher's conceptions of mathematics teaching and learning

The relationship between teacher's conceptions and their instructional practices

Changing teacher's conceptions.

Op't Eynde, De Corte and Verschaffel (2002) propose a framework of students' mathematics – related beliefs with three dimensions: object (mathematics education), self, and context (class). This model is based upon three propositions:

Student's beliefs are grounded in their social life and are fundamentally social,

Beliefs and knowledge operate in close relations, and

There are fundamental differences between the structure of belief and knowledge systems (belief system: quasi-logical structure; knowledge system: logical structure).

Based on their framework, Op't Eynde, De Corte and Verschaffel (2002) formulate a definition of students' mathematics – related beliefs:

“Students' mathematics – related beliefs are the implicitly or explicitly held subjective conceptions students hold to be true about mathematics education, about themselves as mathematicians, and about the mathematics class context. These beliefs determine in close interaction with each other and with students' prior knowledge their mathematical learning and problem solving in class” (p. 27).

Comparable to the description by Op't Eynde, De Corte & Verschaffel (2002) but focussed on teachers' beliefs instead of students' beliefs, McLeod (1992) differentiates between beliefs about mathematics, beliefs about the self, beliefs about mathematical teaching and beliefs about the social context.

Simons et. al (2000) described (metacognitive) ‘beliefs’ as the broader general ideas and theories people have about their own (and other people's) cognition. Lucangeli and her colleagues (1998) classified the beliefs within metacognitive knowledge, as support or hindrance and misconceptions or as a truly individual mathematical epistemology. They found that false convictions or beliefs, such as the belief that it takes only a few minutes to solve a word problem, could cause inappropriate skilfulness and be a hindrance to the solution itself (see also Schoenfeld, 1992; Desoete & Roeyers, 2006; Desoete, 2007b).

Ambrose, Clement, Philipp and Chauvot (2004) list four characteristics of beliefs which are identified in literature as accounting for the important role beliefs play in teaching and learning: beliefs influence perception, beliefs are predisposing one to a particular direction, beliefs are held with differing intensities, and beliefs are context specific. Also Hoyles (1992), Skott (2001), Sztajn (2003), and Philipp (2007) stress the important influence of the context on beliefs.

Three major areas of research on teacher's beliefs are beliefs about students' mathematical thinking, beliefs about the curriculum, and beliefs about technology (Philipp, 2007).

Regarding the conceptual understanding, research illustrates a variety in use of terms (e.g., Correa, Perry, Sims, Miller and Fang, 2008; Goldin, 2002; Hannula, 2007; Skip Wilson & Cooney, 2002; Thompson, 1992; Philipp, 2007;). According to Pajares (1992), the terms beliefs, values, attitudes, judgments, opinions, ideologies, perceptions, conceptions, conceptual systems, preconceptions, dispositions, implicit theories and perspectives have frequently been used almost interchangeably. Clandinin and Connelly (1987) suggest that most of the terms are different words with the same meaning and according to Bishop et al. (2003), there are more similarities than differences between the different terms researchers use.

In an attempt to indicate clearly what we mean with the term ‘perception’, we lean on the advices proposed by Furinghetti and Pekkonen (2002). Both authors propose that when dealing with beliefs and related terms, it is advisable:

- to consider objective knowledge and subjective knowledge as two types of knowledge
- to consider beliefs as belonging to subjective knowledge
- to consider affective and cognitive factors in the belief systems
- to consider degrees of stability
- to take care of the context and the research goal in which beliefs are considered

We situate perceptions under the subjective knowledge, as a part of the beliefs system where the cognitive factors are stressed. This is in accordance with the meaning Saari (1983) gives to *conception*: a conscious beliefs, a subgroup of beliefs where the affective component is stressed. A lot of attention is also paid to the context: in examining teacher’s perceptions, teachers are asked to clearly keep in mind the classroom they are teaching so that their perceptions are related to one classroom (a specific context).

METHODOLOGY

Semi-structured questionnaire

In Flanders – the Dutch speaking part of Belgium – educational authorities do only put forward a set of attainment goals that learners should attain at the end of the primary school. Schools are autonomous in the way they develop ways to attain these final goals (Desoete, Roeyers & De Clercq, 2004). They are therefore expected to develop a school curriculum and time table. But, schools mostly work together within umbrella organisations that are called “educational networks”, such as the Catholic Church, city councils, provincial authorities, ... These network organisations draw up a concrete curriculum and timetables. In the present study, we based the design of a questionnaire on these curricula. Considering the fact that three different curricula dominate Flemish primary education, the questionnaire builds upon these three dominant curricula.

Each questionnaire centres on the five mathematics sub-domains: knowledge of numbers, calculations, measuring, geometry and problem solving. In relation to each domain, items are presented to classroom teachers. Items ask to judge if *a)* ‘In general, students have difficulties to learn this’ and if *b)* ‘The way the CALP supports this learning goal, causes difficulties in learning’. Respondents could indicate on a 5-point Likert scale to what extent they agreed with the statement. By answering ‘1’, they totally not agreed with the statement, by answering ‘2’ they indicate that they did not agree with the statement. Answering ‘3’ is a more or less neutral answer. If they agreed with the statement, they answered ‘4’, and if they

totally agreed, they answered ‘5’. If they scored a ‘4’ or ‘5’, they were asked to document their answer with concrete problems they experienced in their classroom.

Respondents were also asked to specify the CALP used in their classroom, to indicate how rigidly they stuck to the CALP, what kind of didactical materials they used, and in what way they developed or acquired extra exercise materials.

A pilot version of the questionnaire was administered. Building on the comments of support staff of the educational networks and teachers, a final version of the questionnaire was developed.

Respondents

To attract a wide variety of teachers and schools in the present study, a specific sampling approach was adopted. The research project was announced via the media. Schools and teachers were contacted via a professional journal, the official electronic newsletter for teachers and principals distributed by the Department of Education, an Internet site, the official Learner Support Centres, the different educational networks and via labour unions. When respondents showed interest, they contacted the researcher for more information and were sent the specific questionnaires. This approach resulted in a large opportunity sample of 734 teachers from 190 schools, completing the questionnaire. As illustrated in Figure 1, this sample is representative for the population of primary school teachers in Flanders.

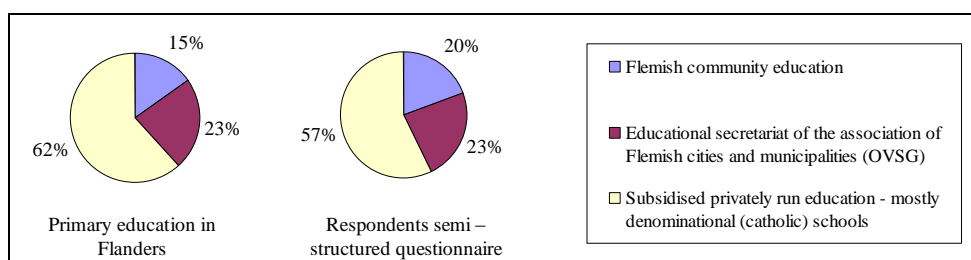


Figure 1. Population

Selected CALPs

The results indicate that five CALPs are dominantly used by primary school teachers: EB (*Eurobasis*), used by 26.9% of the teachers; ZG (*Zo gezegd, zo gerekend*), used by 26.2% of the teachers; KP (*Kompas*), used by 11.8% of the teachers; NT (*Nieuwe Tal-rijk*), used by 11.7% of the teachers; and PP (*Pluspunt*), used by 9.9% of the teachers. In the remainder of this text, we focus our analysis on the data of teachers using one of these five CALPs. KP is an adapted version of EB and at the moment questionnaires were administered, there was yet no version available of KP for the 4th, 5th and 6th grade.

Statistical analyses

Considering the exploratory nature of the study, statistical analysis is mainly based on descriptive and basic inferential statistics. SPSS was used to analyse differences in reported difficulties, related to a specific CALP.

DATA SOURCES

On the following two pages, we present some remarkable statistically significant differences. Table 1 presents differences concerning first and second grade teacher's opinions, Table 2 presents differences concerning third and fourth grade teacher's opinions, and Table 3 presents differences concerning fifth and sixth grade teacher's opinions. For each CALP used in this sample (KP, ZG, EB, NT, PP), the mean score (M) and SD on the 5-point Likert scale is calculated. By means of this 5-point Likert scale, respondents indicated to what extent they agreed with a statement (see above). If the statement 'In general, students have difficulties to learn this' is mentioned, an index ^A is placed next to the item in the left column of each table. If the statement 'The way the CALP supports this learning goal causes difficulties in learning' is mentioned, an index ^B is placed next to the item in the left column of each table (see Table 1, Table 2, Table 3).

Table 1. Differences concerning first and second grade teacher's opinions

Item	CALP used in classroom															F
	KP			ZG			EB			NT			PP			
	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	
Fractions ^B	2.83 ^a	1.0	6	2.73 ^a	1.0	5	2.59 ^a	1.0	2	2.21 ^a	.78	2	3.47	1.2	1	F(4,177)
	^b	8	0	^b	1	2	^b	5	7			4	^b	6	9	= 4.175*
To subtract ^A	3.14 ^a	1.0	6	2.90 ^a	1.0	5	3.19 ^a	.96	2	3.08 ^a	1.0	2	3.81	1.1	2	F(4,191)
	^b	5	4		0	8	^b		7	^b	9	6	^b	2	1	= 3.011
To multiply ^B	2.91 ^a	1.1	3	3.03 ^a	1.1	3	3.15 ^a	.93	2	2.24 ^a	1.3	1	3.77	1.2	1	F(4,113)
	^b	5	5	^b	6	3	^b		0		0	7	^b	4	3	= 3.462
Relation	2.22 ^a	.89	6	2.42 ^a	1.0	5	2.31 ^a	.84	2	2.36 ^a	.62	2	3.26	1.0	1	F(4,190)
between			5		5	7			6			8	^b	5	9	= 4.926*
operations ^B																
Length ^B	2.46 ^a	1.1	6	2.73 ^a	1.2	5	2.89 ^a	1.1	2	2.32 ^a	1.0	2	3.31	1.1	2	F(4,200)
		5	7	^b	0	6	^b	3	8		9	8	^b	6	6	= 3.464
Volume ^B	2.40 ^b	1.1	6	2.88 ^a	1.0	5	2.72 ^a	1.1	2	2.15 ^b	.99	2	3.33	1.1	2	F(4,203)
		0	7	^b	6	8	^b	0	9			7	^a	1	7	= 5.741*
Volume ^B	2.40 ^a	1.1	6	2.88 ^b	1.0	5	2.72 ^a	1.1	2	2.15 ^a	.99	2	3.33	1.1	2	F(4,203)
	^b	0	7		6	8	^b	0	9			7	^b	1	7	= 5.741*
Weight ^B	2.33 ^b	1.0	6	2.74 ^a	1.0	5	2.69 ^a	1.1	2	2.04 ^b	1.0	2	3.07	1.3	2	F(4,204)
		8	7	^b	9	8	^b	4	9		7	8	^a	6	7	= 4.098*
Money ^B	2.21 ^b	1.0	6	2.43 ^b	1.1	5	2.34 ^b	1.0	2	1.81 ^b	.80	2	3.19	1.3	2	F(4,201)
		6	6		6	8		1	9			6	^a	3	7	= 5.873*

Temperature <i>B</i>	2.16 ^a b	.96	4 9	2.72 ^b	1.1 3	4 6	2.17 ^a b	.70 4	2	1.85 ^a	.59	2 0	3.05 b	1.1 9	2 0	F(4,154) = 6.078*
Reference points / estimate ^B	2.54 ^a b	1.0 6	6 5	3.00 ^b	.97 4	5	3.00 ^a b	.96 7	2	2.21 ^a	.96	2 8	3.70 b	1.2 6	2 0	F(4,189) = 7.870*
Reference points / estimate ^B	2.54 ^b	1.0 6	6 5	3.00 ^a b	.97 4	5	3.00 ^a b	.96 7	2	2.21 ^b	.96	2 8	3.70 a	1.2 6	2 0	F(4,189) = 7.870*
To construct ^B	2.10 ^a	.99	6 8	2.25 ^a	1.2 3	5 1	2.35 ^a b	.94 6	2	2.04 ^a	.87	2 6	3.12 b	1.1 7	2 5	F(4,191) = 4.739*
Movement & direction ^B	1.88 ^a	.90	6 6	2.20 ^a	.95 5	5	2.21 ^a	.88 8	2	1.92 ^a	.80	2 6	3.20 b	1.4 1	2 5	F(4,195) = 8.831*

Note. Different indexes ^a, ^b, ^c refer to post hoc between-group differences with $p < .05$; * $p \leq .005$

An index ^A next to the items refers to the following question teachers had to judge ‘In general, students have difficulties to learn this’; an index ^B refers to the following question teachers had to judge ‘The way the CALP supports this learning goal, causes difficulties in learning’

Table 2. Differences concerning third and fourth grade teacher’s opinions

Item	CALP used in classroom															F
	EB			ZG			NT			PP			KP			
	M	SD	N	M	SD	N	M	SD	N	M	SD	N	M	SD	N	
Mathematics language ^A	2.47 ^a	.94	7 3	2.64 ^a b	.98	6 4	2.96 ^a b	1.3 7	2 5	3.35 ^b	1.0 4	2 0	2.75 ^a b	1.0 0	1 6	F(4,193)) = 3.385
Proportions ^B	3.17 ^a	.83	6 0	2.62 ^b	.95	5 0	2.50 ^a b	1.0 3	1 6	2.46 ^a b	.66 3	1 3	2.67 ^a b	.87	9	F(4,143)) = 4.087*
Volume ^A	3.00 ^a	.87	7 7	3.05 ^a b	1.0 5	6 4	2.44 ^a	1.0 0	2 5	3.35 ^b	1.0 9	2 0	2.94 ^a b	1.2 0	1 7	F(4,198)) = 2.611
Time ^B	2.95 ^a b	1.1 1	7 6	2.95 ^a b	1.1 1	6 3	2.40 ^a	1.3 2	2 5	3.00 ^a b	1.2 1	2 0	3.75 ^b	1.1 8	1 6	F(4,195)) = 3.352
Degree of angle ^A	2.22 ^a	.88	7 2	2.34 ^a	.87	5 8	2.61 ^a b	.84 3	2	3.05 ^b	.85	1 9	2.27 ^a b	.80 5	1	F(4,182)) = 3.983*
To construct ^A	2.26 ^a	.65	7 2	3.22 ^b	.97	6 3	2.75 ^a b	1.1 9	2 4	3.15 ^b	.81	2 0	2.47 ^a b	.92 5	1	F(4,189)) =

Problem solving 2 ^B	3.25 ^a	1.0	7	2.85 ^a	1.1	6	1.88 ^b	.73	2	3.20 ^a	.77	2	3.25 ^a	1.2	1	F(4,194) = 11.501*
		8	7		4	1			5			0		9	6	
Problem solving 5 ^A	3.53 ^a	.92	7	2.81 ^b	1.1	6	3.04 ^a	1.2	2	3.59 ^a	.80	1	3.93 ^a	.96	1	F(4,190) = 6.554*
			6		6	2	^b	1	5	^b		7			5	
Problem solving 5 ^B	3.08 ^a	1.0	7	2.44 ^b	1.2	6	2.20 ^b	1.0	2	3.18 ^a	.88	1	3.07 ^a	1.2	1	F(4,189) = 5.350*
		3	6		3	1		0	5	^b		7	^b	8	5	
Problem solving 7 ^B	3.08 ^a	1.0	7	2.57 ^a	1.2	5	2.29 ^b	.81	2	2.72 ^a	1.2	1	3.06 ^a	1.1	1	F(4,187) = 3.467
		3	6	^b	0	8			4	^b	3	8	^b	2	6	

Note. Different indexes ^a, ^b, ^c refer to post hoc between-group differences with $p < .05$; * $p \leq .005$

An index ^A next to the items refers to the following question teachers had to judge ‘In general, students have difficulties to learn this’; an index ^B refers to the following question teachers had to judge ‘The way the CALP supports this learning goal, causes difficulties in learning’

Table 3. Differences concerning fifth and sixth grade teacher’s opinions

Item	CALP used in classroom												F
	EB			ZG			NT			PP			
	M	SD	N	M	SD	N	M	SD	N	M	SD	N	
Percentage ^A	2.52 ^a	.90	8	2.80 ^a	.92	6	3.16 ^b	1.1	3	2.96 ^a	.95	2	F(3,206) = 4.131
			8	^b		6		1	2	^b		4	
Mathematics language ^B	2.21 ^a	.93	8	2.08 ^a	.99	6	1.78 ^a	.91	3	3.25 ^b	1.3	2	F(3,202) = 10.943*
			5			5			2		6	4	
To divide ^A	3.17 ^a	.79	8	2.86 ^a	.86	6	3.29 ^a	.94	3	3.50 ^b	.83	2	F(3,204) = 4.191
	^b		8			5	^b		1			4	
To divide ^B	2.68 ^a	1.0	8	2.36 ^a	1.0	6	2.87 ^a	1.2	3	3.21 ^b	1.1	2	F(3,202) = 3.920
	^b	8	7		7	4	^b	3	1		0	4	
To estimate ^A	3.51 ^a	.95	8	2.88 ^b	.94	6	3.00 ^a	1.0	3	3.00 ^a	1.0	2	F(3,204) = 6.200*
			8			5	^b	2	2	^b	4	3	
To solve long divisions ^A	3.30 ^a	1.1	8	2.75 ^b	.88	6	3.34 ^a	1.2	3	3.58 ^a	1.2	2	F(3,205) = 5.096*
		0	8			5	^b	3	2		5	4	
To solve calculations ^B	2.01 ^a	.99	8	2.03 ^a	1.0	6	2.16 ^a	1.0	3	3.13 ^b	1.3	2	F(3,201) = 7.570*
			6		2	4		7	1		3	4	
The concept	3.33 ^a	.93	8	3.13 ^a	.94	6	3.00 ^a	.77	3	3.74 ^b	.96	2	F(3,198) =

scale ^A	b	5	b	3		1		3	3.534
The concept scale ^B	2.45 ^a	1.0 8	2.50 ^a	1.0 6	2.52 ^a	1.1 3	3.22 ^b	1.1 2	F(3,196) = 3.354
Area ^A	3.33 ^a	1.0 8	2.76 ^b	.90 6	3.28 ^a	1.0 3	3.39 ^a	.89 2	F(3,202) = 6.317*
Area ^B	2.60 ^a	1.0 8	2.28 ^a	.98 6	2.19 ^a	.90 3	3.48 ^b	.95 2	F(3,200) = 9.469*
Volume ^A	3.33 ^a	1.0 6	2.63 ^b	.79 4	2.84 ^a	1.1 2	3.40 ^a	.88 2	F(3,153) = 5.692*
Volume ^B	2.76 ^a	1.2 6	2.17 ^b	.96 4	2.04 ^b	.84 2	3.20 ^a	1.0 2	F(3,151) = 6.926*
Time ^A	3.36 ^a	1.0 8	2.80 ^b	.89 6	2.88 ^a	1.0 3	3.13 ^a	.92 2	F(3,204) = 4.834*
Degree of angle ^A	3.16 ^a	1.0 8	2.62 ^b	.92 6	3.13 ^a	.92 3	2.91 ^a	1.0 2	F(3,204) = 4.067
Rapidity ^A	3.10 ^a	1.0 8	2.68 ^b	.89 6	2.84 ^a	.72 3	3.22 ^a	.95 2	F(3,204) = 3.347
3D orientation ^A	2.37 ^a	1.0 8	2.52 ^a	.92 6	3.38 ^b	1.1 3	2.48 ^a	1.0 2	F(3,200) = 7.782*
Problem solving 2 ^B	3.00 ^b	1.0 8	2.44 ^a	.91 6	2.63 ^a	.91 3	3.43 ^b	.95 2	F(3,198) = 7.588*
Problem solving 2 ^B	3.00 ^a	1.0 8	2.44 ^b	.91 6	2.63 ^b	.91 3	3.43 ^a	.95 2	F(3,198) = 7.588*
Problem solving 1 ^B	2.45 ^a	1.0 8	2.28 ^a	1.0 6	2.34 ^a	1.0 3	3.30 ^b	1.1 2	F(3,198) = 5.825*
Problem solving 3 ^B	2.45 ^a	1.0 8	2.31 ^a	.85 6	2.31 ^a	.90 3	3.05	1.0 2	F(3,196) = 3.454
Problem solving 6 ^A	3.19 ^a	1.0 8	2.88 ^a	.77 6	3.28 ^b	.63 3	2.74 ^a	.92 2	F(3,201) = 3.173

Note. Different indexes ^a, ^b, ^c refer to post hoc between-group differences with $p < .05$; * $p \leq .005$

An index ^A next to the items refers to the following question teachers had to judge ‘In general, students have difficulties to learn this’; an index ^B refers to the following question teachers had to judge ‘The way the CALP supports this learning goal, causes difficulties in learning’

RESULTS, CONCLUSIONS AND FUTURE DIRECTIONS IN RESEARCH

Table 1, Table 2, and Table 3 reveal that there are differences in teacher’s opinions depending on the CALP they are using. This is a striking observation. For example,

when looking how well fifth and sixth grade teachers agreed with the statement ‘The way the CALP supports this learning goal, causes difficulties to learn this’ for the item Area (see Table 3, Area^B), one can see that according to the perception of the fifth and sixth grade teachers using EB, ZG or NT as CALP, the way the CALP supports this learning goal *does not* causes difficulties in learning (mean ≤ 3). This is in contrast with the perception of teachers using PP as a CALP (mean >3) and this difference is statistically significant ($p \leq .005$).

Those three tables list all the items where the difference between teacher’s opinions using another CALP is statistically significant. One could also notice that there are more statistically significant differences between fifth and sixth grade teacher’s opinions as compared with first and second grade teachers on the one hand and with third and fourth grade teacher’s opinions on the other hand. The same pattern remains when studying the descriptive statistics: fifth and sixth grade teachers report more difficult items as compared with first and second grade teachers and as compared with third and fourth grade teachers.

We now compare the fifth and sixth grade teacher’s perceptions with a study about mathematics learning performance in primary education from 2002 (Ministry of the Flemish Community, Department of Education, 2002). In this earlier study, the actual mastery of the attainment goals – as stated by the Flemish government – was studied, involving 6069 sixth grade pupils from 200 schools. The availability of the mathematics performance results can be linked to the – by the teachers perceived – difficulties pupils have.

The 2002 study distinguishes four mathematics domains and fourteen sub-domains:

Numbers and making calculations:

- numerical values and equivalence
- proportions
- fractions and decimals
- calculation of percentages in practical situations

Measurement:

- measures in meaningful situations
- unit of measure: concepts and symbols
- meaningful conversions

Geometry:

- concepts and symbols
- space and 3D orientation
- perimeter, area and volume

Strategies and problem solving skills:

reference points

problem solving in the field of measuring and geometry

problem solving in the field of numbers and calculations

rounding off problems and estimation

The results of the 2002 study reveal three mathematics sub-domains in which pupils do not master the attainment goals at a sufficient level: calculation of percentages in practical situations; meaningful conversions; and perimeter, area and volume. When looking at the fifth and sixth grade teacher's perceptions, in general we observe that teachers report less difficulties in particular sub-domains when they teach 6th grade pupils. This is a logical finding since sixth grade pupils have a larger experiential base and have acquired more knowledge and skills as compared to fifth graders.

We also observe a partial level of agreement and some disagreement between the quantitative findings in the 2002 sample study and the perceptions of fifth and sixth grade teachers:

The 2002 study points at the weak mastery of the sub-domain *calculation of percentages in practical situations*. Also the teachers report that these curriculum goals are hard to attain by 5th and 6th grade pupils.

Perimeter, area and volume learning goals, attained – according to the 2002 study – by only 53% of the pupils, is also according to the teachers hard to handle by 5th grade pupils, but not by 6th grade pupils.

Meaningful conversions are – in contrast to the findings of the 2002 study – not seen as a difficult sub-domain.

Proportions, problem solving, rounding off and estimate are difficult sub-domains according to all 5th and 6th grade teachers, but seemed not to pose problems for the pupils in the 2002 study.

A limitation in this part of the study is the fact that we focus almost solely on teacher's perspectives. According to Pajares (1992) and others (e.g., Correa e.a., 2008; Perkkilä, 2003; Philipp, 2007; Staut & Stern, 2002), we also have to consider teacher's perceptions in relations with teacher's practices and student outcomes. For example, according to Thompson (1992) we have to "*examine teachers' verbal data along with observational data of their instructional practice or mathematical behaviour*" (p.135). According to Simon and Izur (1999), the term teacher's practice not only includes the teaching (planning, assessing, interaction with students), but also the teacher's values, skills, intuitions and feelings.

In order to meet those needs, we already gathered mathematics performance results of the pupils from the teachers who filled in a questionnaire and we also videotaped several mathematics lessons while focussing on the teacher's behaviour. The results

of that part of the study will enable us to analyze to which extent teacher's perceptions match with the performance results of their students. We will also be able to get a clear picture of how teachers use their CALPs in lessons. This all will lead to a clearer understanding of the relationship between teacher's perceptions, teacher's practice and student outcomes, including mathematics learning difficulties.

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