The following is a pre-publication version of

Flanders not Finland holds the key? Looking beyond PISA for indicators of mathematics teaching quality

Abstract

Over the last decade Finnish students’ performance on the mathematical literacy components of PISA has created much international interest. However, with respect to the two times Finland has participated in the Trends in International Mathematics and Science Study (TIMSS), Finnish students’ mathematical performance has painted a very different picture, particularly at grade 8. What is less well known is that Flanders, whose Programme for International Student Assessment (PISA) achievements have been masked by those of Belgium as a whole, has performed as well as Finland with respect to mathematical literacy and, on the three TIMSS in which it has participated, it has been the most successful European system at grade 8. Thus, while Finnish performance on tests of technical competence, despite success on tests of mathematical applicability, has been moderate, Flemish students have led the Europeans on both. In this chapter, the author examines two sequences of videotaped lessons taught on percentages, a topic resonant with ambitions of both technical competence and mathematical applicability, by case-study teachers considered against local criteria to be effective. The evidence suggests that Finnish mathematics didactics are more likely to explain Finnish TIMSS failure than PISA success. Flemish didactics may have greater explanatory potential for both PISA and TIMSS success. Such findings suggest that performance on international tests of achievement may be unrelated to didactical quality as other, typically hidden, cultural factors intercede.

Introduction

In this chapter I compare the two most successful European educational systems – Finland and Flanders – from the perspective of the mathematics achievement of their students and the evidence available with regard to how the two systems construe and, through the practices of their teachers, present mathematics to their students. In so doing I demonstrate that PISA success is neither a guarantee nor a consequence of pedagogic quality. I show, also, that it is not necessarily a predictor of mathematics achievement against other forms of assessment like TIMSS but, in some cases, a consequence of cultural factors that extend substantially beyond the classroom.

But first, by way of background, I summarize the recent histories of the two systems. Both are economically strong, have similar populations and are relatively recent additions to the map of European nations. Finland achieved independence from her successive Swedish and Russian masters in 1919, following a short but violent civil war between, essentially, conservative Swedish-speaking middle classes and the landed agrarian population on the one hand and Finnish-speaking urban workers and the landless agrarian population on the other. Belgium, as a French-speaking Catholic nation, achieved full independence from the Dutch-speaking protestant Netherlands after the treaty of London in 1839. However, the formal recognition of the sovereign region of Flanders began in the second quarter of the twentieth century when its provinces were granted the right to conduct their business in their dialect of Dutch and continued until the end of the twentieth century when Belgium became federated in 1993. In other words, both systems are relatively modern and have been subjected to considerable foreign, typically imperialist, influences in their development.

Finnish and Flemish performance on PISA and TIMSS

Over the last two decades two series of large scale international tests of mathematical competence have dominated much of the mathematics education discourse and provided the bases, whether warranted or not, for much research and political decision making. These have been the five published manifestations (1995, 1999, 2003, 2007 and 2011) of the Third International Mathematics and Science Study (TIMSS) and four published cycles (2000, 2003, 2006 and 2009) of the Programme of International Student Assessment (PISA). The emphasis of each PISA has varied,
with the first focusing on literacy, the second mathematical literacy and problem solving, the third scientific literacy, and the fourth literacy again. That said, each assessment has included substantial assessments of students' ability to apply their mathematical knowledge and skills in authentic settings, both within mathematics itself and a wider world (Adams 2003). The five TIMSS assessments have typically retained the same focus – an examination of mathematics and science curricula at three levels; the intended, the implemented and the attained curricula (Howie and Plomp 2005) - although most published material has focused on the achievement of students at grades 4 and 8.

Table 1: Finnish and Flemish mathematics performance on all PISA and TIMSS assessments

<table>
<thead>
<tr>
<th></th>
<th>PISA (Age 15)</th>
<th>TIMSS (Age 14)</th>
<th>PISA problem solving</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finland</td>
<td>536 544 546 541</td>
<td>*** 520 *** *** 514</td>
<td>548</td>
</tr>
<tr>
<td>Flanders</td>
<td>543 553 541 537</td>
<td>565 558 537 *** ***</td>
<td>547</td>
</tr>
</tbody>
</table>

Finnish PISA success (Table 1) has prompted “more than 100 delegations from all over the world … to find out how the Finnish system works” (Crace 2003). What is less well-known has been the performance of Flanders, mainly because its achievements have been masked by the OECD’s reporting of Belgian performance as a whole. However, internal reports (De Meyer et al. 2002, 2005; De Meyer 2008; De Meyer and Warlop 2010) have shown that Flemish mathematics-related PISA achievement has been consistently comparable to Finnish.

The two countries’ TIMSS scores present very different pictures. Flanders was consistently the highest performing European nation on the three cycles on which it participated. The Finns participated in TIMSS 1999 and 2011 only and its scores were, by European standards unexceptional. Significantly, its 1999 performance on algebra and geometry (Table 2) was poor and elicited negative reactions from the Finnish mathematics community, arguing that current procedural emphases had not only marginalized logical thinking, elegance, structure and proof (Malaty 2010) but were incompatible with the preparation of students for higher mathematics (Astala et al. 2006; Tarvainen and Kivelä, 2006).

Table 2: Finnish and Flemish performance on the five mathematics domains of TIMSS 1999

| TIMSS 1999 (Age 14) (International mean 487) |
Perspectives on Finnish PISA success

While the literature with regard to Flanders is scant, that concerning Finland is extensive and attributes PISA success to, inter alia, the comprehensive school system, high expectations of all participants, a well-qualified and committed teaching force that enjoys the trust of society in general and parents in particular (Välijärvi 2004; Tuovinen 2008) and the systemic investment in the language acquisition and competence of special educational needs students (Kivirauma and Ruoho 2007). Less bullish commentators have suggested that an understanding of Finnish educational success requires a “social and cultural analysis of the place and meaning of education in contemporary Finnish society” (Antikainen 2005, 6), not least because Finnish history has brought about a collective mindset closer to that of the Pacific Rim than Europe’s (Simola 2005) and a strong cultural homogeneity conducive to educational achievement (Välijärvi 2004).

Other evidence presents a different perspective on Finnish PISA success. Firstly, while Finnish teachers may be well-qualified and enjoy high status, neither is a guarantee of teaching quality. Indeed, research has found a tradition of teacher-dominated practice that had changed little in fifty years (Carlgren et al. 2006), prompting a commission of enquiry to advocate a “diversification of teaching methods” and a shift of emphasis from “routine skills onto development of thinking” (Kupari 2004, 11). The outcomes included curricular decentralization but, it seemed, little change to teachers’ practices (Savola 2010), as a conservative workforce, uncertain how to adapt to expected changes, continued to teach as it always had (Norris et al. 1996). Today, Finnish teachers continue to subordinate the teaching of mathematical concepts to procedures (Desimone et al. 2005) and rarely, despite decades of systemic encouragement, incorporate mathematical problem solving into their repertoires (Pehkonen 2009).

<table>
<thead>
<tr>
<th>Fractions and number sense</th>
<th>Measurement</th>
<th>Data representation and probability</th>
<th>Geometry</th>
<th>Algebra</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finland</td>
<td>531</td>
<td>521</td>
<td>525</td>
<td>498</td>
</tr>
<tr>
<td>Flanders</td>
<td>557</td>
<td>549</td>
<td>544</td>
<td>535</td>
</tr>
</tbody>
</table>

Table 3: PISA 2009 mathematics literacy scores for three cultural groups

<table>
<thead>
<tr>
<th>Finnish-speaking Finns</th>
<th>Swedish-speaking Finns</th>
<th>Swedish-speaking Swedes</th>
</tr>
</thead>
<tbody>
<tr>
<td>541</td>
<td>527</td>
<td>494</td>
</tr>
</tbody>
</table>

Secondly, claims about Finnish cultural homogeneity mask a significant issue for the Finnish authorities. The largest minority in Finland is the Swedish-speaking community living mainly in the
south and west of the country and comprising around 6 per cent of the population. It comprises a
disproportionate 24 percent of the board members of the 50 largest companies listed on the Helsinki
stock exchange (Wallgren 2011) and invests, per capita, three times as much in shares as the
majority Finnish-speaking community (Karhunen and Keloharju 2001). In such circumstances, it
would seem reasonable to expect this economically powerful group to perform at least as well as the
Finnish-speaking community, particularly as the systemic investment in schools is independent of
the language group to which a school belongs (Kupiainen et al. 2009). But this is certainly not the
case, as shown in the figures of table 3.

In sum, Finnish mathematics-related PISA success appears to defy simple explanation and be a
consequence of a range of socio-cultural factors possibly unrelated to classroom practice. However,
relatively little is known about Flanders, not least because it has failed to attract the attention given
Finland. In this chapter, therefore, I present analyses of two pairs of lessons, one Finnish and one
Flemish, each taught on percentages to students in grade 5. In so doing I aim to examine the extent
to which the achievement of Finnish and Flemish students may be explained by mathematics
teaching they experience. The analyses are framed against notions of adaptive expertise, a widely
accepted objective of the international reform movement in mathematics education resonant with
PISA's mathematics-related objectives and stemming from an awareness that the procedural
emphases of traditional mathematics teaching offered inadequate preparation for both further study
and a changing labor market (Hiebert 1999). Traditional mathematics teaching, focused on routine
expertise (Hatano and Inagaki 1986), emphasized facts and skills, which are learned with little
understanding and then applied to familiar problems (Lloyd 1999). Routine experts lack the
resources to solve non-routine problems different from the familiar (Martin et al. 2005). In contrast,
reform mathematics emphasizes deep conceptual knowledge and connections between concepts as
the means by which procedural skills are made sensible (Hiebert 1999). Learners are encouraged to
solve non-routine problems both individually and cooperatively (Lloyd 1999). Reform mathematics,
which encourages students to make links within mathematics itself and between mathematics and
the real-world (Cady et al. 2007), valorizes adaptive expertise, whereby learners have sufficient and
connected underlying understanding to solve non-familiar problems (Heinze et al. 2009). Adaptive
experts understand why the procedures they use work, can modify them, or even invent new ones
(Hatano and Inagaki 1986).

The project
The data presented in this paper draw from those collected by the European Union-funded
Mathematics Education Traditions of Europe (METE) project, whose broad aim was to examine
how teachers conceptualize and present mathematics to students in the age range 10-14 in Flanders,
England, Finland, Hungary, and Spain. These countries reflect well not only the cultural diversity of
Europe but also variation in achievement on both TIMSS and PISA. Project data were video
recordings of four or five successive lessons on topics agreed as representative of their countries'
curricula. The teachers involved, four per country, were selected against local criteria of
effectiveness, thus not only minimizing selection bias but offering the opportunity to understand
how a system construes effectiveness. The Finnish teacher, Jari, was one of several engaged in
teacher education with the project university who would have had “to prove they are competent to
work with trainee teachers” (Sahlberg 2011, 36). Moreover, the same teacher education department
had been nominated by the Finnish authorities as a Centre of Excellence in Mathematics Teacher
Education. The Flemish teacher, Emke, was also engaged in teacher education activities at the
project university and, having been identified as exemplary, had been videotaped over several
successive lessons as part of a government-funded project to create teacher training materials for use
by student teachers as part of both cooperative and independent learning. In other words, at least as
far as teacher education expectations were concerned, both were viewed as models of good practice.

In all cases, a tripod-mounted camera was placed near the rear of the room, guided by the objective
of capturing all utterances made by the teacher and as much board-work as possible. Teachers wore radio microphones while strategically placed telescopic microphones captured as much student-talk as possible. After filming tapes were digitally compressed and transferred to CD for coding, copying and distribution, with the first two lessons of each sequence being transcribed and translated into English to create subtitled recordings. With respect to analysis, each subtitled video was viewed several times to get a feel for how the lesson played out. Next, an annotated transcript was produced. This meant that with each viewing notes were inserted into the transcript to document emergent understandings of the discourse being enacted. Thus, the annotated transcript was refined with each viewing of the video. For reasons outlined above, this chapter draws on Finnish and Flemish data and, for reasons of space, focuses on a single topic, percentages. However, this is a topic located in the application of mathematics to a world beyond school and appropriate, therefore, for analyzing the relationship between didactics and PISA success.

The teaching of percentages

The two teachers introduced the topic in very different ways. Jari began by asking, what do we mean by per cent? A student volunteered one hundredth and Jari wrote this on the board. Students were then invited to write, in equation form, three ways of denoting this, after which a girl, Salla, wrote on the board, with no hesitation, 1/100 = 1% = 0.01. Next, Jari asked for examples of one hundredth from everyday life. Several examples were offered, both correct and incorrect, that evoked the single word response, yes, before he announced that percentages could be seen in the labels on alcoholic drinks. Jari then modeled several equations connecting fractions, percentages and decimals. Typically, he sketched a cake and shaded one fifth, which a volunteer declared to be equal to 20 per cent. In response to Jari’s questioning another volunteer asserted that this was equal to zero point two. Finally Jari asserted that in order to retain a logical connection between decimals and percentages it would be better to write decimals as hundredths, and rewrote 0,2 as 0,20.

Jari’s introduction is interesting for a number of reasons. Firstly, having been informed that this class had not met percentages before, Salla’s confidently presented equation implied that students must have experienced a range of informal opportunities to make such links. That said, linking the three forms of representation in this manner appeared a clear attempt to make explicit conceptual relationships. Secondly, during students’ offering of real world examples Jari responded, irrespective of the relevance of the suggestion, by saying yes and nothing else, leaving observers to infer whatever sense they could. Thirdly, emphasizing alcoholic drinks with no reference to issues of health seemed incongruous in the education of eleven year olds. Fourthly, this was the only explicit link to a world beyond the classroom in the sequence of five lessons. Fifthly, in instructing students to retain a logical connection by writing 0,2 as 0,20 he indicated an expectation that students would learn rules without understanding. This sense of rote permeated other aspects of the introduction, with Jari generally asking procedural questions demanding numerical answers that went without comment or clarification. Students, it seemed, were left to infer whatever meaning they could from the opportunities they received.

Emke began by asking her students to show the percentage-related artifacts they had brought from home before asking questions to elicit their understanding of the relationships embedded in them. For example, in relation to a yoghurt pot containing nine percent fruit, Emke asked, does this mean there are nine pieces of fruit in the yoghurt? Nine grams? Would it make a difference if the pot were larger or smaller? A volunteer said it would stay the same. The same process was repeated with various other artifacts such as advertisements cut from newspapers and magazines pertaining to, say, sales in furniture shops or bank loans.

Emke’s introduction located the teaching of percentages explicitly in the real world and invited students to think about percentages as representing proportions. It could be argued that embedded in her approach was an allusion to the Dutch realistic mathematics education (RME) tradition, based on problems or tasks that are imaginably real (Van den Heuvel-Panhuizen 2003). Students’ artifacts
highlighted well the variety of contexts in which percentages are located and made them real, it is argued, for her students. The episode was conceptually focused with no obvious attempt to introduce any procedural matters.

The episodes following the introductions were also very different. Jari posed and solved publicly several questions, based on shading parts of a hundred square, to elicit, for example, the equivalence of five percent, five hundredths and zero point zero five. This was followed by several minutes of individual working before invited students read out answers in equation form. Finally, Jari posed the question, if you take 40% from a cake, what percentage is left? He sketched a cake and asked if 40% has been eaten, how much of the cake should be shaded? A volunteer suggested spitting it into ten and taking four pieces. Jari replied what if they have too little patience to do that? Another suggested dividing the cake into five and taking two. When prompted, another suggested that two fifths expanded by two would yield four tenths and, if the process is repeated by ten, would give forty hundredths or 40%. Jari agreed and sketched the five portions. Now, we want to know what is left, how do we do that? A child volunteered 100 minus 40, after which Jari wrote 100%-40%=60%.

Jari’s first exercise, based on the hundred square, was an opportunity for students to rehearse the earlier equation, a process supported by his modeling of the first few examples. For example, the dialogue with respect to the first example went as follows:

<table>
<thead>
<tr>
<th>Jari</th>
<th>How much of the square is red? (…) Give it first as a fraction. Aku?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aku</td>
<td>Five hundredths</td>
</tr>
<tr>
<td>Jari</td>
<td>Yes. What about as a percentage? (…) In percentages, Eemeli?</td>
</tr>
<tr>
<td>Eemeli</td>
<td>Five percent.</td>
</tr>
<tr>
<td>Jari</td>
<td>And as a decimal? (…) Noora?</td>
</tr>
<tr>
<td>Noora</td>
<td>Zero point fifteen</td>
</tr>
<tr>
<td>Jari</td>
<td>Yes.</td>
</tr>
</tbody>
</table>

Throughout this exchange Jari neither offered nor sought explanation. Answers, not solutions, seemed to be the expected norm, although the manner in which the process was undertaken allowed all students to infer a straightforward rule – the number of shaded unit squares provided the answer to each component of the equation – that would provide an unambiguous procedure for getting the correct answer. However, this unambiguity was undermined when Jari introduced the cake problem. In this case, students were taken on a protracted and seemingly irrelevant journey to the conclusion that 60 percent remained. Admittedly, there was some important work undertaken with respect to equivalences and related procedures, but these seemed unrelated to the goal of determining how much cake remained and left one to ponder what the students were expected to infer from the intervention.

Emke’s next phase exploited base ten number blocks. She invited students to take four hundreds and place five cubes in front of each hundred. A short discussion highlighted the arbitrary nature of prepositions and led to the discussion of equivalent expressions like five for each 100 of four hundred or five at each 100 of four hundred. That is, she alerted her students to the fact, at least as far as their dialect of Dutch was concerned, that sentences beginning five for each, five at each or five on each were mathematically equivalent and logically consistent statements. At this stage Emke wrote what she called the formulation, (5 for each 100) of 400, on the board. Several related tasks were completed similarly, including, for example, (8 on each hundred) of 450, before Emke shifted attention in various ways. Firstly, she asked students to construct concrete models for different formulations. Secondly, she asked them to stack their blocks rather than lay them side by side. That is, she continued to offer formulations like (3 per 100) of 400 but expected students to work with a stack rather than separately placed hundred squares. Thirdly, she showed various concrete representations from which students had to write formulations. Fourthly, she drew representations, for example, three squares with two in front of each, and invited students to write the formulation.
Finally, she offered, orally, examples like *two for every hundred of three hundred* and asked students to write both diagrams and the formulations. The first lesson closed with her asking students to work in pairs and use the blocks to write formulations for their artifacts.

Throughout this phase of the lesson, which lasted around forty minutes, Emke’s attention was on the conceptual basis of percentages. Each task, involving the use of number blocks, was solved individually before being discussed collectively. The various shifts of attention reinforced this conceptual objective alongside Emke’s repeated emphases on linguistic matters and the arbitrariness of the preposition. Interestingly, her formulations, every one of which was written on the board, trailed the procedure she would introduce the following lesson. Thus, procedures were beneath the surface of the lesson but subordinated to a deep conceptual knowledge.

Jari’s second lesson, after volunteers had read the equations yielded by their homework, began with his drawing on the board three columns, headed fraction, decimal and percentage. He then wrote $\frac{1}{6}$ under the fraction heading and asked how it could be converted to a decimal. After Aku had volunteered *one divided by six* Jari began the division, which he said should be to an accuracy of one hundredth. Students were invited to call out each step, which Jari undertook with no seeking or offering of clarification. Having got as far as 0.166, Jari reminded the class of the desired accuracy and wrote 0,17 under the decimal column. Next, reminding the class that when decimals are written to an accuracy of a hundredth percentages can be read directly, Jari wrote 17% under the final column. Other examples were managed similarly before he shifted attention by asking how percentages could be changed into fractions. A brief discussion led to the conclusion that 20% was equivalent to $\frac{20}{100}$ and, by a process of simplification, $\frac{1}{5}$, before repeating the process by collectively reducing 45% to $\frac{9}{20}$. The lesson ended with an exercise based on these procedures.

As with his earlier lesson, Jari’s work seemed focused strongly on procedures. The conversion of the fraction to a decimal by division, following a student’s suggestion, was managed without reference to the meaning of any of the actions involved. For example, Jari asserted that 0.166 was equivalent to 0,17 to an accuracy of one hundredth. In similar vein, when converting percentages to fractions, Jari drew on student responses to closed questions to derive the desired answers, but never was any clarification as to the conceptual bases of or rationales for the procedures sought or offered.

Emke’s second lesson began with a discussion, involving several students, focused on summarizing the previous lesson. This was followed by her inviting her students to imagine that one thousand and three hundred was placed in front of them and to think about the result of placing two at each hundred. In response to an invitation to formulate a girl offered (2 for every 100) of 1300. Next, Emke asked, so how many unit cubes are there? A short discussion led to the conclusion that there were 26, as a consequence of 13 lots of two. Several further examples were resolved similarly before she showed the class *four for every hundred of five hundred* and asked students to write not only the formulation but also the calculation. A volunteer said that 4 for every 100 of 500 equals 20 because 4 times 5 is 20. This was followed by similar examples, including four at every hundred of two hundred and fifty. Finally, she invited her students to complete a worksheet-based exercise before initiating a discussion that led to the conclusion that they had been calculating percentages.

In this phase of her sequence Emke revised explicitly what had occurred the previous lesson. This was followed by, although she continued to allow the use of blocks, her encouraging her students to imagine them where possible. However, the main thrust of the lesson was her making explicit the calculation implicit in the formulation she had encouraged her students to develop. In so doing she drew explicit links between the dominant concepts and the subordinated procedure.

**Discussion**

It is difficult conveying the complexity of lessons in a short paper. However, I hope the above offers sufficient to help the reader see some substantial differences, despite superficial similarities, between the two teachers’ practice. In terms of similarities, both teachers seemed prepared to take
whatever time was necessary to complete the tasks they had initiated. Both ensured, implicitly at least, that students had time to think and make notes in their books. Also, assuming that “a mathematical problem presents an objective with no immediate or obvious solution process” (Xenofontos and Andrews 2012) and, importantly, is not “a property inherent in a mathematical task” but a “a particular relationship between the individual and the task” (Schoenfeld 1985, 74), neither teacher encouraged their students to solve problems but worked in teacher-managed ways that circumvented student decision making. That is, while both Jari and Emke modeled the tasks on which their students worked neither offered anything that could be construed as non-routine.

Despite such similarities, the data indicate that Jari’s practice tends towards routine expertise while Emke’s to adaptive (Hatano and Inagaki 1986). Jari’s constant privileging of procedures at the expense of conceptual knowledge, highlighted by implicit allusions to conceptual links between number representations, and the rarity with which he sought or offered clarification during public exchanges point towards rote learned skills focused on problems amenable to simple and mechanically learned procedures. Emke privileged conceptual knowledge above procedural; the various ways in which she shifted the focus of attention on the structural relationships between the concrete, the iconic and the symbolic representations of the various formulations was clearly focused on establishing the conceptual knowledge necessary for student acquisition of meaningful procedures. This perspective found resonance in subsequent lessons, in which she introduced a conceptually based procedure whereby students were encouraged to calculate 1 percent of an amount before multiplying the outcome by the required percentage. Emke did not teach rote procedures but a secure conceptual understanding from which students would always be able to reconstruct, if necessary, procedures from first principles.

In related vein, the ways in which the two teachers managed public discourse supported these differing learning outcomes. On the one hand, Jari drew extensively on closed questions rarely requiring more than a numerical response. He also drew extensively on students, as with Salla’s equation connecting three representations of number, with the mathematical competence to provide the intended model from which less competent learners might learn. Moreover, there was no evidence of his construing incorrect student offerings as opportunities for exposing and rectifying underlying misconceptions for the benefit of both individual and collective. Such practices confirm the findings of earlier studies that Finnish mathematics teaching has changed little for decades (Norris et al. 1996; Desimone et al. 2005; Carlgren et al. 2006; Savola 2010). In short, Jari’s practice appeared largely incommensurate with the attainment of adaptive expertise and, by implication, PISA mathematics-related expectations. Therefore, it is not unreasonable to infer that if the practice of effective teachers is unsympathetic to such goals then neither would be the practice of typical teachers. This prompts the question, if teachers’ practice presents an unlikely explanation for Finland’s PISA success, then, particularly in the light of relatively poor Finnish attainment with regard to the technical competence expectations of TIMSS, what does?

Explanations found in the literature tend to take one of two forms; those that are located in policy and, essentially, replicable and those that are located in culture and beyond replication. In terms of replicable explanations, there is evidence that the Finnish curriculum is closely aligned with PISA expectations (Uljens 2007), particularly when compared with countries like France (Bodin 2007) and Ireland (Shiel et al 2007). Also, there is increasing evidence that equitable systems produced not only equitable outcomes but higher overall achievement than inequitable systems (Wilkinson and Pickett 2009). Thus, the well-established comprehensive school system (Välijärvi 2004; Tuovinen 2008) and the systematic support of special educational needs students (Kivirauma and Ruoho 2007), both of which reflect commitments to equity, are likely contributors to repeated PISA success. However, significant though these are likely to be, they would not explain the achievement disparity between the Finnish-speaking and Swedish-speaking communities.

Non-replicable factors can be found in the influence of the centuries-old Lutheran expectation that
Finns were permitted to marry only if they were able to demonstrate publicly their reading competence (Linnakylä, 2002), a tradition creating a community with a strong appreciation for education (Halinen and Järvinen 2008; Niemi 2012; Simola and Rinne 2011). It is not surprising, therefore, that Finnish students, who are invariably born of literate parents, have a higher engagement with and greater interest in reading than students elsewhere, as evidenced in their borrowing more library books than anyone (Linnakylä 2002; Sahlberg 2007). Such traditions are significant in the light of research showing a strong correlation between Finnish students’ reading competence and mathematical word problems (Vilenius-Tuohimaa and Nurmi 2008). In sum, and acknowledging Finland’s very high PISA reading performance, evidence that when students struggle with reading they tend to struggle with mathematics (Light and DeFries 1995) and the greater than average correlations between Finnish PISA literacy scores and the other PISA content domains (Kjaernsli and Molander 2003), one can construe Finnish PISA success not as a function of didactic excellence but a complex juxtaposition of replicable systemic policies and non-replicable factors pertaining to the nature of being Finnish in general and the deeply embedded cultural emphasis on reading in particular.

Emke, on the other hand, engaged in authentic bouts of questioning focused on student understanding not only of the conceptual issues under scrutiny but how they underpinned the procedures being introduced. This was particularly so in the second lesson when students were expected to explain publicly the reasoning underpinning their answers. Such practice, with its lack of problem solving but strong emphasis on conceptual knowledge, mathematical structures and subordinated procedural skills, is resonant with earlier analyses of Flemish mathematics teaching (Andrews 2009a, 2009b) and are entirely commensurate with the development of adaptive expertise. Thus, if all Flemish teachers privilege such goals then there may be PISA-related explanations to be found in Flemish classrooms. Fortunately, this speculation finds support in the Flemish mathematics curriculum, which presents the objectives for each content area in three sections; concept formation, procedures, and cohesion between concepts, indicative of a structure conducive to adaptive expertise. However, this prompts the question, if Flemish didactics are better aligned with PISA expectations than Finnish, why do Flemish students not outperform Finnish students?

As with Finland, it is possible to interpret Flemish PISA success against policy- and culture-related characteristics of Flemish education. For example, Flanders operates a diverse school system with three-quarters being government-funded independent and one quarter public schools (Corten and Dronkers 2006). The former, typically Catholic, allow parental choice, work within similar curricular frameworks and receive equal state funding (Dronkers and Robert 2008). Within all secondary schools, although the mathematics curriculum remains similar, students elect to follow one of three tracks, vocational, humanities and classical, which are informally construed as an intellectual hierarchy (Op ’t Eynde et al. 2006). Government-funded independent schools produce more proficient readers than public schools (Dronkers and Robert 2008; Pustjens et al. 2007). Despite this, Flanders produces, in relation to PISA, very competent readers, being consistently the second ranked European nation behind Finland. However, there is no deep-seated reading tradition, although it is not unlikely that curricular emphases on “effective cognitive and metacognitive strategies that facilitate text comprehension” (De Corte et al. 2001, 532) will have influenced student achievement. Importantly, both school type and student track have been shown to impact on mathematics achievement (Opdenakker et al. 2002; Pustjens et al. 2007). Thus, in negotiating an ethnic heterogeneity not found in Finland, and a school system more likely to perpetuate rather than ameliorate inequity, Flemish teachers, who are viewed positively by Flemings (Verhoeven et al. 2006), appear able to create competent learners in circumstances less conducive than those found in Finland.

Thus, and acknowledging the somewhat speculative nature of the previous paragraphs, the successes of Finland and Flanders seem attributable to a variety of replicable and irreproducible...
characteristics of their respective cultures. Finnish PISA success appears to be a consequence of irreproducible cultural factors associated with what it is to be a Finn and replicable policies linked to the maintenance of social equity. Flemish PISA success, located in policies unlikely to foster equity, seems based on something missing in Finnish classrooms; a didactic tradition conducive to the acquisition of adaptive expertise.

Acknowledgements

The METE project team acknowledges the generous support of the European Union, Socrates Action 6.1 Programme Code 2002-5048.

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