CULTURE, CURRICULA AND CLASSROOMS

Understanding the construction of school mathematics

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What is culture?

- Culture is a social, historical and behavioural construction that reflects the “collective mental programming” of its people (Hofstede, 1980, p. 43).

- Culture is a collective psychological conditioning (Triandis & Suh, 2002).

- Culture embodies the shared ideas about what is good, right, and desirable in a society (Schwartz, 1999, p. 25).

- Culture includes those beliefs, artefacts and practices that history has shown to be effective for the maintenance of a society and its future generations (Hofstede, 1980; Triandis & Suh, 2002).
Why examine culture and mathematics?

- It can “explain why children in certain countries so dramatically outperform their counterparts in other countries” (Yoshida et al, 1997: 329/330).

- It offers “insight into the ways in which mathematics is systemically conceptualized and presented to learners in different countries” (Andrews, 2007: 489).

- It can “reveal taken-for-granted and hidden aspects of teaching” (Hiebert et al. 2003: 3) and helps us “become more aware of our own implicit assumptions concerning the learning of mathematics” (Knipping, 2003, p. 283).

- It facilitates our awareness of the adaptive potential of another country’s teachers’ practices for our own (Clarke, 2004).
MODELS OF CULTURE
And how they impact on education
Hofstede’s dimensions of culture 1

A study of 40 nations, 116,000 questionnaire responses from IBM employees over two data collection periods in the late 1960s and early 1970s. Four dimensions of culture were identified, which, being continua and data derived, can be construed differently from the dichotomies rejected earlier.

Power distance concerns the extent to which people accept being led. It is reflected in the ways that societies encourage obedience or initiative.

Individualism reflects the extent to which people are programmed to look out for particular small groups. In contrast, collectivist cultures programme people to function as part of a large group.
Hofstede’s dimensions of culture 2

*Uncertainty avoidance* concerns the extent to which cultures programme their members to feel either uncomfortable or comfortable in unstructured situations.

*Masculine as opposed to feminine cultures* “strive for maximal distinction between what men are expected to do and what women are expected to do”.

### Education and Hofstede’s dimensions

<table>
<thead>
<tr>
<th>Weak Uncertainty Avoidance Societies</th>
<th>Strong Uncertainty Avoidance Societies</th>
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<tbody>
<tr>
<td>• teachers are allowed to say “I don’t know”</td>
<td>• teachers are expected to have all the answers</td>
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<tr>
<td>• a good teacher uses plain language</td>
<td>• a good teacher uses academic language</td>
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<tr>
<td>• students are rewarded for innovative approaches to problem solving</td>
<td>• students are rewarded for accuracy in problem solving</td>
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<tr>
<td>• teachers are expected to suppress emotions (and so are students)</td>
<td>• teachers are allowed to behave emotionally (and so are students)</td>
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<tr>
<td>• teachers interpret intellectual disagreement as a stimulating exercise</td>
<td>• teachers interpret intellectual disagreement as personal disloyalty</td>
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<tr>
<th>Small Power Distance Societies</th>
<th>Large Power Distance Societies</th>
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<tr>
<td>• a teacher should respect the independence of his/her students</td>
<td>• a teacher merits the respect of his/her students</td>
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<tr>
<td>• student-centered education</td>
<td>• teacher-centered education</td>
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<tr>
<td>• teacher expects students to initiate communication</td>
<td>• students expect teacher to initiate communication</td>
</tr>
<tr>
<td>• students may speak up spontaneously in class</td>
<td>• students speak up in class only when invited by the teacher</td>
</tr>
<tr>
<td>• students allowed to contradict or criticize teacher</td>
<td>• teacher is never contradicted nor publicly criticized</td>
</tr>
<tr>
<td>• younger teachers are more liked than older teachers</td>
<td>• older teachers are more respected than younger teachers</td>
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<tr>
<td>COLLECTIVIST SOCIETIES</td>
<td>INDIVIDUALIST SOCIETIES</td>
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<tr>
<td>------------------------</td>
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<tr>
<td>positive association in society with whatever is rooted in tradition</td>
<td>positive association in society with whatever is “new”</td>
</tr>
<tr>
<td>neither the teacher nor any student should ever be made to lose face</td>
<td>face-consciousness is weak</td>
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<tr>
<td>education is a way of gaining prestige in one’s social environment</td>
<td>education is a way of improving one’s economic worth and self-respect</td>
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<tr>
<td>acquiring certificates is more important than acquiring competence</td>
<td>acquiring competence is more important than acquiring certificates</td>
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<tr>
<td>teachers are expected to give preferential treatment to some students</td>
<td>teachers are expected to be strictly impartial</td>
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<tr>
<th>FEMININE SOCIETIES</th>
<th>MASCULINE SOCIETIES</th>
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<tr>
<td>teachers avoid openly praising students</td>
<td>teachers openly praise good students</td>
</tr>
<tr>
<td>teachers use average student as the norm</td>
<td>teachers use best students as the norm</td>
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<tr>
<td>a student’s failure in school is a relatively minor accident</td>
<td>a student’s failure in school is a severe blow to his/her self-image</td>
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<tr>
<td>students practice mutual solidarity</td>
<td>students compete with each other in class</td>
</tr>
<tr>
<td>students choose academic subjects in view of intrinsic interest</td>
<td>students choose academic subjects in view of career opportunities</td>
</tr>
<tr>
<td>male students may choose traditionally feminine academic subjects</td>
<td>male students avoid traditionally feminine academic subjects</td>
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The genesis of English education

Emphasises Protestant values and the importance of sport in the development of a healthy mind and body (Cummings 1999). Personal morality and experiential knowledge are privileged above rationality (Pepin 1999): “the chapel and the playing field were in many ways more important… than the classroom” (Lauwerys 1959, p. 288).

Drawing on the English public school’s liberal arts tradition and its rejection of science and engineering it offers an education appropriate for gentlemen (Holmes and Mclean 1989).

Thus, the English tradition accords with Kamens et al.’s (1996) description of an arts and humanities curriculum predicated on the maintenance of both an intellectual elite and an established high culture.

Modern emphases on employment have compromised this tradition in mass education, although successive governments have allowed increasingly many schools not to follow the pragmatic centralised curriculum.
The genesis of German education

German education, rooted in Lutheran notions of justification by faith (Lauwerys 1959), emphasises an encyclopaedic perspective on knowledge and personal piety (Cummings 1999; Prange 2004).

Based on an underlying belief that every occupation has dignity, the tripartite structure of German schools, with its equal privileging of academic and practical knowledge, poses no barrier to higher education (Pepin 1999).

The German tradition is resonant with the comprehensive curriculum that aims not only to allow all children, irrespective of background, similar opportunities to learn and achieve but also “to produce competent citizens and productive workers rather than technical specialists” who are endowed with “certain rights and duties” (Kamens et al., 1996, p. 120).

Unification has led to a rejection of the East German Soviet model in favour of an adapted version of the West’s (Wilde, 2002).
The genesis of French education

French education draws on Enlightenment principles that education should not only be separated from superstition but include all human knowledge in ways that emphasise rationality (Holmes and McLean 1989; Cummings, 1999; Lauwerys 1959).

Post-revolutionary principles of égalité and laïcité underpin a curriculum focused on the removal of social inequalities and the expectation that moral issues will be addressed at home (Pepin 1999).

The French tradition resonates closely with classical curricula whereby an “intellectually demanding and character-enhancing” experience produces “well-rounded generalists rather than highly trained specialists” to form a political and social elite whose responsibility is the maintenance of the natural social order (Kamens et al., 1996, p. 119).

Post-war reforms have addressed, in particular, concerns with respect to a “scientific and technical lag” (Resnik 2007, p.157).
The genesis of Russian education

Russian education draws on Soviet principles of egalitarianism and juxtaposes vocationalism and an encyclopaedic model of knowledge within a socialist moral philosophy (Cummings, 1999).

Described as polytechnicalist (Holmes and McLean 1989), it reflects a “desire to use education as an instrument for changing the conventional attitude to work”, with not only manual labour to be “as highly considered as intellectual or clerical work” but also every subject “considered from the point of view of the help which it is capable of giving to the … builder of a socialist society” (Lauwerys 1959, p. 291).

Such a tradition, alongside emphases on industrial and military growth, fit well with notions of mathematics and science curricula, which developed to facilitate a rapid growth from an agrarian to an industrial society (Kamens et al. 1996).

Recent changes have included a decentralisation of responsibilities, reforms to curriculum and assessment (Mitter 2003) and the introduction of parental choice (Laczik 2006).
Models of curriculum growth

<table>
<thead>
<tr>
<th></th>
<th>Prussia</th>
<th>France</th>
<th>United Kingdom</th>
<th>United States</th>
<th>Japan</th>
<th>Russia</th>
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<tbody>
<tr>
<td>Ideal</td>
<td>Loyal Mandarin</td>
<td>Technical elite</td>
<td>Educated gentleman</td>
<td>Continuous development of the individual</td>
<td>Competent contribution to group</td>
<td>Socialist achievement</td>
</tr>
<tr>
<td>Representative school</td>
<td>Primary school</td>
<td>Lycée, grand école</td>
<td>Public school</td>
<td>Comprehensive high school, liberal arts college</td>
<td>Primary school</td>
<td>General school</td>
</tr>
<tr>
<td>Scope</td>
<td>Whole person, many subjects, humanistic bias</td>
<td>Cognitive growth, academic subjects, arts/science</td>
<td>Academic subjects, civic and religious values, culture and cocurriculum</td>
<td>Cognitive development, civic values, social skills</td>
<td>Whole person, wide range of subjects, moral values, physical and aesthetic skills</td>
<td>Whole person, broad curriculum, technical bias</td>
</tr>
<tr>
<td>Learning theory</td>
<td>Natural unfolding</td>
<td>Mental discipline</td>
<td>Hereditary brillance</td>
<td>Aptitude and growth</td>
<td>Effort</td>
<td>Interactive</td>
</tr>
<tr>
<td>School and classroom technologies</td>
<td>Lectures, self-study</td>
<td>Lectures, exams</td>
<td>Tutors, cocurriculum, boarding school</td>
<td>Individualized courses and instruction</td>
<td>Teacher-centered use of groups, school as unit</td>
<td>Collective learning</td>
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THE CLASSROOM MANIFESTATION OF CULTURE
Comparing mathematics teaching

- In German mathematics teaching theoretical considerations and proof are important. The order of mathematical content is defined by the structure of the subject with large thematic fields taught independently of each other. New topics or methods are given high priority and introduced by means of class discussions. Lessons are progressed by high expectations of students’ correct and confident execution of algorithms alongside an importance on precise mathematical language in all official discourse.

- In English mathematics teaching neither theory nor proof is of great importance. The order of mathematical content is arbitrary, presented spirally and taught independently of any obvious sense of structure. New topics or methods, are often presented as recipes, highlighting the lack of importance given to standard algorithms. Thus, priority is given to students’ own solutions. Precise mathematical language is of little relevance.

Comparing text books

- French texts are comprehensive and cognitively challenging. They incorporate extensive explanatory text that is sufficient for students not to require additional support. Exercises include opportunities for students to speculate and links to other topic areas.

- German texts establish links “between everyday situations and what pupils are to learn” (p. 578). Detailed explanatory text is included and technical vocabulary is used consistently. “Pupils are not required to speculate and most questions require low-level applications of the skill”.

- English texts are less densely packed and contain fewer examples than their French or German equivalents. They incorporate little explanatory text, ensuring teacher mediation, and little emphasis on technical vocabulary. Exercise are undemanding with little scope for extension.

Comparing classroom interaction

- English lessons comprise four or five sections, within which are large numbers of private interactions, typically located between introductory and closing public interactions. An English pupil response may invoke a method unfamiliar to other pupils with the consequence that they may have to make sense of an approach different from their own.

- Russian lessons are dominated by public interactions. When a Russian student responds in a public interaction, he or she “appears to do so on behalf of the class as a whole and is expected to articulate the standard answer; the rest of the class is expected to participate by silently rehearsing the same answer while listening” (p. 431).

- In both countries public interactions involve teacher initiation and class response. Russian responses focus on the concepts or algorithms underlying the question while the English focus on the numerical operations necessary to address it.

Comparing teachers’ beliefs

- Hungarian teachers see mathematics as an intellectually-challenging and problem-solving discipline. Teaching is focused on the development of learners’ logical reasoning through the solution of non-routine problems. Hungarian teachers’ professional identities are rooted in collaboration and the study of a subject with little explicit, but clearly-defined implicit, real-world relevance.

- English teachers typically see mathematics as applicable number focused on real-world preparation located in a differentiated curriculum. English teachers’ professional identities seemed rooted in a model of education in which learners’ attainment was frequently predetermined, and therefore individualized, and focused explicitly on real-world relevance.

We all teach to a script

- There is growing evidence that teachers in one country behave in ways that identify them more closely with compatriots than teachers elsewhere (Schmidt et al. 1996).

- This is because “teaching and learning are cultural activities (which)... often have a routineness about them that ensures a degree of consistency and predictability. Lessons are the daily routine of teaching and learning and are often organized in a certain way that is commonly accepted in each culture” (Kawanaka 1999, 91).

- Such scripts embody the pedagogical strategies which, through repeated enactment, are typical of a country’s lessons and which appear routine and beneath the consciousness of most teachers (Cogan and Schmidt 1999).
Bringing it all together: A tripartite curriculum

Teachers work within an *intended* curriculum, as conceived by the second international mathematics study (Garden, 1987), reflecting the knowledge and skills privileged by the system in which teachers operate.

Teachers work within a *received* curriculum, typically amenable to inference, reflecting the hidden and culturally derived beliefs and practices teachers acquire by dint of being who they are.

Finally, they work within an *idealised* curriculum, which is articulable, reflecting individual teachers’ personal and experientially informed beliefs.

FINLAND: An educationally cultural enigma
Such has been the interest in this small country’s success that envoys from all around the world have visited Finland to uncover the story behind the success (Laukkanen, 2008).
How the Finns explain their success

- The comprehensive school system is based on equity for all, irrespective of gender, social status or ethnicity, and a compulsory nine-year basic curriculum (Laukkanen, 2008; Sahlberg, 2011; Välijärvi, 2004).

- Students, who are neither tracked (Antikainen, 2006; Reinikainen, 2012) nor streamed (Halinen and Järvinen, 2008; Lie et al., 2003), are taught in schools typically construed as learning and caring communities (Aho et al., 2006; Sahlberg, 2007).

- The right to choose the school their children attend has little influence on parents’ decision making (Poikolainen, 2012).

- Finland achieved the lowest PISA-related between school variation (Halinen and Järvinen, 2008; Liang, 2010; Reinikainen, 2012; Schleicher, 2009).
How the Finns explain their success 2

- Integrated SEN, involving around 1 in 6 students and requiring no formal statement of need, begins when difficulties arise and has both reduced the stigma of special needs and promoted inclusion (Halinen and Järvinen 2008; Savolainen 2009).

- Primary years SEN provision is typically focused on supporting pupils’ mother tongue and basic mathematical skills (Hausstätter and Takala, 2011; Kivirauma and Ruoho 2007).

- Thus, since PISA and Finnish special education both focus on the same areas “it seems plausible that the special educational system in this country plays a positive role in relation to PISA” (Hausstätter and Takala 2011: 276), not least because Finnish students’ mathematical word problem competence is a function of their reading competence (Vilenius-Tuohimaa, et al., 2008).
How the Finns explain their success 3

- Teaching is a popular career choice among school leavers, even though fewer 20% of applicants are successful (Laukkanen 2008; Niemi & Jakku-Sihvonen, 2006).

- Finnish teachers enjoy high public esteem (Sahlberg, 2007, 2011; Simola 2005; Tuovinen, 2008), being considered professionals who know what is best for their students (Aho et al 2006).

- A master’s degree, requiring 4 to 5 years to complete, is an essential prerequisite (Antikainen, 2006; Laukkanen, 2008; Jyrhämä et al., 2008; Niemi & Jakku-Sihvonen, 2006) that ensures “an academically high standard of education for prospective teachers” (Niemi, 2012: 29) and have been well received by teachers who saw them as enhancing their professional status (Jyrhämä et al., 2008).
Finnish PISA success: at what cost?

- Earlier deductive approaches to mathematics have been replaced by procedural approaches that have marginalised logical thinking, elegance, structure and proof (Malaty, 2010).
- Finnish performance (520) on TIMSS 1999, the sole TIMSS in which Finland participated, was average for European nations and masked disappointingly low scores on algebra (498) and geometry (494).
- This reflects a decline in the mathematical knowledge necessary for students to continue to higher education (Astala et al., 2006; Tarvainen and Kivelä, 2006). And…,

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<th>PISA 2009 Mathematics</th>
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<tr>
<td>Finnish-speaking Finns</td>
<td>Swedish-speaking Finns</td>
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<tr>
<td>541</td>
<td>527</td>
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My perspectives on Finnish teaching

- My analyses, based on video data collected during the period 2003-2005, indicate that teachers work within a tradition (is this a culture?) of implicit didactics – they offer definitions and model procedures in ways that leave students to infer meaning.

- During public exchanges teachers rarely, if ever, seek or offer clarification. Students are left to infer meaning.

- Students are encouraged, implicitly and explicitly, to make extensive notes. Teachers write extensively on the board, typically very slowly in capital letters to support student inference.

- There are various indications that students are expected to discuss their notes and sense-making at home.

  (Andrews, 2011a; Andrews, 2012; Andrews et al., 2012)
Culture and its impact on Finnish PISA success

- A strong Finnish identity grew from successive periods of Swedish and Russian colonialism lasting from the mid-thirteenth century until independence in 1917 (Niemi, 2012).

- For more than four hundred years, reading competence was a prerequisite for receiving Lutheran sacraments. Failure in the public examination, or *kinkerit*, meant a denial of permission to marry with the consequence that Finns have, for centuries, been raised in a culture of high expectations not only with respect to learning but also personal responsibility (Linnakylä, 2002).

- This created a community with a “strong appreciation for education” (Halinen and Järvinen 2008: 80); reading is valued so highly that the Finnish library network is among the densest in the world, with Finns borrowing more books than anyone else (Sahlberg, 2007).

- Such traditions may explain why there is essentially no illiterate underclass in Finnish society.