The Problem of Recontextualisation

Part 1: A case for abandoning mathematics

Paul Dowling
Institute of Education, University of London

> The mathematics questions in PISA aim at assessing the capacity of students to draw upon their mathematical competencies to meet the challenges of their current and future daily lives. Citizens have to use mathematics in many daily situations, such as when consulting media presenting information on a wide range of subjects in the form of tables, charts and graphs, when reading timetables, when carrying out money transactions and when determining the best buy at the market. To capture this broad conception, PISA uses a concept of *mathematical literacy* that is concerned with the capacity of students to analyse, reason and communicate effectively as they pose, solve and interpret mathematical problems in a variety of situations including quantitative, spacial, probabilistic or other mathematical concepts. (OECD, 2009; p. 98)

This introduction to the mathematics section of *Take the Test* illustrates a number of the features of school mathematics that I want to discuss in this paper. The first sentence seems to describe the use of mathematical competences as what I want to refer to as *fetch* strategies. Students engaging in non-mathematical, quotidian activities fetch resources from mathematical activity in solving problems. The second sentence, however, reverses this action. The mathematical voice of the author if the document seems to be fetching resources from the non-mathematical activities of what are now ‘citizens’ that it recognises as mathematical, in some way. In doing this, it constructs part of what I call the *public domain* of school mathematics as a *collection* of everyday sites and activities. The final sentence now re-labels this collection as ‘mathematical problems’ in a *push* strategy that potentially integrates the collection as essentially mathematics; it is a push strategy in the sense that mathematical schemes, such arithmetical procedures, geometry, and probability, are being imposed on non-mathematical contexts. Of course, in order to understand the fetch and push strategies in the second and third sentences, you need to be in the position of the mathematical author that has access to the *esoteric domain* of mathematical schemes and principles etc; someone not well-versed in school mathematics would not necessarily think of catching a train or going to the supermarket as mathematics. The extract also makes reference to what I shall call *forensic assessment* practices—the identification of competence; I shall be returning to this in Part 2.[1]

Nowadays, it is, of course, commonplace to point out that the ‘real world’ contexts of the ‘real world’ tasks in school mathematics are merely exploited for the purpose of mathematical description. The action of such fetch strategies is quite visible in the PISA test items presented in *Take the Test*. One question shows a (presumably real) photograph of a farmhouse that has a roof in the shape of a square-based pyramid and requires the student to calculate the lengths of line segments labelled on a ‘student’s mathematical model’ of the roof. Another task presents a distance/speed graph for a racing car and, amongst other things,

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[1] The use of the terms ‘fetch’ and ‘push’ is inspired from the documentation accompanying my iPhone, which I can set to allow service providers to ‘push’ data etc on to it or to limit downloads to ‘fetch’ mode, which has to be initiated by myself. The terms ‘collection’ and ‘integrating’ are related to Bernstein’s (1977, 2000) collection and integrated curriculum codes; I shall have more to say about this later.

asks the student to identify the plan of the racetrack from a number of options. Both tasks—perhaps particularly the second—offer problems that may be of interest to the mathematically minded. Neither comes close to coincidence with a plausible fetch strategy operating in the other direction: architecture/farming or F1 racing fetching a mathematical resource for its own purpose. Samuel Taylor Coleridge provides a metaphor for what is happening here:

> In this idea originated the plan of the 'Lyrical Ballads'; in which it was agreed, that my endeavours should be directed to persons and characters supernatural, or at least romantic; yet so as to transfer from our inward nature a human interest and a semblance of truth sufficient to procure for these shadows of imagination that willing suspension of disbelief for the moment, which constitutes poetic faith. Mr. Wordsworth, on the other hand, was to propose to himself as his object, to give the charm of novelty to things of every day, and to excite a feeling analogous to the supernatural, by awakening the mind's attention from the lethargy of custom, and directing it to the loveliness and the wonders of the world before us; an inexhaustible treasure, but for which, in consequence of the film of familiarity and selfish solicitude we have eyes, yet see not, ears that hear not, and hearts that neither feel nor understand. (Coleridge, 1817; p. 314)

Coleridge's poetics here distinguishes the poem from its to be recontextualised resources, preferring, himself, to fetch the 'supernatural, or at least romantic' from human nature, whilst Wordsworth prefers, it seems, to push poetic sensibility into the mundane. Either way, poetic faith entails a 'willing suspension of disbelief for the moment' that also seems to be encouraged by the PISA items. The process of 'mathematisation', however, explicitly limits this suspension, it involves five steps:

- Starting with a problem in reality.
- Organising it according to mathematical concepts and identifying the relevant mathematics.
- Gradually trimming away the reality to transform the real-world problem into a mathematical problem that faithfully represents the situation.
- Solving the mathematical problem.
- Making sense of the mathematical solution in terms of the real situation.
(OECS, 2009; p. 99)

Here, the poet/mathematician starts—do they start there, or are they merely visiting?—in 'reality' in order to fetch resources for poetic/mathematical manipulation within poetry/mathematics, the results of which are then fetched by 'reality' What is ignored is the very real problem of recontextualisation as resources are fetched between activities: 'reality' must be transformed (explicitly, in the above extract) in order to move into mathematics; mathematics must be transformed (made sense of) in order to move into 'reality'. The problem with the mathematics curriculum is that it never seems to be very good at the latter move—the fetch from reality. This is because school mathematics is only ever elaborated within the context of school mathematics. Fetching is only ever from the 'real world' into mathematics; the move the other way is always a push. I'll offer another three examples to illustrate the potential danger of this.

Bridget Sewell (1981) interviewed adult numeracy students as part of her study commissioned by the Cockcroft Report into school mathematics (Cockcroft, 1982). In her report she proposes that '[a]n understanding of the national economy assumes a sophisticated comprehension of percentages, as does much of the discussion about pay rises.' However, this is meaningful only if either a sophisticated comprehension of percentages is a sufficient condition for understanding the economy or if complementary skills are to be provided elsewhere. In fact, neither is the case as is illustrated by one of the questions that Sewell herself put to her interviewees:

> On the news recently it was said that the annual rate of inflation had fallen from 17.4% to 17.2%. What effect do you think this will have on prices? (If answer 'none') What do you think ought to happen if it had fallen to, say, 12%? (Sewell, 1981; p. 33)

Now, apart from the fact that times have changed in terms of the UK economy, the most noticeable thing about the question in the second sentence is its suggestion that Sewell's hermitage in school mathematics seems to have limited her own understanding of the economy and/or causation. The rate of inflation is a retrospective measure that cannot, in and of itself, have any effect on prices. We could write this off as a literacy problem were it not for the fact that mathematicocentrism seems pervasive in the utterances of mathematicians. Here is an anecdote from a different context reported by Mike Cooley from his research conducted in the aerospace industry.

> At one aircraft company they engaged a team of four mathematicians, all of PhD level, to attempt to define in a programme a method of drawing the afterburner of a large jet engine. This was an extremely complex shape, which they attempted to define by using Coon's Patch Surface Definitions. They spent some two years dealing with this problem and could not find a satisfactory solution. When, however, they went to the experimental workshop of the aircraft factory, they found that a skilled sheet metal worker, together with a draughtsman had actually succeeded in drawing and making one of these. One of the mathematicians observed: 'They may have succeeded in making it but they didn't understand how they did it.' (Cooley, 1985; p. 171)

I have never thought that this needs very much by way of a commentary!

I shall spend rather more time on my third example, which concerns a mathematics lesson described by Eric Gutstein (2002). Gutstein was concerned to get across the idea of expected values. His resources included graphing calculators and data on police traffic stops in Illinois and on the ethnic profile of the state. Gutstein explains:

> In mathematics, expected value is based on theoretical probability. If 30 percent of drivers are Latino, we would expect that 30 percent of random stops would be of Latinos—but only in the long run. This does not mean that if police made ten stops and five were of Latinos that something is necessarily out of line, but it does mean that if they made 10,000 stops and 5,000 were of Latinos, that something is definitely wrong. (Gutstein, 2002; no page nos)

In evaluating the lesson, Gutstein reports that:

> Students learned important mathematical ideas about probability through considering actual data about "random" traffic stops and compared these to the theoretical probability (what we should 'expect.') Graphing calculators can easily simulate large numbers of random 'traffic stops' (since they have a built-in 'random' number generator). (ibid)

What was learned is revealed in this 'fairly typical response' (ibid):

> I learned that police are probably really being racial because there should be Latino people between a range of 1-5 percent, and no, their range is 21 percent Latino people and also I learned that mathematics is useful for many things in life, math is not just something you do, it's something you should use in life. (ibid)

Emancipatory potential—albeit rather slender—was also apparent:

> What did emerge was students' sense of justice ('Why do they make random stops? … just because of their race and their color?') and sense of agency, as well as perhaps a sense of naïveté

('And Latinos shouldn't let them [police], they should go to a police department and tell how that person was harassed just because of a racial color'). (ibid)

The curriculum object—expected value—is explicit in Gutstein's text. The lesson itself—including the post-mathematical reflections—seems to follow the five steps of mathematisation quite well although, as usual, there is no real return to reality. Of particular interest, is the appearance of the term 'random', with and without quotes. The extracts seem to suggest that the police only pretend at randomness, whilst the graphing calculator is able to reveal what real randomness would look like using imagined 'traffic stops'. A mathematical and political success, it would seem.

But here's the thing: random traffic stops are illegal in the US, being a breach of Fourth Amendment rights; police have to be able to demonstrate probable cause for their suspicion that an offence has been committed.[2] In fact, one might suppose that police are often not able to estimate the ethnicity of a driver until after they have made the stop. This would seem to suggest that, if there is a correlation between ethnicity and the probability of being stopped, then we might look for the presence of intervening variables for an explanation—a correlation between ethnicity and relative poverty and the association of the latter with the use of elderly and poorly maintained vehicles having visible defects, for example.

Statistics can be used in all sorts of way, of course. One Illinois Department—the Wilmette Police—used their data on traffic stops to demonstrate that stops for different ethnic groups and genders were, in fact, in proportion to their representation in the community, thus demonstrating that 'Wilmette police officers are engaging in bias free traffic enforcement' (Carpenter, 2004; p. 66). One possible interpretation might be that, if the stops are non-random (as the law requires), then behaviour that might lead to a stop being made is evenly distributed in terms of ethnicity. Another might be that there has been some quota stopping going on.

The mathematics lesson and, in this case, the annual reporting of police activities by a police department, have privileged a mathematical scheme—probability theory—and, in doing so, have recontextualised police actions to the point of rendering them illegal! Rather more comprehensive reports are produced annually for the Illinois Department of Transportation (for example, Northwest University Center for Public Safety, 2007), again, though, the presumption that the expected value of stops for each category of driver is presented as the ideal state and any deviation is *prima facie* evidence of bias.

I need to introduce a little explicit sociology in order to make clear the basis of my argument here. I am conceiving of the sociocultural as constituted by action leading to the formation and maintenance (and sometimes to the destabilising) of alliances and of oppositions. We can think of the participation of mathematics teachers and textbook and test authors, and mathematics educationists as comprising one such alliance. Industrial mathematicians, perhaps, participate in another, skilled manual workers in manufacturing industry, another, police officers in Illinois, another,[3] and so forth. In the main, activity within an alliance will tend to reproduce that which marks it out as distinct from activity in other alliances. Of course, there are analytical decisions to be made in conducting a sociological analysis of any given alliance. For example, do we consider road users to be

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[2] Decker *et al* (2004) do argue that US courts have been very liberal in respect of what might count as probable cause. However, the principle that there must be a reason for a traffic stop does undermine the assumption in the mathematics lesson that the stops are intended to be random; they are not.

[3] Although the Wilmette Police Department seems to be taking advantage of mathematical recontextualisation.

participating in an alliance that is in opposition to the police, or as participating in different roles in the same alliance? The same kind of question might be put in respect of domestic shoppers and supermarkets. In general, though, we can think of the sociocultural as a collection of such alliances, each exhibiting a degree of regularity in its practice that bears on its individuality.

It is interesting to note that the same applies to school subjects that seem to be almost indifferent to each other. Thus, we do not find repetitions of elements of the mathematics syllabus on the physics syllabus or *vice versa*—as a perusal of the Swedish school syllabuses, for example, will illustrate (Swedish National Agency for Education, 2008)—even though they may be thought to be closely related subjects. This is not surprising; the training and appointment of teachers—at least, in high school—the school timetable and national assessments and international tests (for example, PISA and TIMSS) are generally organised on the basis of what Bernstein (1977, 2000) refers to as a collection code, the component fields of which must deploy what I want to refer to as *disciplinarity* strategies to constitute public singularities.[4] However, some activities—school mathematics, in particular—also operate *integrating* strategies through the fetch and push strategies that I have described. This is not to claim that they effect sociocultural integration, because the integrating strategies are generated by and within and essentially for the integrating activity and not those that it would integrate.[5]

Now this formulation of the sociocultural undermines faith in categories such as transferrable skills and migratory concepts because, although everyone will move between various activities on a day-to-day basis, as they do this the alliance—the basis of accountability of their actions—must also change; they move between activities that exhibit different rules, as it were. Dramaturgical and other exigencies, for example, frequently force more or less radical recontextualisation even in realist dramas; the need to fit case story arcs into single episodes of TV crime series effecting dramatic reductions in the amount of time necessary to carry out many forensic tests being a case in point; the need to establish forensic heroes also tends to result in the considerable enhancement of the accuracy, validity and reliability of such tests. We are, of course, generally quite happy to suspend our disbelief in such situations, or shift to another genre if we are not. Activity—the practice relating to a particular alliance—broadly regulates who can say or do or even, to a degree, think what. The use of fetch strategies—an activity fetching resources from another—is clearly important. We can enjoy our TV dramas without worrying about how realistic they are, we can pick up inspiration from anywhere. Further, activities need to include public domain language if they are to apprentice novices. There is a danger, however, in an activity operating in integrating mode via the deployment of push strategies. This danger resides in the corrosive ideology of integrated rationality and also in presenting distorted practices to students who may not have had the chance to participate in the relevant activity and so know better.

Let's look again at Sewell's contention about percentages:

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4 Bernstein refers to these as boundary maintaining strategies. My approach, however, is relational, so the concept of 'boundary' is unhelpful.

5 It is for this reason that I consider Bernstein's 'integrated code' and, in his later terminology, 'vertical discourse' to be impossible (or, perhaps, perpetually deferred) states. My description of the sociocultural does not rule out the forms of interdependence that appear in Durkheim's (1984) 'organic solidarity', but I would speculate that these will be constituted by local fetch strategies and would not radically transform the sociology that I am constructing.

> For the shopper, the ability to estimate 10 per cent can be a valuable 'key' to checking other percentages—even if a precise answer seems too difficult. Since the currency became decimalised, it is a trivial matter to work out 10 per cent of a sum of money, and this can easily be used to estimate other percentages. Those who lack the skill even to calculate 10 per cent are surely handicapped when attempting to understand the affairs of society. (Sewell, 1981; p. 17)

There may have been a point in time when this was the case (although I doubt it). Now, however, it is generally no more necessary for us to be able to calculate the effect of a ten percent reduction on a price than it is for us to be able to calculate our mortgage repayments. Our culture incorporates calculators in the forms of price labels, tables, shop assistants and so forth. It is necessary for *some* people to be able to deploy the appropriate technology in order to perform such calculations, but not for everybody to be able to do so. I have to report that I virtually never perform any kind of calculation in any context. When it comes to shopping, this may be because a full professor's salary, though very far from magnificent, at least allows me not to have to worry that I won't be able to cover the cost of the goods in my supermarket trolley or the increase in my mortgage repayments when the rates go up (well, actually, I don't have a mortgage any more). But there is also ample evidence that shoppers who do need to shop economically are able to do so without any assistance from school mathematics, devising context specific tactics in making best-buy decisions (as we all know, Lave, 1988; Lave et al, 1984). I have noticed, also, that many of the price labels in major supermarkets in the UK have, for some time, included the price per unit of measurement.

I have already questioned Sewell's understanding of the economy, but it's also not entirely clear what inflation rates tell any of us about what has been happening to prices; here is a piece from the 'Money' section of *The Guardian*, a UK daily newspaper quite widely read by teachers and other middle class professionals.

> Government data puts annual food inflation at 6.6%. But in the malls of Britain shoppers would be quick to say the number-crunchers are having a laugh. At Asda, a dozen free range eggs cost £1.75 in May last year. Now the price tag is £2.58—a rise of 47%. In Sainsbury's, 500g of pasta has gone up from 37p to 67p—an 81% increase. Bread is up by 20%, English cheddar by 26% … the list goes on (see page 3). (*The Guardian*, 17th May 2008)

What is important is not so much an understanding of the economy—who has that?—but an ability to maintain a household budget and, as I have indicated above, that is done effectively (or not) without the assistance of school mathematics. If we are engaging in political discourse, then we may take a view on inflation. Is it bad, because prices go up and wages generally don't seem to go up as much. Is it good, because, although wages don't keep up with inflation, they nevertheless go up, generally entailing that the proportion of our income that we spend on mortgage repayments goes down, leaving us with a net effective increase in spendable income. We are not often told that, are we, but I didn't calculate it, I experienced it. Having had an extended period of low levels of inflation, I've found that I'm not getting any better off as I used to in the 'bad old days'.

The Guardian also has tips for coping with price inflation:

> Don't casually buy ready made things that take moments to make at home at a fraction of the price, […] "Never buy pre-made pasta sauces (£1.50 a jar) as these can [be] whipped up in the same time it takes to cook the pasta—at a fraction of the cost. Fry an onion, add some tinned tomatoes, a few herbs, a dash of wine—and in eight minutes you're done."
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> [Allegra] McEvedy, who co-owns the Leon chain of restaurants, says it will not only taste better, it will have less salt and sugar often used to bulk out factory-made sauces. *The Guardian*, 17th May 2008)

I would certainly agree with Allegra that the sauce is likely to taste better, though I would also suggest including a little shoyu (increasing the salt content), cayenne or black pepper and, if one wants to sweeten the sauce by marmalising the onion, then it's going to take a great deal longer than eight minutes. On the price, checking with some recent till-slips, a tin of tomatoes costs 42p (what if I'd bought organic?) and a large onion 30p (but you have to buy three). I believe (from memory) that a small pack of fresh basil costs about 70p. Now assuming that I have the wine (open) and am happy with just one herb, then I've made a saving of 8p. The particular fraction of the cost in this case (not counting the cost of the wine, additional cost of cooking over heating up, or my time) is 95%, but it's only this calculation that has required any knowledge of percentages. Unless one is cooking and buying in bulk (like a restauranteur), in which case many of us would have storage difficulties, then I have no doubt that cooking from the basics at home generally costs more than buying prepared food and one frequently does have problems buying the right quantities (hence recent reports of large amounts of food being wasted in the UK[6]). I didn't need to do any calculations to know this; during periods when I have relied on buying prepared food, my shopping bills have been distinctly lower than they are when I do my own cooking. One doesn't do it because it's cheaper, but because it tastes better and gives one more choice.

And, as an aside, because my partner is Japanese and lives and works in Japan, we are together for only about half of each year. So I spend a good deal of the time living on my own. Comparing this with my experience of my previous marriages, I find that, despite the fact that I always did my share of housework etc, I am spending far more time on housework and other domestic responsibilities (dealing with banks, stores etc) than I ever used to and also that buying food for one is far less economical than buying for two. But this, as with home cooking, is a lifestyle choice and not a financial one. Where household income is such that financial criteria do come to the foreground, most people manage at least to develop tactics for quantification. It's poverty that drives them to the pawn shops and loan sharks (including the increasing number now advertising on English TV) and not a lack of mathematical skill. For the overwhelming majority of people, mathematics is not of any use to them whatsoever.

A similar argument might be presented in respect of Gutstein's probability lesson, though I have already spent quite a bit of time on it. The push strategy here proposes mathematics as a mechanism for critical action. However, not only has the mathematising corrupted the policing activity, but statistical arguments can always be reversed—as both Disraeli and the Wilmette Police recognised—precisely because they must eliminate the detail in which the devil is inevitably to be found. The presence of mathematics on the school curriculum does not enable critical political action. What it does do is provide an alibi for the use of often spurious statistical arguments by governments and institutions precisely because statistics is a part of the national, and indeed, international curriculum.[7] There is a sense in which what I have termed the *mathematicoscience* of the school curriculum (Dowling, 2007, 2009) combines the binary logic and syllogistic form of argument of mathematics and the

[6] http://www.guardian.co.uk/environment/2008/may/08/food.waste.

[7] This is not to deny the value of quantitative research methods—perhaps particularly in respect of asking rather than answering questions—and other activities involving quantification. However, these take their meanings from their native activities, which, in general, are not school mathematics and cannot be taught within the context of school mathematics. Nor do we need ten or twelve years of compulsory school mathematics for all in order to prepare what will inevitably be a very small proportion of school students for subsequent apprenticeship into these activities.

objectivity of school science as the *lingua franca* of public discourse, leaving those in a position to negotiate and make policy and run organisations and institutions to do so only provided that they announce a rational recontextualising of their actions. Mathematics as a compulsory school subject is of very little use to anyone, is dangerous and, almost incidentally, very expensive and must be abandoned.

It will or course be argued that I am myself presenting a rational (though not mathematically rational) and objective (though not scientifically objective) integrating discourse by fetching selectively from activities beyond my sociology. It will be argued, further, that, in offering a policy to an activity that is beyond my sociology I am engaging in a push strategy. This is entirely correct. However, I am speaking from one activity to an audience already fully participating in another. You may feel that there are no problems with mathematics teaching and the mathematics curriculum, including the PISA and TIMSS tests etc. You may feel that such problems as you do identify are most appropriately solved by equilibrating your own individual and collective experiences and expertise and/or by selective fetching of resources from other disciplines, such as psychology, or even other sociologies. On the other hand, though, I also used to be a participant in your alliance, before turning traitor. What I recall from that time was that it was the very compulsion and the curricular obligation to market mathematics in terms of the *myth of participation*—the claim that mathematics is a necessary supplement to what the student already knows if they are to optimise their own lives—that was so corrosive. Rather than pushing it down students' throats, into their lives, we should craft and market mathematical productions in the same kind of way that others craft and market good TV drama (mainly American rather than British, these days). If we do it well enough, then we'll attract an audience; otherwise, let them switch channels.

References

Bernstein, B. (1977). *Class, Codes and Control: towards a theory of educational transmissions*. Volume 3. London: RKP.

Bernstein, B. (2000). *Pedagogy, Symbolic Control and Identity*. New York: Rowman & Littlefield.

Carpenter, G. (2004). *Wilmette Police Department 2004 Annual Report: Traffic stop data collection and analysis*. Wilmette: Wilmette Police Department.

Cockcroft, W. *et al*. (1982). *Mathematics Counts*. London: HMSO.

Coleridge, S. T. (1985 (1817)). Bibliographia Literaria. In H. J. Jackson. (Ed). *Samuel Taylor Coleridge*. London: Oxford University Press.

Cooley, M. (1985). 'Drawing up the Corporate Plan at Lucas Aerospace.' In D. MacKenzie & J. Wajcman (Eds). *The Social Shaping of Technology*. Milton Keynes: Open University Press.

Decker, J.F., Kopacz, C. & Toto, C. (2004). 'Curbing Aggressive Police Tactics During Routine Traffic Stops in Illinois'. *Loyola University Chicago Law Journal*. 36. pp. 819-892.

Dowling, P.C. (2007). 'Quixote's Science: Public heresy/private apostasy.' In B. Atweh *et al* (Eds). *Internationalisation and Globalisation in Mathematics and Science Education*. Dordrecht: Springer.

Dowling, P.C. (2009). *Sociology as Method: departures from the forensics of culture, text and knowledge*. Rotterdam: Sense.

Durkheim, É. (1984). *The Division of Labour in Society*. Basingstoke, MacMillan.

Gutstein, E. (2002). Math, SATs, and Racial Profiling. *Rethinking Schools Online*. 16(4) (no page numbers). www.rethinkingschools.org/archive/16_04/Math164.shtml

Lave, J. (1988). *Cognition in Practice: mind, mathematics and culture in everyday life*. Cambridge: CUP.

Lave, J. *et al*. (1984). 'The Dialectic of Arithmetic in Grocery Shopping.' *Everyday Cognition: its development in social context*. B. Rogoff and J. Lave (Eds). Cambridge, Mass., Harvard University Press.

OECD. (2008). *Taking the Test: Sample questions from OECD's PISA assessments*. Paris: OECD

Sewell, B., 1981, *Uses of Mathematics by Adults in Daily Life*. London: ACACE

Northwest University Center for Public Safety. (2007). *Illinois Traffic Stops Statistics Study 2007 Annual Report*. Evanston: NUCPS

Swedish National Agency for Education. (2008). *Compulsory School Syllabuses. Revised 2008*. Stockholm: Fritzes