# History and Mathematics or History with Mathematics: does it add up?

Ian Phillips expresses some frustration with the way the *Numeracy across the Curriculum* strand of England's Key Stage 3 Strategy is sometimes presented. He argues that the acid test of cross-curricular numeracy is the value of mathematical understanding in aiding historical thinking and imagination. He criticises attempts to plant numeracy activities in history lessons for their own sake. Instead, Ian encourages history teachers to think about the potential of mathematics to enrich history. Using the kind of data that some history teachers might judge dry or lacking in human interest, he argues that elementary work on such data can illuminate disturbing, colourful and significant stories or trends. Armed with purposeful historical enquiry questions and some basic calculations, pupils can learn to use numerical data to assess historical significance and to build a sense of period that embraces motivation, attitudes and values in the past.

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Within much current curriculum guidance in England,[1] there is an assumption that, whenever and wherever possible, history teachers will make links with the mathematics curriculum. This is based on a further assumption: that history can also somehow promote the numeracy strand of the government's Key Stage 3 Strategy.

Curriculum guidance in most documentation is, to say the least, vague. It might best be described as well-meaning exhortation. The Teachers Guide in the QCA Schemes of Work defines numeracy as: 'The product of success in learning mathematics'. It states 'pupils' numeracy will benefit from the opportunity to apply their mathematics in history.'[2] It also makes the less than helpful suggestion that:

> *Some of the characteristics of mathematics, e.g. problem solving, sequence, patterns and relationship, causation, hypothesis, can be developed through history and opportunities occur in many of the units.'*[3]

I would think that this might be an example of a 'standard insert' such as the statements in the National Curriculum document about inclusion. Ideas of patterns, relationships and concepts such as causation are certainly present in historical study but they are completely different from similar ideas in mathematics where predictability and logic apply. A more up-to-date definition of numeracy and its place in the wider curriculum appears in DFES Key Stage 3 Strategy guidance:

Priorities for cross-curricular numeracy

- To improve accuracy, particularly in calculation, measurement and graphical work
- To improve interpretation and presentation of graphs, charts and diagrams
- To improve reasoning and problem solving.[4]

In both documents, examples include pupils collecting and recording, presenting and interpreting data. There appears to be a significant degree of confusion here. The contexts include everything from medieval monarchs and castles to details of people, family relationships and occupations in Victorian census details. Arguably, it is good use of ICT in history to use spreadsheets or databases to manipulate evidence by sorting or identifying patterns or categorising. ICT can be used to aid historical thinking by cutting out the boring processing of data. But the other activities are rather different. Many of them are deeply worrying to any history teacher concerned about valid historical activities. Recently emerging evidence from colleagues in partner schools undergoing, or enduring, orientation in the cross-curricular numeracy strand of the Strategy, report one commonly recommended activity which clearly has the official seal of approval and links history and numeracy by suggesting that pupils can draw pie charts of a day in the life of a monk to show the times spent at prayer, work, contemplation and so on. This activity requires pupils to plot and draw graphs and pie charts by hand apparently enabling them to practise the skills of measuring angles accurately and to demonstrate the sophisticated concept that a full circle can be divided into 360 degrees. 'Yeees,' as Jeremy Paxman might say. This is not quite drawing a picture of a Spinning Jenny but it's close. The crucial difference between these approaches is that the ICT processing tasks can be used to aid pupils' historical thinking but the mechanical task outlined above requires little in the way of original thinking. Nor does the mathematics derive from any obvious relationship to an *historical* question, problem or issue that needs to be resolved.

**In understanding why the war crippled the British economy the small, rusty mound of bullets offers an eloquent testimony.**

## Mixed methodology

The problem lies in the idea that we should be able to demonstrate that, throughout Key Stage 3, pupils will be able to do some mathematics in their history lessons. There is an assumption, which largely remains unchallenged, that mathematics is of pre-eminent importance. Indeed, the DFES claim that a weakness in mathematics is a serious handicap: 'evidence shows that poor numeracy skills are a greater impediment to life chances than poor literacy skills. If all members of staff support the drive to raise standards of numeracy the career prospects of pupils will be improved.'[5]

The message appears to be coming over loud and clear: if we history teachers are unable to demonstrate that our subject cannot incorporate mathematics then we are, like Private Fraser, doomed. This is a strange attitude. As history teachers, we are, more or less, comfortable with the idea that ICT is a useful tool to support and develop pupils' historical understanding. We are even more convinced that literacy and history have a natural, symbiotic relationship: develop one and understanding in the other grows. There are lessons here for an emerging relationship with mathematics. The relationship with mathematics should be stood on its head: pupils should not be required to 'do' maths in history lessons; rather, maths should be used, where necessary, to aid pupils' historical understanding.

## How many millimetres of rain does it take to fill a bath?

Over the half-term holiday, I managed to snatch one day away in the Langdales with my 13-year-old son. We had reached a summit when rain began and rapidly became one of those Cumbrian downpours which turn entire hillsides into rivers. It was a very heavy and sustained rainstorm. Trying to estimate how much rain had fallen was difficult but what was interesting was the question 'what does 10mm of rain mean?' It is at this point that my meteorological and mathematical understanding might part company but 10mm of rain probably means that for every square millimetre 10mm of rain falls. Profound? If, however, you use mathematics to convert this to something more meaningful the ability of mathematics to aid understanding becomes obvious. 10mm of rain on 1sq meter = 10 multiplied by 1000 = 10 litres of rainwater. The hillside we were descending and which drained into Stickle Tarn, covered about 1sq. kilometre. Therefore, according to my calculations, 1sq km = 1,000sq m multiplied by 10 litres per sq m = 10,000 litres of rainwater running down the mountainside into the Tarn in perhaps less than 30 minutes. This means something – even if you are not very good with metric measurements and still use miles per gallon. It is possible to equate the volume of rainfall with average daily household consumption.

The point of this excursion into geography fieldwork is that simple mathematics has been used to make some abstract notion such as rainfall into a readily understandable concrete example.

There is any number of opportunities to make use of simple mathematics to help historical understanding and this is perhaps the direction we need to go: show pupils they can use and apply mathematical skills to help the history. This time, a concrete historical example: on a field visit to the 1st World War battlefields with trainee history teachers last summer we stopped for lunch at a guesthouse – Estaminet – in the village of Auchonvilliers, familiar perhaps to readers of Edmund Blunden. The farmhouse had been a dressing station just behind the front line close to the modern day Newfoundland Park. A historian from the National Army Museum has spent a number of summers excavating the grounds and unearthed numerous trench lines behind the farmhouse leading into the cellar. Drying in the sun were examples of the still dangerous ironware, so common in this part of France. One find was a rusted mass of machine gun bullets, threaded on a belt which had long since rotted. Altogether about 10,000 rounds of bullets had been dug up, seemingly just dumped when the line moved. The interesting statistic was that each bullet cost, in modern money, about 50 pence. The various piles of 10,000 rounds of machine gun bullets simply dumped represented a cost of £5,000. And this was just one very small patch of the old Western Front. In terms of understanding why the war crippled the British economy the small, rusty mound of bullets offers an eloquent testimony. Take the mathematics further forward: an average rate of fire for a machine gun would be 400 rounds per minute. Multiply by 60 rounds per hour to get 24,000. To keep one machine gun firing for one hour therefore cost approximately £12,000 in today's money. The same amount of money is equivalent to the cost of two history PGCE trainees' salaries for an entire year.

Aiding understanding here requires nothing more than simple mathematics and then a degree of equivalency: what does the sum of £12,000 mean in terms that are readily comprehensible to history PGCE trainees – or to your pupils? Total sums and bigger pictures are often too great to comprehend. They do not necessarily mean anything, even to adults. They are just figures with a lot of zeros at the end. What is important is the ability to link arithmetical calculation with historical imagination. The sum here creates an appreciation of the crippling cost of war.

## The mathematics of slavery

During a recent visit to the Atlantic Slavery Gallery at the Merseyside Maritime museum it became apparent that a major impediment to understanding the

**Figure 1:** The profitable voyage of the Chesterfield

| Item | Expenses | Receipts | Profit |
|---|---|---|---|
| Fitting out the Chesterfield This was a single cost and was therefore a significant capital expense but not a recurring item. | £10,000 | | |
| Sale of slaves in the West Indies | | £22,000 | |
| Agent's commission, (for arranging sale of slaves in Americas) | £300 | | |
| Cargo (this included both the cost of slaves bought in Africa and cargo loaded in the Americas) | £2,500 | | |
| Outfitting (costs involved in getting ship ready for voyage) | £4,500 | | |
| Wages (It is not clear if this is simply crew's wages. Officers, and certainly the captain, received a percentage of profits and were sometimes even able to sell their 'own' slaves.) | £1,300 | | |
| Costs on voyage (costs of food etc for voyage) | £ 950 | | |
| Total expenses for voyage | £9,550 | | £12,450 |
| Less capital expense of refitting vessel | | | £2,450 |

significance of the slave trade lay in the inability of the Museum to make use of much of the data, which is used in the displays. The moral argument against slavery requires little amplification for most pupils. Usually their innate sense of justice – that slavery is simply wrong – is reinforced by the evidence of personal testimony which is used very well in the museum.

What the museum does not do particularly well is to help pupils to understand why slavery was so enduring and why the force of the abolitionists' moral arguments were singularly unsuccessful for so long in Liverpool and other ports involved in the trade. The evidence is there but it is unattractive. Difficult to read instructions to ship's captains and accounts produced following 'successful' voyages in eighteenth-century handwriting are left to the imagination, or not, of visitors. They might not be harrowing stories of a voyage across the Atlantic but the accounts offer an equally persuasive witness to the realities of the slave trade. How could 'good' Christian men (and women), at a time of enlightenment, involve themselves in a trade which today is clearly wrong? The evidence of one voyage of one ship answers most of these questions. Unfortunately the ship's accounts are presented in a glass case with very little or no interpretation and most visitors pass them by with very little regard or thought. They are, after all simply figures on a sheet of paper.

One such voyage of the merchantman, the 'Chesterfield' (see Figure 1), in the 1770s, is full of rich clues that can easily enable pupils understand the significance of this trade. The figures do not give a full picture but there is sufficient detail available to give a snapshot and it can serve as a means of deepening pupils' understanding of the nature of the slave trade:

- Some costs are hidden, such as insurance and banking: Who would provide these financial services? Were the bankers and insurers 'guilty' men?
- How were the refitting costs met? Was it just one owner or were other investors who owned a 'thirty-second' or 'sixty-fourth' part of the ship?
- We do not know what happened to the cargo brought back from the West Indies.

The additional evidence would present a fuller picture but from the evidence available it is apparent that the slave trade did not just involve the ship owner and the crew but was an inseparable part of the business life of the port (see Figure 2 for some of these calculations). Perhaps the most significant question is 'What could you do with £10,000 in the 1770s?

These figures alone open up any number of points for consideration:

- The relative cost of cargo compared to the prices slaves brought in the Americas.
- The levels of profit which could be made from a single journey: if refitting expenses are removed, the Chesterfield was working on a profit margin of over 100%.
- It could be possible to consider where and how such profits could be made today on a similar scale.
- There are also the facts that such a balance sheet does not reveal: did the profits just go to the ship owner, for example, or were there other investors?

The mathematics or, in this case, the arithmetic, in Figure 1, is not very difficult. The historical significance comes from being able to transform these sums into an understandable context for pupils. At University I have

**What is important is the ability to link arithmetical calculation with historical imagination.**

Figure 2. The 1770s: A profitable decade?

| | |
|---|---|
| 280,000 | The number of slaves shipped across the Atlantic in Liverpool ships |
| 280 | An average number of slaves carried on each voyage |
| 1,000 | The approximate number of voyages made by Liverpool ships in the 1770s |
| £12,000 | An average profit made by a Liverpool slave ship per voyage |
| £12,000,000 | The profits Liverpool ships made in the 1770s from the slave trade |
| £3,800,000 | An estimate of the crews' wages from the slave trade injected into the Liverpool economy in the 1770s |

grim memories of an eighteenth-century history course which was heavily based around Lewis Namier's *Structure of Politics at the Accession of George III* and Mingay's *English Landed Society*. Lectures involved a stultifying series of accounts of income for the landed classes. Despite the experience, one of Mingay's calculations remains fixed in memory: the levels of income for the top 400 landowning families. To maintain their lavish lifestyles this required an income of around £10,000 per annum. These top 400 landed families classes owned around 20% of the cultivated land in the kingdom in the middle of the eighteenth century.[6] The significance of this should be apparent: one successful slave voyage could provide an income, which could put the ship owner amongst the ranks of the wealthiest members of 18th century society. This the product of a single voyage.

Yet more evidence is on display within the museum, with no attempt to contextualise it. In that decade, the 1770s, when the Chesterfield made its average, but spectacularly profitable, voyage to the Americas via West Africa, some 282,000 slaves were transported across the Atlantic in Liverpool-owned vessels (see Figure 2). The arithmetic is again simple and the manipulation of the statistics might be suspect but again within the numeracy strategy there is a requirement that pupils in Key Stage 3 should, by Year 9: 'use proportional reasoning to simplify and solve problems' and 'give results to a degree of accuracy appropriate to the context'.[7] Therefore these mathematical activities are entirely appropriate. But this is where the mathematics ends and history begins.

**Perhaps the most significant question is 'What could you do with £10,000 in the 1770s?**

Contextualising the vast sums shown in Figure 2 and making them accessible to pupils (and museum visitors), is difficult but not impossible. Perhaps this example from Namier might help: in 1759 a severe financial crisis forced the government of the day to seek a loan from the City of London, the sum required was £8,000,000.[8] Put it another way: wealthy Liverpool merchants and ship owners with guaranteed profits from the Atlantic trade (slavery and sugar) could have bailed the government out of this crisis with very little effort. These figures have even more significance when we reflect upon the impact of the downturn in trade which was a feature of the 1770s: the financial problems facing the East India Company and successive crises which foreshadowed the American War of Independence.

## Giving maths meaning

This kind of example does provide a valuable contemporary context and the use of simple mathematics can help develop the appreciation of the nature and scale of money involved in the Atlantic slave trade. What is significant is that the mathematics or the numeracy element is being used in the same way as we might consider using ICT: it is helping us to develop pupils' historical understanding and at the same time demonstrating how a basic command of arithmetic can aid this process. From a numeracy 'angle' I can only assume that it is good practice to be able to demonstrate, practically, how an understanding of number can make another curriculum area more accessible

Translating money and figures into a twenty-first century context can also be useful but again requires careful consideration. There have been numerous ways of demonstrating real prices. Translating historical costs into the equivalent price of a MacDonald's meal or a Mars bar, for example, might provide some sort of constant. Again, the example of the slave trade provides a valuable lesson. There are a number of assumptions made about the slave trade and the value of a slave's labour.

Examples again used in the museum showed that slaves, deemed to be 'prime rice planters' in the Carolinas, commanded prices at auction which represented a significant investment. But once again the museum makes very little attempt to make these figures mean

anything. Figure 3 attempts to do just that by providing an anchor point. The figures might be a little rough and ready but this way of approximating is useful.

The statistics are not important in themselves; it is how the historian makes use of them. The significance of these calculations is that they both provide a valid modern reference point and a starting point for discussion and informed speculation:[9]

- The cost of a slave in the eighteenth century was the equivalent of seven to ten years' income of a working man.
- Translated into twenty-first century terms, we are looking at an equivalent price of £75,000 to £100,000 or the price of a modern 3 bed semi in the North West: or a small garage in London.
- Buying a slave was a significant investment and had to be justifiable in terms of a return on an investment.
- Would it have been cheaper to free plantation slaves and employ them as free workers?
- Pupils studying this topic would probably already be familiar with working conditions in Britain during the industrial revolution. It might be appropriate to make links with the issue of 'Yorkshire Slavery' and the agitation for changes to working conditions in the mills and mines.
- Rice plantations were very often growing food for sugar plantations in the Caribbean, this was not a high value crop like sugar. This opens up further avenues for discussion about the real extent of the slave trade.

We could also look at these figures in the context of the slaves carried to the Americas in Liverpool ships. Assuming that only 100,000 of the 280,000 slaves would be classed as 'prime' – i.e. young, strong, male and healthy – this figure would represent a very significant investment by the sugar or rice planters. In twenty-first century terms the calculation would be 100,000 slaves multiplied by the market price of £100,000 an 'investment' of £10.000.000.000 or TEN BILLION POUNDS and this just for one port: Liverpool. It might all come down to money but the scale of the Atlantic slave trade can best be appreciated within this commercial context.

This approach to Atlantic slavery makes for more interesting and challenging questions on the nature of the trade itself. It is not removing the important human element and reducing slavery to an economic model; it is offering the potential for a far richer and deeper appreciation of the significance of the slave trade to the British economy in the eighteenth century. Much of the evidence used both in the Maritime Museum and in numerous school texts consists of eyewitness testimony and of equally powerful images. As a consequence slavery is often taught as an exercise in empathetic understanding. The sources are powerful and compelling. They rightly and naturally confirm pupils' views that slavery is morally reprehensible. But if pupils are to gain an insight into the ideas, beliefs and attitudes of the Liverpool or Bristol merchants or members of the new moneyed classes: for example the Grosvenors and the Lascelles, the mathematics can provide additional evidence which adds substance to pupils' understanding of the issues involved. If pupils are working through an overarching enquiry question such as 'Why did the slave trade last so long?', 'Who benefited the most from the slave trade?'

**One successful slave voyage could put the ship owner among the wealthiest members of 18th century society.**

Figure 3. Making the numbers add up.

| | 18th century prices | 21st century prices |
|---|---|---|
| Statutory minimum wage | | £4.00 per hour |
| Daily rate @ 10 hours per day | | £40.00 |
| Weekly rate @ 50 hours per week | | £200.00 |
| Annual income | | £10,000 |
| Weekly wages | 10s. or 50p | |
| Annual income | £26.00 per year | |
| Rowntree's recommended minimum wage 1900 | £52.00 | |
| Cost of prime slave in South Carolina | $1,275.00 or between | |
| working on rice plantation | £250 and£300 | |

**This approach to Atlantic slavery makes for more interesting and challenging questions on the nature of the trade itself.**

or 'What makes the slave trade historically significant?' such mathematical activity provides access to hard evidence and fertile ground for inferences, hypotheses and assertions.

Of course, the obvious 'economic' approaches to this topic could lead to some dull history. The trick is to use the mathematics and the economics to put more flesh on the bones of the story. The potential for active involvement with this kind of historical evidence is significant. The 'sums' have been done for you in Figures 1, 2 and 3 but they should be within the capabilities of many pupils. The real trick, however, is to draw out the conclusions from evidence of this kind. The real thinking comes with working out the proportions and percentages or with the ability to make modern day comparisons or references. Using evidence in this way offers a way into questions about significance, or about rates of change and growth. Above all pupils are provided with tools for making substantiated arguments and developing a line of reasoning based on hard evidence. Mathematics becomes the servant of history: QED.

The examples provided in Figures 1 – 3 demonstrate how the manipulation of economic 'evidence' through simple mathematics can add a significant dimension to pupils' historical understanding. I have seen similar figures which relate to coal owners' profits from pits in the St Helens area. These present similar insights into the scale and profitability of the coal industry in the mid-nineteenth century. It must be possible to dig up any number of factory or estate accounts to provide the kind of evidence which pupils would find accessible. In terms of the work on the Atlantic slave trade I would not envisage that the kind of economic evidence referred to above would replace the rich personal testimony or the immediacy of the visual sources but it could provide an additional and highly significant strand of evidence which would help to make the debates for and against slavery far more rigorous and historically valid.

These examples drawn from the Liverpool slave trade add another dimension to pupils' understanding. The mathematics involved is not difficult. What has triumphed here is historical imagination over essentially mundane mathematics. Instead of trying to demonstrate how history can help to teach maths, history teachers should take the initiative and show how maths teachers, or the maths curriculum, can help pupils make sense of the past. It is, after all, the method that history teachers have adopted with ICT. Mathematics is a servant, an enabler and not intrinsically of value to the vast majority of the population as a separate subject. If it were, I suppose there would be a www.bbc.co.uk/maths zone on the BBC web site or book titles like *The Romance of Maths* would be up alongside *Stalingrad* on the 'best sellers' list. Some maths-related books do make it: Dava Sobell's *Longitude* being one such example but the nature and style of the work betray her background as a science journalist. The film was decidedly better, the book: a disappointment, nothing more than a humdrum matter of fact chronicle.

This approach to mathematics or arithmetic within the history curriculum might not be the way that the planners of the QCA *Schemes of Work*[10] envisaged the connections working but the use of basic arithmetic can transform pupil understanding, provide a significant context and demonstrate any number of human motives.


REFERENCES

1. The Key Stage 3 Strategy is a policy being applied to secondary schools in England and not in Wales, Scotland or Northern Ireland.
2. QCA (2000) *History: A Scheme ofWork for Key Stage 3. Teacher's Guide* p 13.
3. *ibid* p13
4. DFES (2001) *Numeracy Across the Curriculum: Unit 1 The Importance of Numeracy Across the Curriculum* p23.
5. *ibid* p20. This would appear to be 'evidence' in the Woodhead rather than the historical sense of the word.
6. Mingay, G. (1976) *English Landed Society in the 18th Century,* Routledge p20.
7. DFES *op cit* p22.
8. Namier, L . (1973 ) *The structure of Politics at the Accession of George III* Macmillan p55.
9. Some of the issues relating to the economics of slavery and the condition of American slaves are discussed in Parish, P. (1989) *Slavery: History and Historians* Harper Row New York. Parish examines a range of views on slavery in the southern United States, in particular the view of Ulrich B Phillips, a southern historian writing in 1918, who described slavery as a patriarchal but unprofitable institution. The problems of over-reliance on 'hard' economic or quantitative evidence are also highlighted by reference to Fogel and Engerman's (1974), *Time on the Cross.* Amongst their conclusions was that slavery was efficient, profitable and mild in as much as the slave was a valuable capital asset.
10. QCA (2000) *op cit.*