RESEARCH IN SECONDARY TEACHER EDUCATION
Vol.1, No.2. October 2011. pp. 20–23.

Is the Handling Data Cycle about to do a runner?

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This article reflects back on a previous review of the Handling Data Cycle (HDC), part of the statistics section of the National Curriculum programmes of study for mathematics. It summarises the findings of the earlier review, considering these in light of recent experiences in school of a group of trainee secondary mathematics teachers. In particular, the effect of there no longer being GCSE statistics coursework is discussed. With reference to the priorities of different educational ideological groups, the article supports a continued emphasis on HDC in our training, despite indications that it is becoming increasingly marginalised in the secondary mathematics curriculum.

Keywords: Handling Data Cycle; Statistics, Coursework; Trainee Mathematics Teachers; Ideology.

Introduction

For the past eight years the majority of mathematics graduates training as secondary mathematics teachers at the University of East London (UEL) have taken a pre-PGCE two-week maths 'booster' course, a recap of topics from the higher tier of GCSE mathematics. This includes a statistical investigation – the 'Water' project – which is undertaken according to the requirements of 'The Handling Data Cycle' (HDC). Specified in previous versions of Mathematics in the National Curriculum (NC), it continues to be set out explicitly, yet GCSE syllabi have dropped statistical coursework. After carrying out a review of our training provision in the area of 'Statistics and Probability' as this evolved from 'Handling Data' in the previous NC four years ago, this paper considers the extent to which there will be a continued need to focus on HDC from September 2012.

The previous review

At the time of the previous review, the 'Water' project had been running for four years in the 'booster' course. The Secondary Mathematics PGCE had doubled in size, with just under half the trainees now taking a six-month Mathematics Enhancement Course (MEC) beforehand. Almost all of these trainees did their MEC at UEL, part of which was to carry out their own statistical investigation. In common with the 'Water' project, this emphasised that teaching the whole of HDC was required of our trainees during the PGCE. It had become clear that the past mathematical experience of our trainees had often emphasised the third part of HDC – processing and representing data. The second part of HDC – collecting data – had not been undertaken by a substantial number. The first – specifying a problem to investigate – and fourth – interpret and discuss findings – had been carried out by only a minority of the trainees. The variety of educational backgrounds of trainee maths teachers is widely acknowledged, with graduates from many different disciplines suited to teaching mathematics. This can be seen as a challenge: do trainees from a range of degrees have the right level of subject knowledge? Unfortunately, there is arguably a greater, less recognised difficulty. Our trainees usually share (at least) two prior mathematical experiences: the curriculum followed until they were around 16 years old, and their success in studying it. The subject knowledge challenge might be restated as: do trainees with broadly similar experiences of GCSE(-level) mathematics have the right level of subject knowledge? There are several GCSE topics, the hierarchy of operations and congruence being two such examples, where trainees' misunderstandings are not uncommon. Textbooks and exam papers routinely consolidate and assess pupils' knowledge with 'BODMAS-friendly' questions and the avoidance of non-explicit isosceles triangles, narrow and simplistic interpretations of these topics. Our trainees' unfamiliarity with specifying problems and interpreting results from HDC are further symptoms of the traditional focus in school mathematics on 'right' answers at the expense of mathematical reasoning.

The earlier review reaffirmed the importance of a continued emphasis on HDC, and led to the introduction of a reporting-back session during the

PGCE during which the 'booster' groups presented their Water project to the trainees who had done the MEC. The recognition of limited experiences during school mathematics and the arrival of another version of the National Curriculum led me to consider ideas of the curriculum being contested and Paul Ernest's categorisation of ideological positions in education (Ernest 1991), two of which proved useful for analysis of the statistics curriculum. Technological Pragmatists (TP) view education as important in contributing to 'technological and industrial development. . . seen as positive forces for social progress' (Ernest 1991: 165). TP is an absolutist position which represents a utilitarian view of education: mathematics is useful; applied mathematics is prioritised over pure mathematics. As such, mathematics is seen as an absolute form of knowledge, made up of certain truths which cannot be challenged. In adopting a meritocratic system which seeks to allocate individuals to their rightful position in society, TP attaches importance to certification as a measure of achievement.

Public Educators (PE) also view education as playing an important role in changing society, in their case by achieving greater social justice. Their view of mathematics emphasises its connectivity to cultural and social issues: 'it provides an understanding of and power over both the abstract structures of knowledge and culture, and the mathematized institutions of social and political reality' (Ernest 1991: 208). Mathematics is therefore fallibilist, with dimensions of culture and human activity affecting its corrigible and revisable form.

A note of caution regarding the often artificial nature of the sort of context-based mathematics as which HDC can be considered has been sounded by Richard Noss. Commenting on the first version of the National Curriculum, and in particular on three mathematically related situations, he points to the 'extreme artificiality' (Noss 1990: 19) of the problems: 'artificial mini-stories full of spurious contextual clutter but devoid of meaning' (Noss 1990: 19). Noss claims that the inclusion of 'anachronistic algorithms. . . runs directly counter to the utilitarian perspective espoused' (Noss 1990: 20). Noss's analysis has substance, and it was vital that artificially constructed scenarios were not viewed as evidence of TP or PE influence. A third, neutral, category was therefore used to allocate such situations, as well as ambiguous or, indeed, neutral items. Ultimately, however, none of the statements was categorised as 'neutral'.

The review analysed then-current curriculum and examination documents from two ideological perspectives: Public Educators (PE), with an interest in social equity, who aim to develop critical awareness through mathematics, and Technological Pragmatists (TP), who support a meritocratic hierarchy, and aim to develop useful mathematical knowledge according to ability. The review established the extent to which either exerted a dominant influence in recent developments of the curriculum. It also included 'Mathematics Counts' – the Cockcroft report – a still influential review of the UK mathematics curriculum. Here it was stated that 'too much emphasis is placed on the application of statistical techniques, rather than on discussion of results. . . and on the inferences which should be drawn' (Cockcroft 1982: 224). Cockcroft included a 'Foundation list of mathematical topics' (pp. 135–40). This concludes with 'Statistical ideas [covering] a critical attitude to statistics. . . probability. . . . average' (p. 140). Quoting from the Schools Council Project on Statistical Education's (POSE) submission, the report emphasised that 'statistics is not just a set of techniques, it is an attitude of mind in approaching data. In particular it acknowledges the fact of uncertainty and variability in data and data collection. It enables people to make decisions in the face of uncertainty.'

The 1982 position, then, as authoritatively set out in the Cockcroft report, was that statistical teaching in schools overemphasised calculation of statistical methods at the expense of collection and inference. The application of statistical techniques – the processing and representing data part of HDC – is associated closely with TP curriculum aims. Alternatively, adopting a fallibilistic view of knowledge, one which views it as socially constructed, a non-traditional view of mathematics, within which the interpretation of statistical data is readily accommodated, in which 'mathematical problems are embedded in social contexts' (Ernest 1991: 207), relates to PE values. Consideration was given to the extent to which there was potential for teaching of HDC to promote a view of mathematics which connects, not only with other curriculum subjects, but with issues that will allow students to develop a sense of critical citizenship. This provided evidence of PE curriculum aims.

Golby (1989) provided the study with a methodological approach with a clear illustration of curriculum specification within the technocratic tradition, which 'includes verbs of learner behaviour which can be observed to be present' (Golby 1989: 31). These were related to behaviouristic objectives, avoiding 'higher order learning, whether cognitive or affective in character, [where] finite lists of behaviour are inappropriate because the achievements are so

complex' (Golby 1989: 31). Examples of observable behaviours within given statements were treated as indicators of TP influence. At the time I concluded that:

1. the values of Technological Pragmatism receive comparable priority to those of Public Education in both the original and current versions of the National Curriculum for Mathematics in relation to 'Handling data';

2. the values of Technological Pragmatism receive greater priority than those of Public Education in Edexcel's GCSE Mathematics syllabus (1367 higher tier) in relation to 'Handling data'.

The evidence for this was based on three factors, with a fourth possibility indicated but requiring further inquiry. Firstly, the examination syllabus provides opportunities for the curriculum aims of the Technological Pragmatists to be developed in areas which in the National Curriculum emphasise the curriculum aims of the Public Educators. This effectively restricts the curriculum to areas of TP priority. Areas of Technological Pragmatism aims taking priority in the National Curriculum retain this priority. Examples included two 'long' examination questions. Each provided a relevant context for statistical investigation, including an opportunity for developing critical citizenship ideas. Neither offers the opportunity for candidates to demonstrate their ability to 'specify the problem' or 'interpret and discuss', indicating a narrowing of the curriculum that is assessed. All marks, 11 across the two questions, related to processing and representing the data, with 9 of the marks specifically for calculating statistical values.

Secondly, it was noted that broader curriculum themes consistent with the curriculum aims of the Technological Pragmatists were integrated into the syllabus; those relating to the Public Educators were not. The same was true of questions in the specimen papers, the third conclusion.

A fourth possibility raised by the review was that opportunities to develop the curriculum, aims of Public Education, are challenged by the Technological Pragmatists; these efforts had a distorting effect on the statistical process (eg providing data for projects). Further investigation into attempts to limit pupils' 'learning experience' of 'specifying the problem' in this way was felt to be warranted. Related issues of the contribution that statistical questions make to the overall grade in mathematics, and the presentation of statistics as a 'functional' (or otherwise) activity are also addressed.

The present review

At the start of the 2011 second school experience (SE2), we had 38 PGCE Secondary Mathematics trainees, half of whom I tutored and planned to observe twice. Of these 19 trainees, 3 were omitted from the review which surveyed the teaching files of the other 16, During the second half of the PGCE year, our trainees spend 12 weeks in their second school, their second school experience (SE2). Unsurprisingly, those working with Year 11 spend a significant amount of time supporting revision. A few have in the past been able to work with their Year 10 and 11 classes on the statistics coursework project. This opportunity appeared to have reduced last year (2009/10), and seems to have reduced to only 2 (out of 16) trainees this year. With the impending loss of statistics coursework, it is almost certain that there will be trainees whose experience of teaching statistics at Key Stage 4 will be restricted to this revision period.

Surveying the SE2 files of the trainees I have been observing, statistics lessons have prioritised 'processing and representing data'. Two examples went against this trend. In one of these lessons pupils were collecting data (heights of class members), although it was clear that pupils had contributed little to specifying the problem (gender difference) that had motivated the data collection. In the other lesson, pupils were discussing a painting and comparing different interpretations. These discussions led to a focus on 'what the painter is trying to say', and encouraged the class to ask questions and suggest a focus to investigate. This approach provided an interesting variation from that used in the 'Water' project (this trainee had attended the 'booster' course): news reports and publicity materials are discussed, issues raised compared, and potential lines of investigation identified. The stated purposes of the trainees were to develop 'rich tasks' and emphasise 'functional mathematics' – two priorities in the new NC. It was also evident that these lessons departed from the schemes of work for the classes involved, and needed approval.

The indications are that already the imminent loss of statistics coursework from GCSE, along with a streamlined, possibly underspecified NC, may have conspired to effectively eliminate HDC from the secondary mathematics curriculum. What can be claimed for the purposes of the current review is that our trainees have substantially less HDC teaching experience than previous cohorts from three or four

years ago. As indicated at the start, to what extent should HDC feature in the training of Secondary Mathematics teachers from September 2012?

Conclusion

It was stated in the Cockcroft report that 'too much emphasis is placed on the application of statistical techniques, rather than on discussion of results. . . and on the inferences which should be drawn' (Cockcroft 1982: 234). Thirty years on and any progress made faces a challenge. We risk reverting to a pre-Cockcroft approach to statistics. However, just because exam syllabi have minimised HDC requirements, statistics coursework was until recently part of GCSE, and it has been included in all versions of the National Curriculum. Our next cohort of trainees will not be well served if it is not part of their training.

Connections make mathematics meaningful; there is no sense in a disconnected HDC. The two trainees who did teach more than just 'processing and representing' noted the departure from schemes of work, as well as the desire to use rich tasks and promote functional mathematics. Any insistence that trainees have to teach the full HDC may, despite its being a National Curriculum requirement, be met by schools' refusal, a decision which would need to be respected.

The original review opted to compare and contrast the educational aims of the Technological Pragmatists and the Public Educators, both of whom aim to change society. In Broadfoot's analysis, the 'technological imperative' (Broadfoot 1979: 131) is located as global, suggesting that this 'international technocratic culture is sufficient to induce an international uniformity of education values. . . , the rationale reflecting technological imperatives rather than the culture of any one social group' (Broadfoot 1979: 131). Ours is a National Curriculum, one which after the current review stands every chance of being increasingly rooted in an 'economy-orientated curriculum' (White 1988:119). Decisions relating to the place of statistics in GCSE Mathematics are indicative of a blinkered view of mathematics, and suggest a return to values closely associated with Ernest's Industrial Trainers: less concerned with progress than with a 'narrowly utilitarian education' (Ernest 1991: 142) where 'the aims for the masses are the mastery of basic skills. . . in preparation for a life of work' (Ernest 1991: 147).

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