

Developing Quantitative Methods Skills in Trainee Geography Teachers: An Interdisciplinary Approach

Background and context

There has been a significant increase in the importance of quantitative methods or data skills in the geography classroom recently as Government focus has shifted to focusing on improving the numerical literacy of its population, particularly in schools. This comes as a wider range of bodies and authors have highlighted the need to transform the UK's quantitative skills in response to what has been termed the UK's numeracy crisis. As a result of this, quantitative methods have significantly greater focus at A Level and GCSE within the 2016 examination specifications and geography teachers more than ever are required to teach quantitative methods and data skills to students from Key Stage 3. Despite this imperative, research, for example by the RSG, suggests that quantitative methods are not well integrated in the geography curricular, and that geography teachers lack the confidence in their knowledge of quantitative methods, especially geospatial technologies, such as GIS (Geographical Information Systems). It is with this in mind that I wanted to explore how to support PGCE trainee geography teachers with developing their understanding of quantitative methods and data skills and how to teach them effectively in the classroom. In particular, I wanted to consider how we could use interdisciplinary work with the maths trainee teachers to do this.

[Listen to a trainee reflecting on the importance of quantitative methods in geography here \(Video 1\)](#)

Overall programme outline

In order to support trainee geography teachers with quantitative methods I designed an overall training programme for the year. I was working with the trainees in the context of a PGCE; as such, I was able to embed training in quantitative methods across the programme, rather than running a discrete, 'one-off' session which I believe would be less effective in supporting the trainees. The training programme outline is shown in Figure 1.

PGCE training programme for developing quantitative methods skills

1. **Work with mentors:** in order to embed quantitative methods in trainees' practice it is important to ensure our school mentors have the practical and pedagogical skills to support them; with this in mind, we ran a mentor training day in November which incorporated a session on quantitative methods. In it, we explored quantitative methods in the 2016 examination specifications, and considered how we might support our trainees with this in school.
2. **Exploration of new specifications – emphasis on quantitative methods:** when exploring the new A Level specifications across, we emphasised the introduction of more quantitative methods to ensure trainees fully understood the expectations of students in school.

3. **Interdisciplinary session with the maths trainees:** we held a training session with the maths trainees which the main bulk of this article will outline.
4. **Development of exemplar targets and training activities:** we put together a number of exemplar targets and training activities for trainees to use *in school* to continue their development in this area beyond the University. Embedding quantitative methods in trainee practice is vital to ensure they do not see it as a 'bolt-on' which is only useful once or twice a year.
5. **Session on the European I-Use project and the use of statistics in the classroom in June:** we invited Iain Palot, to work with the trainees in the final two weeks of term. This had the aim of revisiting quantitative methods at the end of the course, and introducing trainees to the I-Use project and how it might support them in schools.
6. **Ongoing work with GIS across the year:** we also undertook a number of training sessions with GIS (particularly ArcGIS Online) across the year to develop trainees' understanding and use of geospatial and 'big data' and how this can be used to support geographical learning within the school classroom context.

The interdisciplinary training day

The main support we provided to develop our trainees teachers' understanding and use of quantitative methods is through an interdisciplinary session with the maths trainee teachers at Cambridge. I ran the session along with a colleague and mathematician, Mark Dawes, which had the following aims:

1. To develop geography trainees' understandings of what quantitative methods are and how they can be used in the classroom; and
2. To develop maths trainees' understandings of what quantitative methods are and how geographers use maths in the classroom.

First, Mark introduced the group to Core Maths, a qualification currently which is part of the government's post-16 maths programme and is likely to expand significantly for the 2016 intake and beyond. It aims to provide a qualification for students not taking maths at A Level, and to support subjects, such as Geography, Economics and Biology. This is a really interesting qualification which would very much support A Level geographers with their quantitative methods skills and it is worth speaking to your Maths Department in school about it.

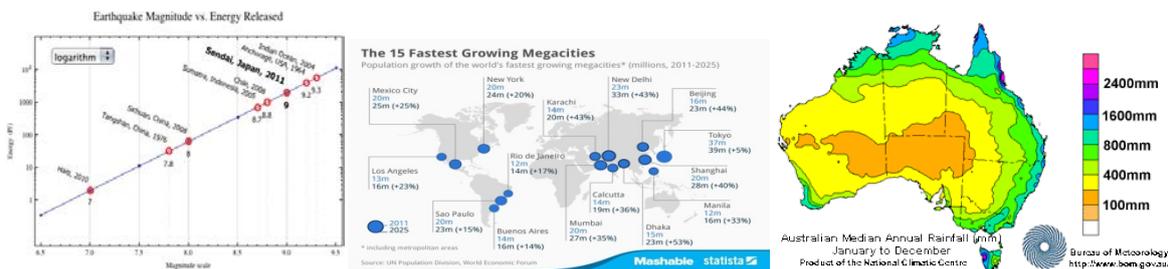
Trainees were then asked to complete a short 'Virgin Atlantic' Maths Task in interdisciplinary groups; they had been seated with trainees who are in the same placement schools this term to facilitate future collaboration. The task was based on the arrival of this lovely glass ornament at a friend of Mark's house and a letter congratulating him on having travelled over one million base flown miles. Mark asked the trainees to ask questions about this, for example, how many times round the world is that, how long has been spent in the air, what was the total cost of the tickets, or what is the

carbon footprint of these flights? Trainees were then asked to try to solve these questions using Google only to search for information (not answers). This task really engaged all trainees; they were able to start to work together in cross-curricular groups, as well as being introduced to basic maths in an interesting way and some have gone on to use this task with tutor groups in school since.



The Virgin Atlantic ornament for having travelled over one million base flow miles

Following the initial group task, I gave an introduction to how quantitative methods are used in Geography, partly to illustrate the diversity within Geography to the mathematicians, but also to remind the geographers of how extensively we use data. I showed them lots of images of, for example, earthquake magnitude graphs using logarithmic scales, population pyramids, climate graphs, choropleth maps, located proportional symbols, isoline maps and GIS.



Maths trainees seemed particularly interested in this section of the morning; they were surprised at the extent to which geographers use mathematics within their subject and teaching.

After my short presentation, trainees were then introduced to the main task of the morning which involved them completing statistical tests on sand dune ecology. Data comprised a range of abiotic (e.g. pH, infiltration time, moisture level, temperature and wind speed) and biotic (e.g. plant cover percentage) factors along a transect at right angles to the coastline. We had

some 'real' data collected by a local sixth form group and provided them with laptops and help sheets for Chi squared and Spearman Rank tests – they were then asked to explore this data in their interdisciplinary groups, the idea being that they would work together to support each other with producing relevant hypotheses and selecting and undertaking appropriate statistical tests etc.

For some of the geographers this task highlighted a subject area they might need to revise, but we had anticipated this and given them information on sand dune ecology to refer to if they wished (including expected relationships which could be used to create hypotheses and null hypotheses to test). Conversely, many of the mathematicians had not heard of either Chi squared or Spearman Rank as they came from a pure mathematics, rather than a statistical, background; this meant that they were unsettled by being faced with unfamiliar statistical methods but feeling as though they should be the 'expert'. In fact in the final questionnaire, when asked about how they could improve the session, several mathematicians commented that they wanted to be told in advance about what they would be required to do so they could 'learn' it first which I think is quite interesting.

Reflections on the interdisciplinary approach

Across the session geography and maths trainees engaged well with the tasks set for them, working collaboratively with each other to support each other's practice. The final part of the session involved a discussion of how we might develop this collaboration within school, giving trainees the time to consider how they might work together (if indeed they wanted to) over the coming two terms. Many of the pairs saw interdisciplinary working as an opportunity to support both individual subjects, for example one maths trainee commented "Instead of boring statistical data that are given to students to work on, I could use geographical data instead"; in this way, mathematicians saw the value of using real data to illustrate how and why maths can be of use in other contexts. Mathematicians also seemed keen to explore how interdisciplinary working might work in school. For example, one commented "We should collaborate more in school - geographers should take pupils to collect raw data, and mathematicians should support them with statistical tests". More generally, the activity appeared to make the maths trainees reflect more on wider links with other subjects in school. For example, one commented "I should think more about what students might already know when they come into maths lessons" and another "We should discuss links between subjects more with students".

Listen to a geography trainee considering how working with the maths trainees supported mathematicians, as well as geographers (Video 2)

But what of the geographers? What value did they place on the work? In questionnaires undertaken at the end of the session, a key point emerging from them was that the session helped them to remember what they know, in doing so removing some of the 'scariness' of doing quantitative methods in schools. For example, one commented "I do have a good knowledge of statistical methods, it just needs refreshing". For those that were less familiar or confident, they seemed reassured by the session, for example stating "Although the equations look complicated, it is not as difficult as it seems at first". Many commented on the value of collaboration, recognising that

geography gives good practical examples of the application of maths, and being very happy that in the case of many of them they had been able to 'teach the mathematicians something'.

Listen to a geography trainee discussing what she enjoyed about the session and the main learning she took from it (Video 3)

They both really enjoyed the interdisciplinary aspect of the session, and the mathematicians really seemed to enjoy finding out about what us geographers 'do'!

Listen to a geography trainee discussing how you could develop interdisciplinary working in schools (Video 4)

Final reflections on supporting trainee geography teachers with quantitative methods

Geography trainee teachers come from a variety of backgrounds and, as a result, have a wide range of levels of experience and expertise with quantitative methods and data skills. However, as Geography teachers they are all now required to teach these to students in schools, not just to satisfy the requirements of exam specifications or government policy, but to develop students' numerical skill-set and use this to support their geographical learning. It is important, therefore, that trainees are given the opportunity to develop their understanding not just of quantitative methods *per se*, but also their ability to teach about and with them in schools. To do this most effectively, I suggest that training in quantitative methods skills should be embedded throughout a teacher training year, both at University and in school. Further, working in interdisciplinary sessions with maths trainees can not only support trainees' development but also illustrate how cross-curricular working can be of benefit to teachers and students alike.