

STEM EDUCATION IN SCOTLAND

Morag Findlay

The Scottish Education System

It is well known that the Scottish and English Education systems are different. I am writing this one week before the Scottish Referendum – whatever the outcome, the Scottish Education system will maintain its distinctiveness. This paper will explore some of the differences between the two systems and examine whether or not they are significant in science teacher education and what the implications of these differences may be. One example of difference is that in Scotland, we refer to Initial Teacher *Education* (ITE) rather than Initial Teacher *Training* (ITT) in England. Whether or not this indicates a wider approach to teacher education in Scotland rather than teacher training in England is another question.

The Scottish Education system has always been different to the English Education system. The Scottish Secretary of State was responsible for education policy in Scotland until the Scottish Parliament reconvened in 1999. From 1999 on, the Education Minister in the Scottish Government¹ has been responsible for education in Scotland (Bryce, Humes, Gillies & Kennedy, 2013). One of the first actions of the Scottish Parliament was to pass the Education (Scotland) Act 2000 which led to the introduction of the new Scottish Curriculum for Excellence – CfE - (Curriculum Review Group, 2004). CfE differs from the English National Curriculum in that it is much less prescriptive and individual teachers and schools are free to interpret the curriculum in a way that suits their local context and professional insights.

Teacher education in Scotland is regulated by the General Teaching Council for Scotland (GTCS). The GTC (as it then was) was set up in 1965, funded by teacher subscription rather than by the government. In 2012 ‘GTC Scotland became the world's first independent professional, regulatory body for teaching’ (GTCS, 2012a). The GTCS has a powerful and influential place in Scottish Education. The GTCS sets the standard for teacher education in Scotland. One of the effects of this is that all teachers in Scotland must have a degree with at least 80 credits relevant to the subject they teach: within the 80 credits, there must be an element of progression. Applicants for teacher education courses can top-up a maximum of 20 credits in their subject (GTCS, 2013).

In Scotland, all science teachers are specialists qualified in a named subject and also general science teachers who can teach General Science from First Year to Third Year (Years 8 to 10 in the rest of the UK). The title of a science teacher's Professional Graduate Diploma in Education (PGDE *not* PGCE) is either “Biology with Science,” “Chemistry with Science” or “Physics with Science.” As a result, science teachers in Scotland have a depth of specialist science knowledge as well as an ability to teach General Science (GTCS, 2013). In terms of their pedagogical content knowledge (Shulman, 1987), Scottish science teachers in-depth science knowledge means that Scottish science teachers are able to combine their subject matter knowledge effectively with their curricular knowledge and general

¹ Previously the Scottish Executive.

pedagogical knowledge (Grossman, 1990). This may contribute to the relatively high uptake of science subjects in post-16 education in Scotland.

One of the results of having specialist science teachers in all secondary schools and pupils who take separate science subjects² at 16 is that the science subjects are very popular in the post-16 Higher Examinations,³ which are the qualifications for university entrance. The most popular Higher Examinations are English, Mathematics, History, Physics, Chemistry and Biology. The numbers of candidates presented in each subjects in 2012 and 2013 are shown in Table 1.

Table 1. Number of candidates presented in selected Higher and Revised Higher⁴ courses in 2013 and 2014 (SQA, 2014).

Number of candidates in Higher:	2013	2014
English	30,401	31,582
Mathematics	20,663	21,851
History	10,337	10,881
Biology ⁵	14,400	14,484
Chemistry	10,653	11,418
Physics	9,629	10,209

Impact on PGDE STEM Courses and Science Teaching in Secondary Schools

What is the impact of this on recruitment for PGDE science and mathematics courses in Scotland?

The Donaldson Review (2011) into teacher Education in Scotland notes that there have been difficulties recruiting science teachers in Scotland like the rest of the UK. However, anecdotally this does not always agree with the experience of science and mathematics teacher educators in Scotland. Biology and chemistry courses are heavily oversubscribed and meet the recruitment targets set by the Scottish Government. Physics teacher recruitment is more problematic: recruitment targets are lower and recruitment seems to fluctuate with the state of the economy and the demand for numerate graduates. The recruitment targets for mathematics student teachers are higher than for biology or chemistry student teachers, but in recent years have not always been met.

The lower recruitment target for physics student teachers than chemistry or biology teachers probably represents a hidden shortage of physics teachers in Scottish schools. In 2013 there were 364 secondary schools in Scotland with 1 190 Biology teachers, 935 Chemistry teachers, but only 822 Physics teachers, as well as 116 General Science teachers (Scottish Government, 2014). The reason

² Pupils in Scotland do not study for a General Science award at 16, but study separate sciences.

³ Examination curricula are determined by the Scottish Qualifications Authority (SQA), which is the unitary examination body in Scotland. Higher examinations are equivalent to AS levels, but structured differently.

⁴ Candidates for Higher Examinations can be in Fifth or Sixth Year at school (Years 12 or 13 in England.)

⁵ Biology figures include Higher Human Biology.

that schools do not have as many Physics as Chemistry and Biology teachers may be due to the structure of science departments.

Science departments in Scottish Schools have teachers with specialisms in biology, chemistry or physics. However, these teachers usually have general science classes in the first three years of secondary education. The greater numbers of biology and chemistry teachers mean that younger secondary pupils see more biology and chemistry than physics teachers. Scottish pupils in Second or Third Year (Years 9 and 10) choose which separate science subjects⁶ they will study for examinations at the end of Fourth Year (Year 11). It would be interesting to explore the hypothesis that pupils' science subject choices are influenced by the number of biology, chemistry and physics teachers in each science department.

The impact of research-informed practice is being increasingly felt in Scotland, again partly in response to the Donaldson Review (2011). The GTCS Standards for Registration (2012c) and Career-Long Professional Learning (2012b) included a requirement for teachers' practice to be research informed. The trend towards increasing the importance of educational research in career-long professional development is also seen in the recent British Educational Research Association (BERA, 2014) reports about research and the teaching profession.

Another major impact of the Donaldson Review (2011) is on the pattern of placement experience in Scotland. Partnership approaches to teacher education between schools and universities are being developed through a number of different initiatives. Glasgow University have developed a clinical model of school placement (Menter et al. 2012), while Strathclyde University has developed the Strathclyde Enhanced Partnership Initiative (McIlroy and Blake, 2013). These initiatives are so new that they are only beginning to be reported in the academic literature, for example Conroy, Hulme and Menter (2013). At the moment, there appear to be no peer-reviewed journal articles about the evaluation of different partnership models. While these peer-reviewed articles may come, it is ironic in view of the international push for research-informed practice that we do not yet have the research evidence for these approaches.

Conclusion

Overall, in Scotland the position of Initial Teacher Education and Career-Long Professional Learning seems to be relatively strong. There is a commitment from the Scottish Government and the GTCS for all secondary teachers to have secure subject matter knowledge and the general pedagogical skills to help children to learn in the classroom. The shortage of specialist science teachers does not appear to be as acute as in the rest of the United Kingdom but it cannot be assumed that this will continue. There is also some concern among science teacher educators about the Science and Engineering Education Advisory Group's Second Report (SEEAG, 2012), which suggests that a scheme similar to 'Teach First' should be introduced in Scotland as an additional route into teaching.

⁶ The new SQA National 4 and 5 courses are equivalent to GCSEs. National 4 courses have no external examinations.

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