

Technoteach: Supporting Computing Teachers Across Wales

Faron Moller
Swansea University
f.g.moller@swansea.ac.uk

Stewart Powell
Swansea University
s.w.powell@swansea.ac.uk

ABSTRACT

Intensive curriculum reform is currently being undertaken in Wales across all school years and all subjects. However, political, geographical and socio-cultural issues have to date hindered any substantive educational policy or curriculum reform for computer science, due ultimately to the marked lack of teachers who are qualified and/or confident to teach the subject. In this paper we describe Technoteach, a University-based model for supporting prospective computer science teachers and thus drive the delivery of the evolving computer science curriculum across Wales. We argue its need, justify its methodology, and detail its impact.

1 INTRODUCTION

There is significant international focus on recent and prospective computer science curriculum reforms, with different initiatives introduced in different countries supporting this movement, such as CS4All in the US [7] and CAS in England [2]. However, addressing curriculum change to incorporate computer science presents a significant challenge with scaling such grassroots initiatives [6].

Essential to the success of such grassroots initiatives is a critical mass amongst the grassroots. According to a 2015 NESTA Report on digital outreach activities [5], “Regions of England other than London and the North West are proportionally well undersupplied for the number of young people living there.” The situation is particularly troublesome in Wales, where its 3 million citizens are spread out over an area that is literally the size of Wales. In comparison: London has three times the population of Wales concentrated in an area which is 5% that of Wales (giving a 60-fold density); and Birmingham has 40% of the population of Wales concentrated in an area which is 1.5% that of Wales (giving a 26-fold density). This leaves the whole nation vulnerable to the absence of organisations which offer support. Secondary schools in Wales have an average catchment area of 100 sq km, with many schools covering far greater areas. Furthermore, Wales has a rugged geography with few fast roads running through it, meaning that a daily hour-long one-way commute is not unheard-of for the nation’s teachers and pupils, resulting in schools – and their teachers – being isolated in terms of geography and, thus, subject support, leading to the ineffectiveness of a teacher-led grassroots approach. On top of this, over 10% of these schools are Welsh medium – and another 20% are bilingual – and they lack Welsh-medium computing resources.

Adding – and likely due in part – to this problem, the raw number of ICT teachers in Wales is dropping at an alarming rate. Despite various initiatives and generous financial incentives on offer to computer science graduates to take up teacher training, Table 1 shows

Year	2012	2013	2014	2015	2016	2017
ICT Teachers	797	762	746	726	704	670
ICT Trained	33.0%	35.9%	37.6%	38.4%	39.4%	39.9%

Table 1: ICT Teachers in Wales

that the number of ICT (computing) teachers in Wales dropped by 15.9% over the five years 2012-2017 [1]. The number of 0-10 year-olds in Wales, meanwhile, increased by 5.0% over this same period [3]. Whilst the percentage of ICT teachers with some form of ICT training has risen moderately from 33.0% to 39.9% over the same period, due to the drop in absolute numbers this merely means that the number of such teachers has remained constant.

2 TECHNOCAMPS

Since 2003, Technocamps [4] – a university-based schools and community outreach programme – has been providing hands-on computing workshops to inspire, motivate and engage young people with a particular emphasis on under-represented communities such as girls. Since 2011 Technocamps has engaged with over 50,000 young people – 7% of the Welsh population between the ages 5-24 – a full 43% of which were girls. It has managed to engage with such numbers across such a wide area by establishing Technocamps hubs in every university across Wales.

The ultimate ambition of Technocamps from its inception was to address and solve a perceived crisis in the teaching of computing in Welsh schools. This meant two things: in the long term, promoting teaching as a career for computer science graduates; and in the short term, providing support and professional development opportunities for any teachers who may currently be charged with teaching computing in schools.

3 TECHNOTEACH

Although Technocamps’ engagements within classrooms and on university campuses across Wales has had a positive impact on the pupils and their teachers alike, to make a significant step change within computer science education it became apparent that prolonged, teacher-focused sessions are essential to build both the confidence and competence within the teaching community in Wales. The Technoteach programme was thus established in 2012, in the form of 6-week, 22-hour modules delivered in the evenings.

Over three years, 18 modules (13 for secondary teachers and 5 for primary teachers) were delivered to a total of 250 teachers (130 male and 120 female), with 26 of them (10%) being from Welsh medium schools. Whilst this programme proved somewhat effective, it still left much to be desired. Teachers were not assimilating the material through active use. Feedback from the teachers made it clear that

they would need time off from their busy school lesson planning for this to be at all possible.

In 2015, a radical change was made to the Technoteach model, turning it into an accredited Level 3 Certificate in the Teaching of Computing. It became an 18-day, 120-hour course which requires teachers to attend for one full day per fortnight, for which they need to be released from school. The course consists of four modules (programming for teachers; teaching programming; data representation; and robotics); and there are primary and secondary versions of each module. As with all Technocamps activities, this course is provided completely free, including lunches and registration fees for the accreditation; however, schools are not compensated for lost teacher time.

In the first year, 13 teachers were attracted onto the programme of study starting in September 2015, and all 13 completed the course and graduated with their qualification in June 2016. In the second year, 17 teachers were attracted onto the programme of study starting in September 2016, and all 17 completed the course and graduated with their qualification in June 2017. Both of these cohorts were run at Swansea University, though some teachers travelled well over an hour from all directions to attend.

When this programme was first advertised to schools, the immediate reaction was “We cannot afford to do this!” Releasing a teacher for one day each fortnight over the course of the year is a huge investment for any school. However, as the quality and impact of the course is being felt, more and more schools are now saying “We cannot afford *not* to do this!” In June 2018 a total of 43 teachers graduated from the course: one primary and one secondary cohort in Swansea; one secondary cohort in Bangor; and one “transition” cohort in Newport.

4 CASE STUDY

We highlight here one of several teacher case studies available on the Technocamps web page¹. Vicki Price is the Assistant Head-teacher at Sir Thomas Picton School in Haverfordwest, a secondary school situated on the far Southwest corner of Wales. As an isolated state-maintained school, they have neither the budget nor the timetable to employ a qualified computing teacher. However, due to a high demand, she took the bold decision to run the new GCSE Computer Science as an option, having personally herself benefited in the Technoteach programme. She had prior to this tried the self-taught route using various books and websites, but these were ineffective; only through the guidance provided by the Technoteach sessions – and with the support offered by the network of other teachers in the same situation following the Technoteach programme – did she develop the competence and confidence to deliver the GCSE programme. In the end, 84% of her first cohort obtained an A* to C grade against a national average of 49%, with over a quarter of her class being awarded an A*.

5 TECHNOTEACH: THE KEYS TO SUCCESS

Technocamps has run the Technoteach operation on a budget of £12K per quarter supplied by the Welsh Government’s National Science Academy, covering the salary costs of one full-time delivery officer; travel and subsistence; and lunches for participants. The

delivery officer also delivers Technocamps workshops in our Play-ground Computing programme. At under £50K per year, this has proven to be an extremely worthwhile investment which has been recognised by Welsh Government through continued funding and promotion to other disciplines as a model well worth replicating.

If other universities were minded to deliver such a programme of teacher training and associated schools outreach, we highlight the principles that are critical considerations.

- **An accredited qualification.** In order to be meaningful, and to be considered worthwhile, the outcome must be a recognised and accredited qualification requiring a substantial investment of time and effort from the teacher undertaking the training. Anything less attracts neither the buy-in from schools nor the commitment from the teachers.
- **Long-term engagement.** Teachers need time to assimilate the knowledge and skills which they develop through this training. With each full day of training, they will have learnt a great deal, and this learning will need to be practiced through a series of assigned exercises – and adapted for use in the classroom – during the fortnight leading up to the next training day.
- **Time off teaching.** It is crucial that teachers are granted time off from their classroom in order to undertake this training. Modern-day teachers in the UK are under extreme pressures and cannot be expected to do this training on top of their full teaching commitments; attempts to do so inevitably lead to failure.
- **University-based.** Universities provide a level of gravitas which helps secure the necessary buy-in from schools and teachers. Furthermore, universities have the geographical reach which other organisations lack. They also have the infrastructure and facilities (specifically, computer labs) necessary to run the training, for which it would be in their interests to provide free of charge.
- **A teacher teaching the teachers.** The training cannot be left to a computer science academic in the University. It is crucial that the right person is hired to teach the teachers; and the right person is himself a computer science teacher who is very much comfortable with the subject. They have to be able to speak to teachers with a full understanding of the teaching profession and of what is required of computer science teachers.

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¹www.technocamps.com