# Technocamps: A Decade of Supporting Computer Science Education in Wales

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## ABSTRACT

Computer Science education in England has recently undergone a tremendous upheaval. However, whilst England and Wales share an education system distinct from Scotland and Northern Ireland, political and geographical concerns have hindered change in Wales. This is despite the fact that Wales was addressing the failings of Computer Science education in schools since at least 2003 with the creation of Technocamps, a pan-Wales Universities-based schools outreach programme. In this paper we outline the history (and pre-history) of Technocamps; explain the evolved nature of education in the UK focusing on Wales with its specific challenges; and present data both in support of university engagement and intervention as well as the positive effect this intervention is having.

## Categories and Subject Descriptors

K.3.2 [**Computers & Education**]: Computer and Information Science Education—*Computer Science Education*; K.4.1 [**Computers And Society**]: Public Policy Issues

## Keywords

Computer Science Education; High School; Teachers

## 1. INTRODUCTION

In the early 1980s, the BBC Micro was introduced to schools throughout Britain for the *BBC Computer Literacy Project*. Before long they were in 80% of UK classrooms [26]. By encouraging young learners to experiment with computers, a generation of creative (and computational) talent was spawned. Applications in the UK to study computer science at university hit a peak, and computer science graduates changed the world as they helped computers come to dominate every aspect of our lives.

Fast forward 30 years and the situation could not be any more different. The computer is no longer a novelty. Children now typically spend more time at home in front of a computer screen than a TV screen, but like the TV, their interest is restricted to using the computer, not in experimenting with it. Computer studies in school – now called Information and Communication Technology (ICT) – has evolved into IT studies with an emphasis on digital literacy and office skills – significantly more mundane than the social networking and gaming for which the pupils use their home computers. A full 66% of ICT teachers in the UK do not have a relevant qualification but have slipped into the role of ICT teacher simply by being sufficiently digitally literate [21]. The situation is worse in Wales, where this figure rises to 75% [11]. Applications to study computer science at university slumped in the early part of the millenium – especially amongst females – and many of those who started a university computer science degree course found themselves dropping out during the first year as they entered unaware of what computer science is and what studying it entails.

In the early 2000s, the Department of Computer Science at Swansea University started looking into ways to address this issue. Unfortunately, attempts to reach out to teachers in local schools faced great resistence, due naturally to their lack of confidence in anything more complicated than using a desktop software package. As an alternative route into schools, Swansea University created *Technocamps* in 2003, an outreach programme which brings groups of school children to the University campus for day-long workshops based on selected computational themes to inform them what computing is about, followed-up by support in setting up extracurricular clubs – *Technoclubs* – in the schools. Technocamps proved very successful as a local initiative, with many students studying computer science at Swansea University claiming to be influenced by Technocamps activities. In 2010, based on empirical data regarding its effect on school children's attitudes towards computing – as well as their teachers – Swansea University was awarded £3.9 million funding towards a £6 million four-year project (with the remaining £2.1 million generated through match funding) by the Welsh Government under the EU's European Social Fund (ESF) Convergence Programme to run Technocamps as a pan-Wales project with regional hubs at the Universities of Aberystwyth, Bangor and South Wales Glamorgan. (Technocamps hubs have subsequently been set up at most of the remaining major Universities in Wales, specifically Cardiff University, Cardiff Metropolitan University, and Glyndŵr University Wrexham.) Though focusing on the children, Technocamps also provides "Technoteach" events aimed at up-skilling ICT teachers in Welsh schools. Technocamps has provided computing-related activities and


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resources for tens of thousands of young people across Wales, as well as interacting with hundreds of teachers at hundreds of the nation's schools.

Technocamps is not alone in exploring solutions to a perceived problem in Computer Science education. In particular, in 2008 the UK-wide organization Computing At School (CAS) was formed, and its current membership of over 18,000 teachers and computing professionals are working hard to promote the teaching of computing at school. However, whilst great changes have taken place in England due in no small part to CAS lobbying, the CAS effect is relatively unnoticed in Wales, and the rapid changes pushed through in England are in many ways resisted by Welsh Government.

Wales is a devolved nation within the United Kingdom, with its own elected national government fully responsible for its education system. At the 2012 Annual Technocamps Teachers' Conference, the Welsh Government's Minister for Education and Skills publicly acknowledged the importance of computer science education, noted that he is a key supporter of Technocamps, and expressed understanding of the wider educational and socio-economic impact that the government can make with reform in Wales. However, with only 5% of the population of England and with its distinct geographical and socio-cultural challenges, Wales presents a variety of unique challenges in addressing curriculum reform.

In this paper, we will describe the backdrop to Technocamps and why it was created in the way it was (Section 2); explain the evolved nature of education in the UK focusing on Wales with its specific challenges (Section 3); and present data both in support of university intervention as well as the positive effect this intervention is having (Section 4). We finish with a consideration of the challenges remaining in Welsh education (Section 5).

# 2. COMPUTING EDUCATION IN WALES AND ENGLAND

In the 1980s, Computer Studies was a popular subject in schools across Britain. The ubiquitous presence, in schools and homes, of the popular BBC Micro – which was useful for little else than writing programs in BASIC – saw a large proportion of school children learning the fundamentals of program design in a curriculum which included a variety of complementary topics such as hardware, software, Boolean logic and binary number representation [9].

By the 1990s, however, the emergence of pre-installed software packages – specifically word processors and spreadsheet programs – meant that computers were no longer predominantly machines that needed to be programmed in order to do anything useful or interesting. Less and less time was being spent in the Computer Studies classroom on thinking about and writing programs, as basic digital literacy became regarded as its key skill. However, as interest in viewing the computer as a creative tool waned in favour of using it for more mundane tasks, various problems were being created, which were highlighted in two independent enquiries in 1997: the McKinsey Report [14] and the Stevenson Report [25]. Both reports concluded that Information Technology in UK schools was in a primitive state and in need of attention and major investment. In line with the Stevenson Report [25], Computer Studies evolved into a new subject whose name was coined in that Report: Information and Communication Technology (ICT). Over the decade starting in 1997, the UK Government invested over £3.5 billion in ICT in schools through various initiatives such as the National Grid for Learning (NGfL) and the New Opportunities Fund (NOF) [8].

By 2000, then, ICT had permeated both primary and secondary school curricula. The emphasis was on developing the children's IT skills and digital literacy in an honest attempt to address the increasing need for digital literacy amongst the public. However, despite enormous government-funded ICT initiatives, various reports throughout the decade identified problems with implementing government policy on ICT educational reform [19, 16, 17, 18, 13]. Younie [28] summarises the problems identified by these reports into five key areas, three being management and the other two being: teacher training and competence; and impact on pedagogy.

A decade later, a Royal Society Report [21] makes the very same observations. The report notes that ICT suffers from a poor reputation amongst pupils and other stakeholders, who consider it dull and unchallenging and hence a low-value discipline, especially compared to other STEM subjects. With ICT embedded across the primary school curriculum, secondary school pupils find ICT in secondary school unstimulating. The Wolf report [27] further notes that the undemanding nature of ICT qualifications in secondary schools is readily exploited by the schools: due to a high league table weighting associated with vocational qualifications, easily-achieved high results in ICT offer a welcome boost to a school's league table position. Furthermore, as ICT is typically presented by schools as their computer science offering, students who might otherwise enjoy studying computer science are left with a positive distaste for what they believe to be computer science.

## 2.1 Technocamps at Swansea University

As experienced by other Universities, the numbers of students enrolling in Computer Science at Swansea University increased through the end end of the millenium due to the dot-com boom. However, the numbers peaked and was followed by a steady five-year decline, dropping more that 40%, with the worst effect on the already-dwindling numbers of female students. Even at its peak, more than a third of students who started a computer science degree programme left the programme before their second year of study,

# 3. SCHOOL SYSTEMS IN THE UK

As reported by Hubweiser et al. [12], when establishing a model for viewing school CS education, it is apparent that there is much diversity between school education systems, and this can create an obstacle when trying to understand progress made in a different country. Here we describe the context of school education in the UK.

For historical reasons, the UK does not have a single nationwide education system. The UK is primarily composed of four devolved nations: England (population: 53.0 million), Scotland (5.3 million), Wales (3.0 million) and Northern Ireland (1.8 million)[1]. Each nation has its own education system, although they are broadly similar in England and Wales.

[1]http://www.ons.gov.uk/ons/guide-method/census/2011/index.html

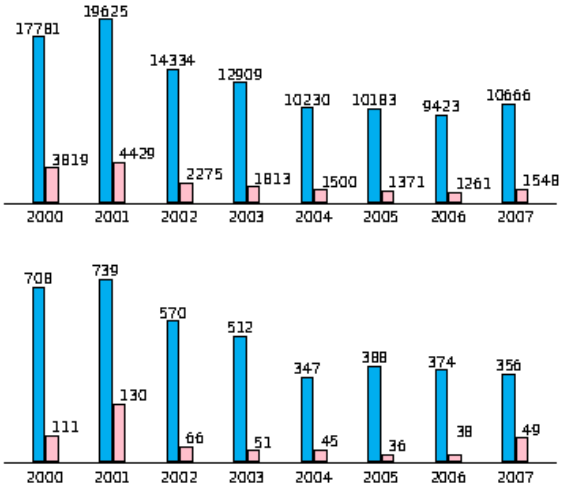


**Figure 1: Applications to University Computer Science programmes in the UK and Wales, males and females. (Source: UCAS, Universities and Colleges Admissions Service, https://www.ucas.com)**

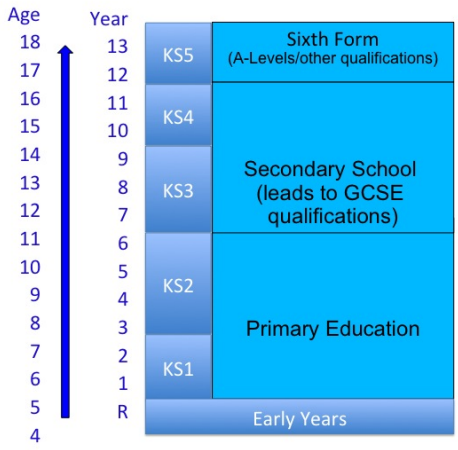


**Figure 2: Key Stages in the English and Welsh education system**

## 3.1 England and Wales

Figure 2 shows the system of five Key Stages (KS) used in England and Wales (although KS1 is called Foundation Phase in Wales) with compulsory schooling until age 16. All subjects are compulsory until the end of Key Stage 3 (KS3) and then students can choose approximately ten subjects to study for the next two years, which each lead to GCSE (General Certificate of Secondary Education) qualifications. However, while the National Curriculum in England and Wales are broadly similar, they are distinct and use different terminology.

There is state provision for education in the UK up to the age of 19, with mostly comprehensive, mixed ability schools across the UK. A few areas in England have retained a system of selective 11+ schools called grammar schools, which require students to sit an exam prior to entry, but these schools are in the minority. As well as state schools, 10% of schools in the UK are independent fee-paying schools. Overall, in England there are approximately 24,000 schools, including 16,800 primary schools, 3,400 secondary schools and 2,400 independent schools (primary and secondary). However, the primary and independent schools tend to be smaller: the state-funded schools had 4.2 million primary pupils and 3.2 million secondary pupils, with 0.6 million pupils in independent schools. The ICT curriculum in Wales (2008)[2], was perceived to be less prescriptive than the ICT curriculum in England, but exhibiting many of the same issues. It was recently reviewed by an independent steering group appointed by the Welsh Government [1], making clear recommendations for reforming the ICT curriculum as part of a broader national curriculum review for September 2014.

# 4. THE TECHNOCAMPS EFFECT

[2]http://wales.gov.uk/topics/educationandskills/schoolshome/curriculuminwales/arevisedcurriculumforwales/nationalcurriculum/ictnc/?lang=en

Technocamps is a multi-faceted Universities-based operation engaging with schools – both their pupils and their teachers – throughout Wales and across all ages. Its main activities are as follows.

**Workshops** One-day campus-based workshops offered to whole classes to give the pupils an introduction to computing, particularly computational thinking and problem solving. The whole class approach allows us: to address the gender divide, by engaging with an equal number of boys and girls; and to engage with those with no predisposition (or indeed an aversion) to digital technology, to create an interest of computing within them.

**Technoclubs** Lunchtime clubs in schools where pupils develop their computational thinking and building skills.

**Bootcamps** Two-day campus-based workshops held during school holidays.

**After Schools Clubs** Two-hour late afternoon sessions held on campus or in the community.

**Playground Computing** Day-long in-school workshops which present the fundamentals of computer science to primary school pupils through playful activities which develop computational thinking and problem solving skills, but do not involve computers.

**Technoteach** Training sessions, typically in the form of 20-hour modules delivered one evening per week over six weeks. Technoteach also encompasses other standalone twilight sessions as well as an annual teachers conference.

**NEET Engagement** Week-long summer residential sessions run in partnership with the municipal youth services in which young people identified as NEET (Not in Employment, Education of Training) carry out a variety of team-building exercises, learn app development and compete to design and build the best app.

**Student Placements** Computer Science students at the University are offered the opportunity to gain university course credits through placements – one day per week – as teaching assistants in school computing/ICT classes.

All Technocamps activities are provided completely free of charge for all of its participants. This represents a huge investment on the part of the Universities, but Technocamps has also received various sources of funding in support of its activities. The main funders are as follows.

**ESF** (October 2010 - September 2014) – A four-year £6 million EU-funded project to engage with secondary schools across South West Wales and the Valleys. This project involved Technocamps hubs at Aberystwyth University, Bangor University and the University of South Wales Glamorgan. Some 9,000 pupils from more than 180 schools and colleges have benefited from this project, as well as their teachers.

**NESTA** (June 2013 - December 2014) – An 18-month £46,000 project to support the Playground Computing programme. This funding allows for a teacher to be seconded for 18 months to Technocamps in order to go out to primary schools throughout South Wales every day to present workshops. It has seen some 5,000 pupils at over 50 primary schools enjoy multiple day-long visits.

**National Science Academy** (November 2013 - March 2015) – A 17-month £24,000 project to support the Technoteach programme; this funding was mainly in support of teachers registering on our six-week Technoteach modules, specifically providing their schools an amount of teacher cover to facilitate their attendance on the module. Over 120 teachers have thus far benefited from this project.

**Welsh Government** (September 2014 - March 2016) – An 18-month £370,000 project under the Welsh Government's Learning in Digital Wales (LiDW) Tender. The LiDW Tender is to deliver 3-hour taster sessions at each of the 210 state-sponsored secondary schools across Wales, and will be delivered by each of the six Technocamps hubs.

# 5. CONCLUSIONS

End here...

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## To Do

In no particular order...

- Set UK context over past 3-5 years
- Link to English and Scottish changes
- Welsh context
- Technocamps: the ten year journey from 2003
- Convergence, the pan-Wales problem
- Key contributions: aims, targets, impacts, young people, NEETs, coverage
- Links with CAS Wales
- Hubs (both TC and CAS)
- Funding models: ESF, NSA, Nesta, etc
- **Key theme**: Building capacity, the problems of England's NoE model in Wales
- UK policy: RS report, English curriculum, qualification change, UKForCE, etc.
- Welsh policy: ICT curriculum, ICT review, Estyn reports, ICT sector support/economic drivers, curriculum change, Donaldson and post-Donaldson
- THE FUTURE...!

## References to fit in

- General CAS citations [6, 4, 5].
- Teachers, CPD and NoE [23, 22, 24].
- Technocamps [2, 3]
- Welsh Government report:
  - ICT Review [1]
  - Graham Report on STEM [15]
  - Donaldson Report [7]
  - Furlong Report [10]
- Misc Reports
  - NESTA Report [20]