Teaching Computing via a School Placement

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ABSTRACT

Across Wales – as, but even more so than, elsewhere – there is a critical shortage of teachers who are qualified to teach Computer Science. This issue is particularly coming to the fore now due to on-going changes to the national school curriculum which is seeing a rigorous computer science curriculum replacing the ICT curriculum which has been passed off as computing in most schools over the past several decades. In this paper we describe the efforts made by Technocamps to tackle this problem by encouraging computer science graduates to consider education as a viable career option. In particular, we outline a credit-bearing module which incorporates an extensive school placement. We discuss the challenges with setting up and running such a module as well as its effectiveness.

CCS CONCEPTS

• **Social and professional topics** → **Computing education**; **Computer science education**.

KEYWORDS

Computer science education, School-university partnership, In-service teacher education, Professional development.

1 INTRODUCTION

Amongst the recommendations in the 2017 Royal Society Report *After the Reboot: Computing education in UK schools* [4], is the statement that *"higher education providers need to promote careers in computing education to a wide range of students."* This is perhaps easier said than done in the current economic climate in which the demand for computing graduates is high – as are starting salaries on offer as compared to that of newly-qualified teachers. There are now very generous tax-free bursaries on offer to computing graduates

which make it attractive to enrol onto a PGCE course. However, these can often prove effective only in generating a pipeline of computer scientists holding teacher qualifications; as these are golden handshakes and not golden handcuffs, the incentive is to earn-and-learn for an extra year before entering the digital job market with the extra desirable marketable soft skills developed through (and evidenced on the CV by) the PGCE.

A number of universities provide modules under the *University Ambassador Scheme (UAS)* [5] which provide undergraduate students direct experience of computing education in schools from a teacher's perspective as a means to encourage them to consider a career in teaching. Brief details of such modules being run throughout the UK can be found in [1].

In this paper, we describe the school placement module on offer at Swansea University which is operated as part of a wider programme of school and community engagement, Technocamps. Whilst embedding the goals and activities of Technocamps, the module is heavily influenced by the UAS, and from a standing start, the UAS is an excellent model for institutions to adopt. The module on offer at Swansea, however, is far more intensive in terms of placement hours than other UAS-style modules which typically cite on the order of 27 school contact hours; the module described in this paper involves a ten extended-day placement (one day per week over an 11-week term with a half-term break), which must include setting up and running a lunch-time Technoclub and supporting an existing after-school extra-curricular activity. A school day will typically start no later than 8:30 am and continue to at least 5:00 pm, and provide for a single free lesson in the middle of the day.

2 TECHNOCAMPS

Since 2003, Technocamps [3] – 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 some 50,000 young people – well over 1% of the whole population of Wales – 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. Every school in Wales is within relatively-easy reach of one of its seven campus Universities, and for Welsh Government's *Learning in Digital Wales* programme [2], Technocamps delivered an average of over 10 hours of Workshops in over 97% of the nations secondary schools during one 18-month period in 2014-2016.

Whilst its programme of activity has expanded over 15 years, 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. In pursuit of the former aim, the majority of the Technocamps activity is carried out by Technocamps Ambassadors, many of whom are (undergraduate and postgraduate) students in the computer science department of the university hosting the relevant Technocamps hub. In particular, many of these university computer science students are deeply involved in the establishment and running of lunch-time and after-school Technoclubs in local schools.

3 TEACHING COMPUTING VIA A SCHOOL PLACEMENT

Since 2012, Swansea University has offered a 3rd-year module, *Teaching Computing Via a School Placement*, which embeds and expands the activities of its undergraduate Technocamps Ambassadors. The main aim of this module is to give computer science students a solid impression of the teaching profession and encourage them to consider teaching as a career. In the ten years prior to establishing this module, the module coordinator had been asked to provide references for only two students applying for PGCE places – and these students' ambitions were to become maths teachers, not ICT/computing teachers. In the six years since this module has been in place, usually at least two students each year have gone on to do a computing-based PGCE programme. Equally important, each year sees a few students indicate in module feedback that – whilst enjoying the module very much and possibly considered teaching as a career before taking it – they have discovered something about themselves: that teaching is not for them. This has saved the time and expense of them earning a PGCE qualification only to discover through PGCE placements that they would not make use of their status as a newly-qualified teacher.

As 3rd-year students choose only either five or six 15-credit optional modules (depending on their programme of study) alongside an individual project, there is a lot of competition in attracting students to this module, particularly given that there are other very popular modules which the majority of students choose. The students pre-select their 3rd-year options near the end of their second year; and those who select this module have to submit a DBS (Disclosure and Barring Service) form at that time to the University, which is a background check required by any adult before working with youngsters.

3.1 Finding school partners

Due to its extensive programme of school engagement, Technocamps has direct links into every secondary school across Wales and a large proportion of their feeder primary schools (through its *Playground Computing* programme). Hence, there is little problem with finding school partners. Indeed, it is more likely that too few students enrol onto the module to satisfy the schools wanting to take part in this programme.

Training Day Programme

1. Introductions
2. Expectations and concerns
3. Your school placement
4. Assessment of the module
5. In your school
   a. Professionalism
   b. Subject knowledge
   c. Teaching skills
   d. Assessment

=== *Buffet Lunch / Discussions* ===

6. Exemplar practical task
7. Code of conduct
8. Completing formal and informal evaluations
9. Final questions and clarifications

Figure 1: Pre-placement Training Day Programme

In placing students, every attempt is made to identify schools that would most benefit from this programme. Many of the teachers who ask to be involved do so as they are struggling to deliver computing lessons due to having no computing background themselves, and thus are appreciative of the support offered by the computer science students and the resources that they bring.

3.2 The Induction Training Day

During the week before term starts (the University's "Induction Week"), the students enrolled on this module get a full-day (9am-4pm) of training. The programme for this training day is presented in Figure 1. This training is provided by a qualified teacher trainer, not a computer science academic, and concentrates on pedagogics and professionalism. It is made clear to the students exactly what they can expect when they go into their school and its classrooms, and exactly how they should present themselves and behave. Exemplar tasks and role-playing exercises are used to consider modes of teaching and how to handle themselves when faced with potentially delicate or disruptive situations.

3.3 The School Placement

Each student is placed in one (typically secondary) school for the whole of the 11-week term; and they are assigned a teacher-mentor in that school, though they may well be participating in different teachers' classes. The classes they take part in ideally are wide-ranging, both in year group and in subject, so that the students experience teaching to different age groups and experience contrasting styles across different teachers and subjects. However, they will for the most part be participating in GCSE and A-level computing and ICT classes lead by their teacher-mentor.

Students are generally placed in pairs, as they can find it daunting – particularly in the beginning – to go in to a school on their own. This has worked out well for both the students and the schools.

However – and particularly for those students who start with a good deal of experience delivering workshops as Technocamps Ambassadors – being assigned to a school on your own is entirely possible.

The vast majority of students taking this module are placed in secondary schools, and become involved in GCSE and A-level computing classes. However, some students who take the module express a desire to work with younger pupils in primary schools, so typically each year a couple students are placed in a primary school rather than a secondary school.

During the first week in school, the students are expected merely to observe lessons and reflect on the presentation of the teachers and how the pupils react to this presentation. As the weeks go on, though, the students are expected and encouraged to become ever more involved in the lessons, initially as teaching assistants helping individual pupils. The level of involvement of the students is at the discretion of their teacher-mentor, and will depend on many factors, particularly the confidence of the teacher in the students being able to deliver the curriculum material given the few lessons in the timetable allocated for this. However, it is almost universally the case that students get at least one opportunity to independently deliver a full lesson during each of the final few weeks of their placement.

It is expected that the students get a free lesson during the school day. However, as well as participating in scheduled lessons, for the module the students are required: (i) to organise and lead a lunch-time Technoclub; and (ii) to assist in an unrelated after-school activity such as a sports team, a music or drama club, or any other club lead by some faculty member in the school. In this way, the students experience the full realm of pupil engagement activities in which school teachers are involved. The Technoclub can be varied, and typically draws on the vast array of workshop resources developed by Technocamps. Robotics activities involving LEGO Mindstorms, the Raspberry Pi, the BBC Micro:bit, and/or Arduinos are a common theme, with clubs often created to compete in the Annual Technocamps Robotics competition and/or Annual Coding competition.

3.4 Assessment

Modelled closely on the assessment criteria of the UAS, the students are assessed on three components:

(1) A commentary, in the form of a reflective log, on their school experience (30%);

(2) The production of a 3-lesson teaching resource (40%);

(3) A report written by the teacher-mentor (30%).

The teaching resource must cover three lessons on one specific topic of the student's choosing, complete with all necessary notes and activities, and assessment material with marking schemes, along with a detailed lesson plan for the teacher. Whilst there is no requirement that these lessons be delivered by the students in the school, quite often the students are given the opportunity to do so; and often the resources are adopted by the teacher-mentor for their own personal future use.

3.5 Schools' Half-Term Break

Halfway through the Autumn term, schools are closed for their half-term break. During this week, the students on the module are required to attend a 4-hour session during which they are provided formative feedback on their reflective logs, and provided with guidance on how to develop their teaching resources, in particular how to present lesson plans, assessment material and marking schemes.

4 CHALLENGES

In running this module, there are a variety of challenges which arise every year.

Scheduling school placement days. Students taking this module spend one full day each week in their school during the Autumn term. This obviously has to be on a day in which they have no lectures or labs for the other modules they are taking. Fortunately, students at Swansea University only take at most two other modules at the same time; also, the Department works hard on the timetable to ensure that each student has one free day during the week. Hence, it generally proves straightforward to find a day during the week for each student to spend in school. However, the final timetable is not published by the University until just before the term starts, and often suffers from last-minute adjustments.

Scheduling school visit days. It is expected that the module moderator visits each participating school twice: once during the term to ensure that the students' engagement and experiences are progressing as expected, and once at the end to discuss the teacher-mentor's assessment. This can be hugely time-consuming, particularly taking into consideration the remoteness of many of the school.

Moderating teacher assessments. Whilst teacher-mentors are provided a proforma for providing formative and summative feedback against set criteria, different teachers provide widely-different marks; as their assessment is worth 30% of the module grade, these can provide an unfair advantage to those students who have teacher-mentors who are generous with their marking, and an unfair disadvantage to those students who have teacher-mentors who are harsh with their marking. Thus, moderation is required, which is facilitated by the school visits made at the end of the term to discuss with the teachers how the term went for the students and to go over their assessment proforma and the marks they assign for each assessment category.

Geography. Wales is a sparsely-populated country with a rugged geography and few top-quality roads, and many "local" schools are difficult to get to, taking over an hour to drive to from Swansea, and substantially more by public transport. These isolated schools tend to be the most in need of computer science support – and thus the ones we most want involved in the programme. However, this then relies on being able to identify students who can (and are willing to) drive to such distant schools, and then reimbursing them for their travel costs.

Language. A number of schools that want to participate in this programme are Welsh-medium schools, which have a particular problem with attracting STEM teachers in general, and specifically computing/ICT teachers. Whilst there are Welsh-speaking students taking the module each year, quite often they ask to be placed in an English-medium school as English is the language they use in their computer science studies. Hence, inevitably some Welsh-medium schools have to be disappointed each year, though each year at least one student is typically placed in a Welsh-medium school. This itself presents a difficulties in assessing such a student's work (with a non-Welsh speaker leading the module), as they are naturally allowed – and indeed encouraged – to submit their work in Welsh. Using a translation service leads to grammatical errors being corrected and technical errors being introduced; whereas using a Welsh speaker from a cognate department to assess the material leads to potential inequalities which the (naturally English-speaking) external examiner would not be able to identify.

5 EFFECTIVENESS

There are two main aims in running this module.

(1) The first main aim is to raise awareness amongst computer science students of the possibility of teaching as a profession. Of course, there are very many tangible learning outcomes and transferable skills, even for those not progressing into a teaching role, which this module very effectively provides: interpersonal and improvisational skills and dealing with difficult or potentially disruptive situations; preparation of presentation materials and development of communication skills; team working and giving and receiving feedback.

Most students who take this module, understandably, do not progress onto a PGCE. However, every year some do, and so this module has created a small but steady pipeline which previously did not exist.

(2) The second main aim is to complement the work of Technocamps in supporting and up-skilling the nation's teachers who are charged with teaching computing in schools. The module has been very effective in this, having a great impact on many of the schools who have been struggling, particularly, with the adoption of the new GCSE Computing curriculum.

Furthermore, very many of those who take this module but don't go into teaching still extend the enjoyment they've had in working in schools with this module by becoming STEM Ambassadors and offering to deliver extracurricular computing clubs in their local schools. In some instances, they have recruited colleagues in the companies they join to do likewise, which futher adds to the impact.

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