CSinc: An inclusive K-12 outreach model

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ABSTRACT

This poster describes the early development of a K-12 outreach model, named CSINC, to promote CS in Ireland. It has already been piloted with over 4500 K-12 students in its first year. At the heart of the model is a two-hour camp that incorporates an on-site school delivery. Schools from all over Ireland self-selected to participate, including male only, female only and mixed schools. The no-cost nature of the model meant a range of schools participated from officially designated "disadvantaged" to private fee-paying. During the initial deployment over 2500 pre- and post- surveys have been collected. This data will allow for further model improvement and validation. A positive initial outcome was the balance of male and female participants, 46:54 respectively. This poster describes the model structure in detail and outlines early findings.

CCS CONCEPTS

• **Social and professional topics → Computer science education**; **CS1**.

KEYWORDS

Computer Science Education; K-12; Outreach, Computing Camps

1 INTRODUCTION

Formal Computer Science Education (CSEd) at the K-12 level in Ireland is a recent development [10]. Currently there are a small number of schools piloting a CS curriculum at upper second level (typically 16-18 years of age), along with an optional coding short course for lower second level (typically 12-15 years of age), with a primary school curriculum under development.

Ireland is a strong player in the global IT industry [1] and there is an ongoing concern about the inability to fill related jobs in the market [7, 8]. This is compounded with falling numbers pursuing third level CS (it fell by 8% last year alone in Ireland [5]) and a low female uptake of the subject [9], which is currently ~20%. Hence many third level institutions are developing outreach models to address this but in many cases the format and pedagogical approach differs significantly. The development of an outreach model that could be validated longitudinally, with a large sample size, at a wide number of schools, with different student profiles, would be a valuable contribution to the community.

2 THE OUTREACH MODEL

The CSINC outreach[1] model in its current phase was developed over two years with a pre-pilot in the first year 2017-18 and a model deployed in the current academic year 2018-19 (the pilot phase).

2.1 Pre-Pilot Outreach Programme

The goal of the pre-pilot phase was to establish points of contact with schools and to develop a skeleton model. During this phase the decision to offer a mobile outreach camp evolved. The team understood that in Ireland funding at K-12 level is almost non-existent and teacher roster time is constrained. This problem is echoed in the literature [4]. Another notable outcome was to develop a camp with a two hour duration, with a typical K-12 class (n ~24-30 students), to accommodate school timetabling in Ireland. In the first year, the CSINC pre-pilot 95 schools composed of ~2900 students. The experience helped identify an initial pedagogical approach.

2.2 Developing the Pilot Model

The pilot model was developed from learning through the pre-pilot phase and validated pedagogical approaches as described later in this section. The primary goal of the pilot study was to examine the pedagogical approach and content to evaluate effectiveness. Furthermore, the team hoped to positively promote attitudes, perceptions and build student interest in pursuing further study in CS. To reflect this, the camp structure was divided into three sections:

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[1]http://CSinc.ie

1. Introduction to the roles and careers of a computer scientist: This session in the camp is short and interactive, consisting of a 15-20 minute presentation using visual aids. Students identify stereotypes in the images using a think-pair-share approach, to encourage critical thinking [6] and group discussion. Work related roles and environments available to computer scientists are also discussed.

2. Hands on coding (Micro:bit): A hands-on coding session, using laptops and tablets brought by the mobile team then follows. The IDE chosen was the MakeCode online IDE[2], which is cached so can be run even if there was no WiFi available. It uses block-based programming, similar to that of Scratch. The coding activities increase in difficulty, up to and including building and testing a step-counter. The activities used in this session consisted of the following: Modelling; PRIMM [11]; Targeted Programming Tasks (Debugging, Intentional Errors, Fill in the gaps, Worked Examples); Narratives; Paired Programming; Algorithm Design.

3. Hands on problem solving (Bebras challenge): Finally, in the last ~30 minutes of the camp, students participate in pen and poster activities using problems predominantly sourced from the Bebras challenge [3], with some additional problems sourced from third level. The activities used in this session consisted of the following (typically under the heading of computational thinking): Algorithm Design; Representation; Computational Thinking; Abstraction.

2.3 Research

Before each outreach visit, parental permission slips, study information and the letter of ethical approval were sent to the school, with only two schools declining to participate in the research survey. Participating students were given a survey form for the outreach camp that they filled partially before the camp and then completed after the camp. The parental consent forms were separated from the surveys to ensure no student was identifiable. In total 2500 surveys were collected for future analysis. The findings of the research are part of an ongoing PhD, and will be developed on in future work.
Prior to the camp: The pre-camp portion of the survey questions gathered demographic data; behavioural data; maths and science performance; prior knowledge of computing careers; consideration of a career in computing, self-reported ability on using computers; reasons why they might not pursue a computing career; role models; family working in computing; and prior computing experience.
Post camp: The post-camp portion was composed of questions asking about having a future career in computing; implications of the camp on their perceptions; facts students did not know about computing; self-perception of programming ability after the camp and provided for open-ended feedback.

3 PILOT OUTREACH OVERVIEW

In the academic year of 2018-19, the CSINC team used an online booking system. It was advertised on social media, our mailing list and the CESI mailing list [2] and resulted in a large number of new schools, not part of the pre-pilot, booking. It is worth noting that within three days, every camp was booked. From the 160 school visit days, the team was able to run one to three sessions per day at each school. This allowed up to 150 students to be reached in a

single day. The geographical spread was very positive, where the camps reached almost every county in Ireland.

For the pilot phase, 4,600 students participated, ranging from third class (7 - 8 years old) in primary school to sixth year in second level (17 - 18 years old). Initial analysis found that 2116 male and 2484 female students participated, with a ratio of 46:54 respectively.

4 CONCLUSIONS AND FUTURE WORK

This poster describes initial work of the development of a K-12 outreach model, named CSINC. The pilot phase of the model reached a large number of students and schools, with varied socio-economic and gender diversity. The camps also reached ~2/3 of the schools (and those students) studying the new upper second level subject named "Computer Science" [10]. This was important to the team, as this is the first group to take the new formal curriculum, and experience with this group is valuable for future developments of the model. The data collected in the pilot phase will be used to steer the CSINC model, informing camp activities and pedagogical approaches. While detailed analysis on the survey data has not yet been performed, the large female participation in the outreach camps is a very positive initial finding. The CSINC team plan to continue the outreach effort and carry out a longitudinal study on the effectiveness of the outreach programme. Finally, when the model has matured, and developed to a point that has been founded on research, the team plan to share all of this work, nationally and internationally.

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[2]https://makecode.microbit.org/