It Takes a Village to Teach Information Technology

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New Zealand Teachers are in Crisis

The recent introduction of a radically updated national secondary school curriculum in computer science (CS) and information technology (IT) has left many New Zealand high school teachers unprepared and anxious. At Otago Polytechnic, we are currently implementing a programme of supported teacher development that joins tertiary teachers, tertiary students and secondary teachers in collaboratively addressing problems of content knowledge, teaching methods and curricular materials. Our aim is to establish a long-term working partnership that will serve to enrich secondary education and strengthen the diversity and preparedness of incoming tertiary students.

Theoretical Framework

Our immediate crisis is the need for retraining of *in-service* teachers who have considerable classroom experience, but little or no formal background in the subject matter they are now expected to teach. In the context of Shulman's knowledge framework [1], the teachers we are working with have considerable pedagogical knowledge (PK) developed through years of teaching, but they have minimal subject matter knowledge (SMK) or pedagogical content knowledge (PCK). Hence, the optimal structure of a support programme for them differs markedly from that of a pre-service programme [2]. Our participants don't need to learn how to teach, they need to learn how to teach CS [3].

Because our teachers are already delivering CS courses, their most pressing need is for techniques they can use in the classroom immediately, and this is a core element of our support efforts. For example, in an upcoming workshop on teaching programming, we will present a modified version of the standard Software Development Life Cycle which teachers can use to guide 14-year-olds through a complete programming project. In addition, while recognising the urgent need for PCK, we believe it is essential to situate specific tools and techniques within the underlying theoretical framework of CS. Following [4], we focus on the problem-solving, analytical, and computational thinking aspects of CS. These are concepts that teachers will recognise from their training in other subject areas. By highlighting the academic core of CS, we hope to enable teachers to leverage their existing pedagogical skills and prepare them for ongoing independent professional development [5].

Programme Principles

Partnership
An experienced high school teacher has an abundance of teaching skills and knowledge. Support for teachers during the transition to the new curriculum must not be seen as tertiary educators bestowing favour upon the less technically skilled. Rather, tertiary CS and IT teachers can contribute content area expertise and experience with specific teaching methods[6], while secondary school teachers contribute their expertise in adolescent education.

Long-term
One-off workshops and seminars are not sufficient to provide the depth required by secondary IT teachers delivering the new curriculum. Instead we wish to build a long-term working relationship where tertiary and secondary educators work collaboratively.

Inclusive
One of the potential benefits of the new digital technology curriculum is that it may encourage more students to study CS and IT subjects in high school. This provides an opportunity to address imbalances in the current IT student population, which is disproportionally male and pakeha. To take full advantage of this, we can include topics and activities outside "traditional" CS and IT, to appeal to a broader range of students

Targets Younger Students
A body of recent work has found that introducing CS and IT subjects late in the high school curriculum is relatively ineffective, whereas a long-term programme beginning in the first years of high school can reach a wide population of students and provide a solid background for tertiary study [7]. We intend to begin working with Year 10 (second year of high school; 14-15 years of age) classes.

Involves the Whole Community
Our community of high school teachers, tertiary teachers, tertiary students and high school students are closely linked. By working together, we can provide an invigorating and unusual learning experience.

Programme Components

Teacher Training Workshops
A series of multi-day workshops for teachers are aimed at improving PCK and SMK. They concentrate on building core foundational area knowledge and developing immediately usable classroom techniques. The topics are chosen to maximise student engagement while aligning with the new digital technology curriculum , starting with visual programming, eTextiles and robotics.

In-class Intervention
Tertiary lecturers and students visit local high schools and work with the students and their teachers in the classroom. Such activities let secondary school teachers practice delivering unfamiliar materials in a supported environment, allow for the testing of newly designed curricular materials and can fill immediate educational gaps.

On-call Professional Development
Tertiary lecturers are available long-term via phone, email and social media to answer questions and help resolve problems as they arise.

Early Results

Successful Initial Workshop
A 3-day intensive training workshop was held on the use of visual programming (Scratch) in Year 10, involving teachers from our city and the surrounding rural towns.
The content covered:
- Day 1: Core principles in programming and programming pedagogy. Implementation exercises using the Scratch visual programming environment.
- Day 2: Supported development/implementation of complete classroom exercises using Scratch.
- Day 3: Discussion of appropriate software development life cycle (i.e. how to build a large project) for Year 10 students with associated classroom materials. Supported implementation exercises using Scratch.

Outcomes
- Extremely positive teacher feedback.
- Noticeable improvement in teachers' own programming skills.
- Teachers planning to use the workshop materials in their own classrooms immediately.
- Teachers enthusiastic about enrolling for the next course.
- Other teachers now contacting us asking to become involved in future workshops.
- Huge commitment in terms of time and energy by all involved required to make this programme a success.

First In-Class Intervention
Tertiary students delivered module on construction and programming of Arduino-based robots in local girls' high school.
- Enthusiastic reception by secondary students.
- Immediately filled a void in class curriculum.
- Enhanced tertiary students' understanding of the difficulties faced by secondary school teachers of digital technologies.

Future Plans

Expansion the support programme
To address the senior high school classes (to Year 13 in New Zealand).

Increase the availability of curricular materials
Through open education resource publication.

Graduate Diploma
Encourage teachers to use existing paid Study Leave option to enrol in our one year full time Graduate Diploma programme .

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