An tSraith Shóisearach do Mhúinteoirí
JuniorCYCLE for teachers

Exploring Coding – a CPD initiative to support the introduction of the junior cycle short course in Coding

Final Report - November 2018

A collaborative CPD initiative with
Lero – the Irish Software Research Centre and Intel Ireland

Authors: Clare McInerney (Lero),
Michael Carey (Junior Cycle for Teachers)

Contents

Introduction

The *Framework for Junior Cycle* (2015)[1] outlines the key educational changes that the Department of Education and Skills (DES) is putting in place for young people in the first three years of their post-primary education and represents one of the most significant educational reforms in Ireland since the foundation of the state. The framework incorporates a shared understanding of how teaching, learning and assessment practices should evolve to support the delivery of a quality, inclusive and relevant education that will meet the needs of all junior cycle students, now and in the future.

Short courses are a new and optional curricular component within the *Framework for Junior Cycle*. Short courses allow a school the flexibility to broaden the range of learning experiences for students, meet student needs, address their interests, and encompass areas of learning not covered by the combination of curricular subjects available in the school. Short courses require 100 hours of student engagement and are assessed through Classroom-Based Assessments, and reported on to parents/guardians and students by the school.

In 2014, the National Council for Curriculum and Assessment (NCCA) developed nine short courses which schools may opt to include in their junior cycle programme. As part of this work, Lero – the Irish Software Research Centre, was commissioned to write a short course, which was entitled *Coding,* in the area of computer science. This represented the first time that computer science could formally appear on the Irish curriculum and also the first time that students could profile their achievement in this area of learning. The course specification was made available to schools in 2014 and revised further in 2016[2]. Another ICT-related short course, entitled Digital Media Literacy was also developed at this time by the NCCA.

The Junior Cycle for Teachers (JCT) school support service was established in 2013 to assist schools in implementing their junior cycle programme through the provision of high quality continuing professional development (CPD) opportunities and relevant learning and teaching resources. The short courses team within JCT were tasked with supporting schools in relation to short courses.

Lero is the Irish software research centre. It brings together leading software research teams from Universities and Institutes of Technology in a coordinated centre of research excellence with a strong industry focus. This initiative is directly aligned with Lero's Education and Outreach Programme, whose goal is to challenge, inform and effectively engage the public and stakeholders in the discipline of computing/software. Since its foundation in 2005, Lero has been conducting activities such as the Scratch programme in schools, summer computing camps, Smart Futures etc… in this area.

Intel is the largest semiconductor manufacturer in the world. Intel Ireland is based in Leixlip, Co. Kildare since 1989, with a research facility in Shannon, Co. Clare, as well as part of the Intel Security Group based in City Gate, Cork. Intel currently has 5,200 employees across the island of Ireland.

In late 2015, JCT, Lero and Intel Ireland established a collaborative CPD initiative entitled *Exploring Coding*, involving 22 post-primary schools which will run from January 2016 – February 2017. The initiative was designed to:-

- examine the current provision and opportunities within schools for Information and Communications Technology (ICT)[3] - related curriculum components at Junior Cycle
- support and document the experiences of a small number of schools as they incorporate aspects of the short course in *Coding* within their junior cycle programme.

[1] http://www.education.ie/en/Publications/Policy-Reports/Framework-for-Junior-Cycle-2015.pdf

[2] http://www.curriculumonline.ie/Junior-cycle/Short-Courses/Coding

[3] There is sometimes confusion over the use and meaning of the terms computer science, information technology, digital literacy, etc. The definitions in Appendix 1 may assist in your understanding of the various terms throughout this report.

- explore further options to support schools and teachers in their implementation of the short course in *Coding*

Participating schools received a donation from Intel Ireland to support their work. This donation comprised of a set of electronic devices or development boards known as Galileo Gen 2[4], as well as a number of component kits.

As well as providing a brief background to the introduction of the short course, this report will outline: -

- the key observations from the 'expression of interest' process as to current practice in Irish schools in the area of computer science
- a description of the CPD activities
- the progress reported upon by participating schools
- the significant findings of the initiative
- the final summary and recommendations

Section 1 Background

The introduction of *Coding* as an option for students at Junior Cycle follows developments on the international stage recognising the importance of Computer Science as a discipline. This is echoed in the rationale in the short course specification:-

'Computer Science is present in every aspect of modern society... A fundamental understanding of how computer hardware and software operate and relate to everyday life is an increasingly important area of learning for students. Problem solving and computational thinking skills are developed… as students build and create software projects using their own ideas and imagination. The course looks to build on any coding skills that primary students might have experienced while offering insight into possible future studies in computer science and software engineering'[5] (p.7)

Computer science education is being prioritised in many countries as the reality of opportunities in computer science related careers grows and is projected to continue growing for the next number of years. In England, a new computing curriculum was introduced in 2014 as an entirely new foundational school subject [1]. Computer science is now taught to every child at every level from primary onwards. In the USA, a group of 100 advisors within the computing community, several states and large schools districts, technology companies and other organisations have joined forces to develop conceptual guidelines for states and districts creating a K-12 pathway in computer science [2]. New Zealand [3], Germany [4], Israel [5] and many more countries have embraced computer science in their educational systems.

In the Irish context, the ICT Skills Action Plan for Jobs 2014-2018[6] and Ireland's National Skills Strategy 2015[7] highlight the importance of technology/ICT skills to support economic growth. The Action Plan for Education 2017[8] outlines government plans to introduce Computer Science as a subject at senior cycle in 2018. The Higher Education Authority (2016)[9] examined progression rates across a range of fields of study in Irish higher

[4] http://www.intel.ie/content/www/ie/en/embedded/products/galileo/galileo-overview.html
[5] http://www.curriculumonline.ie/Junior-cycle/Short-Courses/Coding
[6] http://www.education.ie/en/Publications/Policy-Reports/ICT-Skills-Action-Plan-2014-2018.pdf
[7] http://www.education.ie/en/Publications/Policy-Reports/pub_national_skills_strategy_2025.pdf
[8] http://www.education.ie/en/Publications/Corporate-Reports/Strategy-Statement/Action-Plan-for-Education-2017.pdf
[9] Higher Education Authority (2016), A study of progression in Irish higher education 2012/13 to 2013/14, p.23. Accessed at http://www.hea.ie/sites/default/files/hea-progression-irish-higher-education_final.pdf

education. In comparison to the national average for non-progression of 16% in 2012/13, non-progression within computer science was considerably higher at 25%. There are many reasons why this dropout is high. They include misunderstandings about the nature of the subject, difficulty in differentiating between computer science, digital literacy and information technology as well as public perceptions reflecting stereotypes about people who engage in computer science.

The introduction of a short course in *Coding* at junior cycle will seek to address the above issues by: -

1. Informing students about the nature of the area of learning
2. Equipping students with computational thinking skills and problem-solving skills
3. Enabling them to make informed choices about choosing further studies (at senior cycle or 3rd level or a career in computer science

The Exploring Coding initiative, and indeed this report, were informed by research reports such as the Roehampton Annual Computing Education Report [6]. In this UK study, the authors report that in proportional terms, girls do better than boys at GCSE computing for the highest-grade bands and that discussions about diversity and computing should include socio-economic and ethnic factors. Issues regarding female underrepresentation and lack of diversity in computing are reported widely in research [6, 7] and industry [8, 9]. Bearing this in mind, this report will reflect on the number of female teachers and students involved in the initiative as well as the number of schools which fall within and outside the DEIS (Delivering Equality of Opportunity in Schools) [10] provision; an initiative which since 2005 has sought to better address the educational needs of children and young people from disadvantaged communities.

Section 2 Observations from the 'expression of interest' process

In late 2015, a letter and brochure (See Appendix 2) were circulated to schools inviting them to express their interest in becoming involved in the *Exploring Coding* initiative. This call received an unprecedented level of interest from across the country and 19 schools were selected from the 128 schools that expressed interest in participation. A further three schools were added to the project in May 2016. A list of participating schools is included in Appendix 3.

Schools were selected for participation using the following criteria: -

- Schools that engaged with the short course in *Coding* via NCCA consultation meetings and/or NCCA Junior Cycle Network Schools.
- Schools that engaged in previous Lero initiatives
- Schools that exhibited existing practice and/or teacher expertise and/or currently provide curricular time at junior cycle in the learning area of computer science.

It is also noteworthy that due to the industrial relations dispute at the time, only schools from within the Education and Training Boards (ETB) sector were identified for participation.

The expression of interest process provided an overview of the practice in Irish schools with regard to coding/computer science. Of particular interest are: -

1. Profile of nominated teachers
2. Existing practice with regard to coding/computer science
3. The schools' rationale for the development of this area of learning at junior cycle

[10] https://www.education.ie/en/Publications/Policy-Reports/deis_action_plan_on_educational_inclusion.pdf

2.1 Profile of nominated teachers

As part of the expression of interest process, school were asked to nominate two teachers who would lead learning in *Coding*. The following graphs examine this data in relation to teacher gender as well as teacher subject expertise.

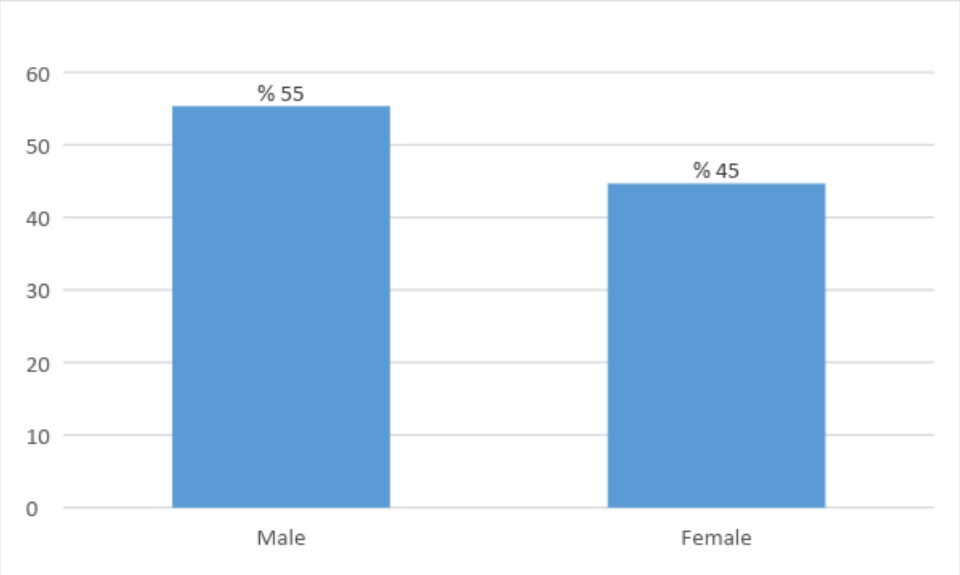

Fig. 1: Gender (%) of nominated teachers (n=244)

Of the teachers nominated 55% were male and 45% were female. From the 22 schools selected for the initiative, the gender breakdown is 63% male and 37% female (n=43)

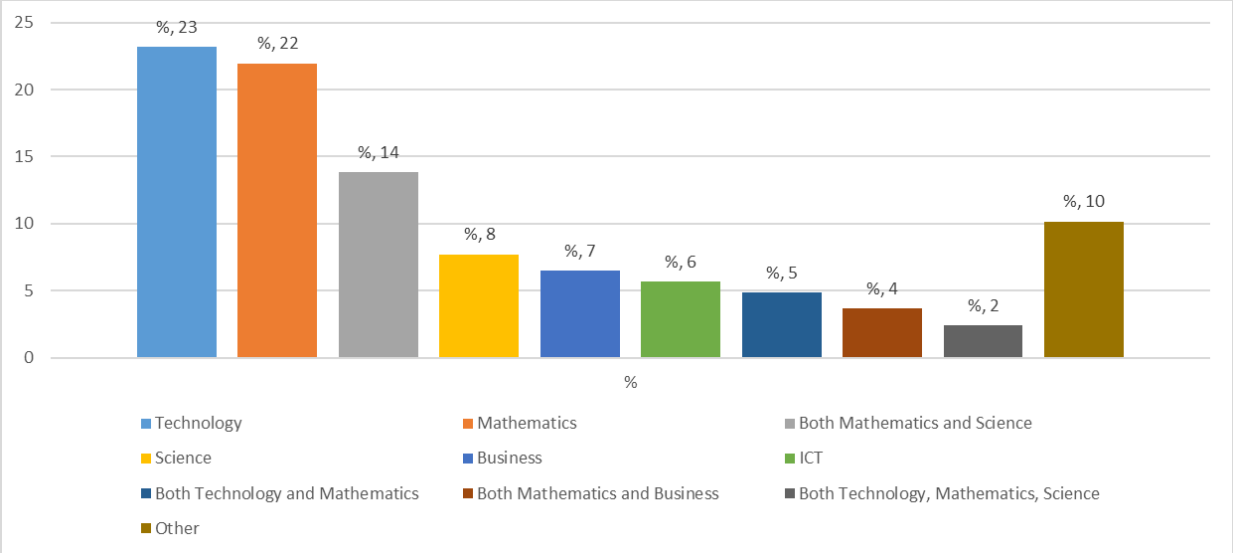

Fig. 2: Teacher expertise (%) of nominated teachers (n=246)

Of the teachers nominated, the subject expertise lay predominantly in the areas of technology (23%) and mathematics (22%), as well as science, business and ICT to a lesser extent. Only 10% of teachers nominated had teaching expertise outside of these four subject areas. From the 22 schools selected for the initiative, the breakdown is extremely similar with only 7% of participating teachers with teaching expertise outside of the four areas above (n=43). Please note that in the above graph, the figure for teachers of ICT reflects those reported to teach ICT only and that teachers across all of the other categories may have taught ICT also.

The expertise in the area of computer science varied, but in the sample of the 22 participating schools, many teachers had undertaken courses and seminars delivered by various providers (e.g. Lero, the Irish Computer Society, the Professional Development Service for Teachers - PDST, Computers in Education Society of Ireland – CESI, British Educational Training and Technology Show - BETT).

Three of the participating schools had participated in the Postgraduate Certificate in 21st Century Teaching and Learning, *Bridge 21 Programme* from Trinity College, Dublin which allowed teachers gain experience in various online platforms, electronic devices and programming languages.

At the higher end of expertise, a small number of teachers had qualifications to BSc, Graduate Diploma or MSc. level in Computer Science. Additionally a number of teachers had worked in the IT industry before entering the teaching profession.

2.2 Existing practice with regard to computer science/coding

Many schools have existing practice in the area of ICT at junior cycle level, but it was clear that this differed greatly from school to school with regard to:-

- the title of the area of learning,
- the type of general practice in ICT, and specific practice in computer science,
- the time provision for ICT.

The **title of the area** of learning included ICT, Computers, Computer Science, Coding and Programming. Modules were mentioned such as Programming and Web design, which indicated a wide spectrum of practice from school to school. A small number of schools mentioned lunchtime and/or after-school Coding clubs or links with local community-based clubs or *Coderdojos*.

The **type of practice** reported in the 'expression of interest' process varied significantly from school to school also. Many schools engaged in basic digital literacy skills such as file management, and the use of applications such as Microsoft Office (word-processing, spreadsheet management, email, etc.)

Some schools built their digital literacy skills around a centralised platform such as Google Apps for Education – GAFE, Schoology, Microsoft 365 for Education. These schools incorporated a high level of technology in their learning and teaching practice and sometimes incorporated certification opportunities, such as ECDL or Microsoft Office Specialist, into their practice

A small number of schools also engaged in other digital literacy skills such as animation.

It is important to note that learning which relates to digital literacy is not specified within the short course in *Coding*. Taking a closer look at the computer science related practice within the sample of the 22 participating schools, the following examples were evident:-

- Use of block-based introductory programming environments (Scratch, Blockly)
- Use of online platforms to support learning (Kahn Academy, Google CS First)
- Engaging in Code Competitions and Initiatives (Google Call to Code, Hour of Code, CanSat)
- Use of electronic devices (Raspberry Pi, Arduino)
- Basic engagement with programming languages (HTML/CSS, JavaScript, Python)
- App Development (MIT App Inventor)

Time provision differed greatly from school to school, and the following graphs explore the total time committed to ICT in a year-by-year analysis.

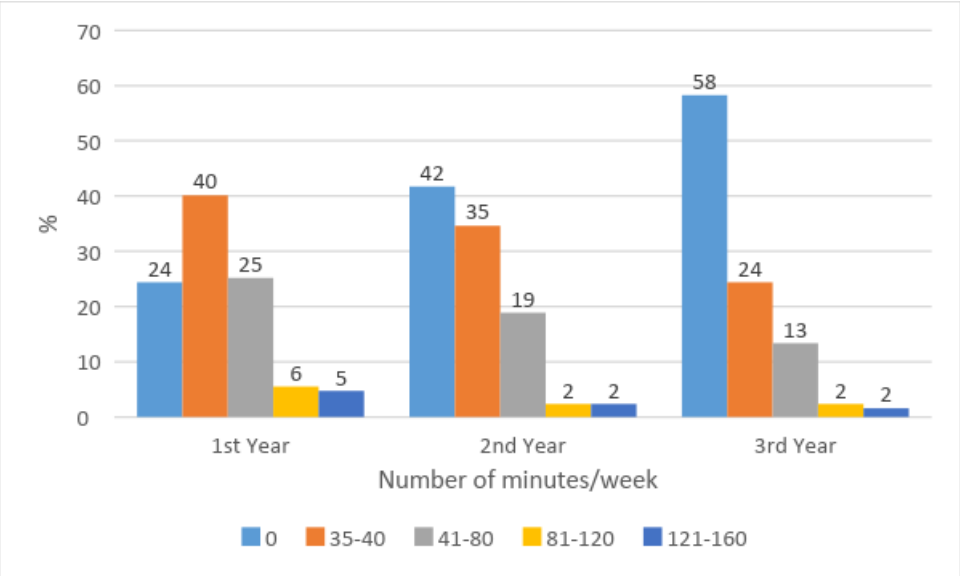

Fig. 3: Time allocated to ICT each year across Junior Cycle (n=127)

The above graph shows a huge variation in practice with regard to ICT. Firstly, close to one quarter (24%) of schools who expressed an interest in partaking in this initiative did not have curricular time allocation for ICT in First Year, and the likelihood of this increased in subsequent years, with 42% not having time provision in Second Year, and 58% in Third Year.

Two fifth of schools (40%) reported having a single (35-40 minute) class period in first year, with this reducing to just under a quarter (24%) of schools in third year.

Also, a sizable cohort, 25%, offered up to two class periods (80 minutes) in First Year, with this reducing to just 13% of schools in Third Year.

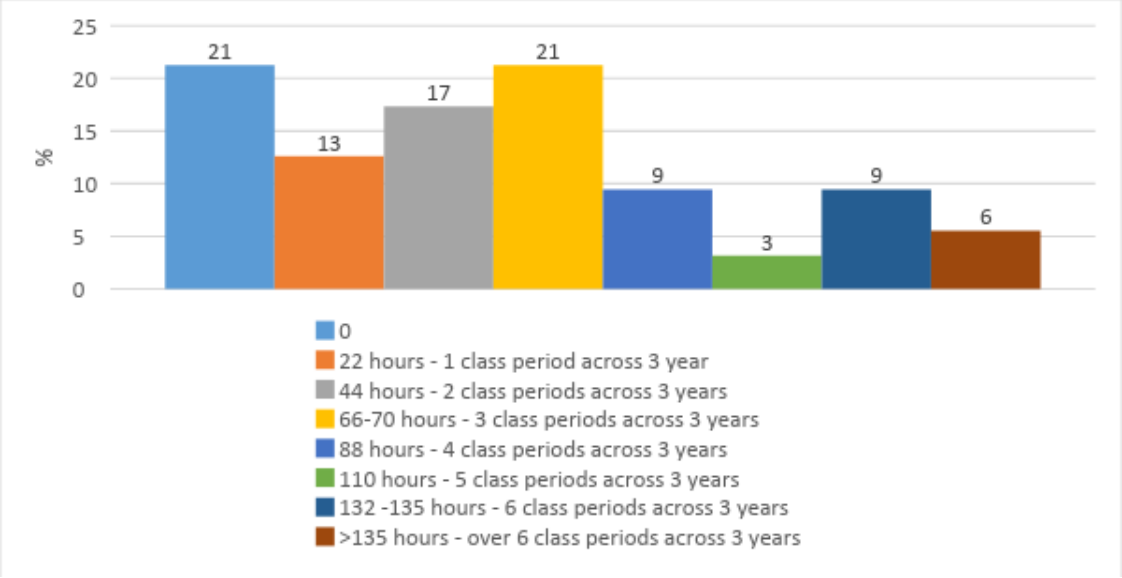

Fig 4: Time allocated to ICT across Junior Cycle (n=127)

The above graph reports the total time allocation across the three years and again shows a huge variation in practice. The short course requires 100 hours of student engagement, and it is acceptable that this may comprise of 88 hours of timetabled engagement with the remaining 12 hours comprising of focused activities (trips out, visits in, focus mornings, etc.). In this context, it is notable that over one quarter (27%) of schools commit four class periods or more as their total time allocation across the three years, which is the equivalent of 88 hours.

The variation across schools is emphasised further where, by comparison to the above, just over one fifth (21%) of schools who expressed an interest in participating in the initiative did not have time allocated to the area of learning in any of the three years.

2.3 The schools' rationale for the development of this area of learning at Junior Cycle

Within the sample of the 22 participating schools, there were a number of key reasons why the schools wished to include the short course in Coding in their students' junior cycle programme.

The schools wished to:-

- Provide opportunities for students to develop particular skills (computational thinking, logical thinking, collaborative skills, numeracy skills, developing projects using hardware devices). A number of principals felt that engaging in these skills would enrich the learning environment, improve student engagement and motivation, and lead to better student outcomes and enable students to make more informed choices regarding future study.
- Build on the student interest in computer science which was evident in existing practice (coding club, transition year) or within the learning taking place in local primary schools.
- Allow their students to experience aspects of what a career in programming and computer science would involve and help them make informed decisions about potential further studies in this area of learning.
- Promote the school as a centre of excellence in their local area with regard to ICT. Many schools had existing links with third level institutes and local industries. A small number of schools wished to be at the 'cutting edge' in developing practice around this short course. In addition, a number of schools felt that the introduction of the short course would allow the school to develop and formalise the practice within their school.
- Engage with a community of other schools to share best practice in the area. Many teachers expressed an interest in developing their own skills in the area.

Section 3 Description of Initial CPD Activities

The 22 schools that were selected to participate in the Exploring Coding Pilot were offered the following CPD supports as they trialled aspects of the *Coding* short course within their school.

<u>CPD Event 1 – Regional Twilight Meeting (January 2016)</u>

The initial session provided information about the initiative, and the short course within the Framework for Junior Cycle, a description of careers and opportunities in computer science. A school case study was presented and schools were also invited to share details of the practice within their own school.

CPD Event 2 – Full Day Workshop (January 2016 – Lero)

During this national event which was hosted by Lero in the University of Limerick, teachers explored the short course specification, followed by a number of hands-on workshops in computer science and computational thinking. The tools and technologies included were:-

1. Kahn Academy[11]
2. CS Unplugged[12]
3. Teaching London Computing[13]

CPD Event 3 – Full Day Workshop (February 2016 – Intel)

At this national event, which was hosted by Intel Ireland in Leixlip, teachers received a workshop on the Intel Galileo Gen 2 board. Software drivers and the Arduino API were installed during the workshop and participants engaged with a set of materials to familiarise them with the hardware.

It is interesting to note that the above event in Intel received a huge level of positive media attention, both locally and nationally. Several schools were subsequently contacted by local newspapers and radio. Schools reported that workshop participation and media attention helped to raise awareness of the initiative within their school and the wider community.

Following the above events, teachers were asked to select and trial aspects of the short course. This involved planning a unit of work and documenting their progress over a number of weeks.

School Visit (April 2016)

This support involved one or two members of the project team meeting with the management and participating teachers of each school. The meeting was structured to support the context-specific needs of each school, and also to gather information on the experience of each school to date.

CPD Event 4 – Two-day Workshop (October 2016)

In response to feedback during the initiative, these regional events provided support to teachers in their work in planning for teaching, learning and assessment using learning outcomes. It also provided a sample of a school's approach to the design of a unit of work and assessment tasks. The programming language of Scratch formed the basis of the workshop with a focus on assessment, including reviewing examples of student work as well as the use of an online platform for assessing computing using a bank of high-quality multiple choice questions, developed as part of Project Quantum[14]

CPD Event 5 – Full Day Workshop (February 2017)

These regional events marked the conclusion of the initiative, and each school was requested to share their practice via an online webpage as well as a brief presentation on the day. This day also featured an input regarding the simulation of a project development environment in the classroom.

[11] https://www.khanacademy.org/
[12] http://csunplugged.org/
[13] https://teachinglondoncomputing.org/
[14] https://diagnosticquestions.com/Quantum

Section 4 Progress within schools during the project

Schools and teachers were aware that reporting on their progress was an important aspect of this initiative, and all agreed to do so. As well as email and phone communications, a visit to each school was undertaken in April 2016. This allowed teachers to report on what aspects of the short course they had undertaken and reflected, with their school management, on their successes and challenges. It also allowed the schools access to context-specific support after three months of participating in the initiative. Questionnaires were administered at multiple checkpoints over the course of the 12 months. This allowed the CPD programme to be tailored to meet the changing needs of the teachers over the course of the project. The concluding CPD day tasked teachers with documenting and presenting their experience of the project. This included details like timetable allocation, success stories, obstacles overcome, resources, student experience and providing advice to teachers embarking on teaching the short course in coding. Student feedback was also captured via surveys from 395 students in 13 of the participating schools. This made it possible to establish the experience of the student over the course of the initiative.

The progress will be described under the following headings:

- Successes at a school level
- Challenges at a school level
- Successes at a classroom level
- Challenges at a classroom level
- Student Feedback
- The use of electronic devices to support student learning

4.1 Successes at a school level

Many schools felt that engaging with the short course was meeting the needs of their students for a number of reasons:-

- Students were entering school with some experience and lots of interest in this area of learning, and the short course offered increased choice and flexibility for their students
- Many past pupils from the school are now working in the technology area or related areas, and incorporating Coding within the junior cycle programme will help support others to do so.
- Engaging in the short course will allow students to enter transition year and progress to senior cycle and beyond with a valuable skill set in technology and an enhanced ability to think logically as they approach projects in the future.

Leadership were happy to support staff in 'pushing their passion' for this valuable area of learning.

Schools also felt that including coding at junior cycle level was a reflection of their progressive ethos and their eagerness to excel in this innovative area. Some principals were happy that their particular school was being acknowledged for their work in promoting computer science, for continuing the work in place in local primary schools, and their strong links with local industries and third level institutions within their community.

On conclusion of the initiative, schools reported how participation had led to the establishment of a coding department within schools with other colleagues tasked with delivery of the short course in Coding. Schools also reported a sharing of practice within and across the schools. Schools received positive feedback from parents and students involved in the initiative. Teachers spoke of the benefit of coding related learning to other STEM projects such as BTYSE, Students Enterprise Awards etc… Schools acknowledged the positive PR exposure associated with participation in the project and the potential influence this could have on incoming students.

4.2 Challenges at a school level

The allocation of 100 hours to include the short course of Coding on the school's Junior Cycle programme was identified as a challenge. Amongst the reasons mentioned were:-

- Tradition – From Section 2, we can see that the time allocation for ICT classes varied from school to school. To include a new area of learning such as Coding, each school needed to reconsider the traditional allocation of time to various junior cycle subject areas. In some cases, incorporating a time allocation of 100 hours to support the short course in Coding was difficult. Some schools identified that the lack of a specific pathway to certification (e.g. senior cycle computer science) also compounded their potential to allocate additional time required at junior cycle. The government has since announced the introduction of computer science at Leaving Certificate in a selection of 40 schools from September 2018.
- Planning the digital pathway – Finding the balance between learning in the area of Coding as well as the need to include other digital media skills such as file management skills, and skills with various applications and programmes to support learning across other subjects proved a challenging task.

An interesting consideration which schools were making was whether Coding was for *all* students or *some* students. In terms of timetabling, an important decision is whether Coding should be offered to all students as part of their core junior cycle experience, or should it be offered as an optional choice or, indeed, a compromise model between both options.

Schools identified lack of training/CPD for a larger number of staff as a limitation as teacher confidence, outside of those involved in the initiative, proved a challenge. In a number of schools, teacher prior experience in this subject area was limited and this initiative was limited to 5 CPD days. A number of issues arose regarding timetable allocation across 3 years of Junior Cycle (teacher continuity with a class group and low levels of contact time per week). The availability of adequate equipment to deliver the course was a challenge in some schools with limited infrastructure. The Digital Strategy For Schools 2015-2020 makes reference to the "implementation of a grant scheme for the purchase of digital equipment by schools"[15], so this issue will be addressed.

4.3 Successes at a classroom level

Teachers identified the wide range of resources to support learning as the key to their successes in the classroom.

- Ease of block-based programming for introductory lessons (Scratch, Blockly)
- Online Platforms (Kahn Academy, Google CS First)
- Hands-on logical thinking puzzles and activities (CS Unplugged)
- Some teachers identified the use of online learning platforms to support learning in this area

A number of teachers commented on how the use of differentiated tasks allowed for the needs of all students to be met in the classroom. In particular, the needs of talented students were met whereby they could mentor their classmates or engage in more advanced challenges.

[15] http://www.education.ie/en/Publications/Policy-Reports/Digital-Strategy-Action-Plan-2017.pdf

Student motivation to engage in learning of this type which incorporates the use of devices and the use of digital skills, as well as engagement in group work, was reported to be very high. Teachers reported an increase in student levels of confidence and their ability to recognise this area of learning in the broader STEM context.

Engaging with other schools in the pilot initiative assisted schools in identifying relevant resources and in establishing best practice for the classroom.

4.4 Challenges at a classroom level

In order to establish coding as an established part of the curriculum the vast cohort of participating teachers identified the need for further training, support and resources to support learning and teaching, particularly in the area of pedagogical approaches (project-based learning, games based learning, inquiry-based learning, etc.) and assessment of student work. Some teachers requested further upskilling in the use of electronic devices, such as the Intel Galileo board, to support student learning.

Although some of the participating teachers possessed qualifications in computer science, support for the development of further expertise in schools was called for, in the form of undergraduate or postgraduate programmes. A small number of teachers felt it important to explore, with the Teaching Council, the status with regard to teacher registration in the area of Coding/Computer Science.

Teachers highlighted a challenge in terms of planning for teaching, learning and assessment using learning outcomes. In particular, the design of appropriate assessment approaches was identified as a challenge by all teachers.

In some contexts, the availability of ICT in the home presented a challenge and curtailed opportunities for learning outside of the classroom.

4.5 Student Feedback

Student feedback was captured at the end of the project with 395 students in 13 of the participating schools surveyed. As well as baseline data on the students, it also made it possible to establish the experience of the student over the course of the initiative, and the key findings are highlighted below.

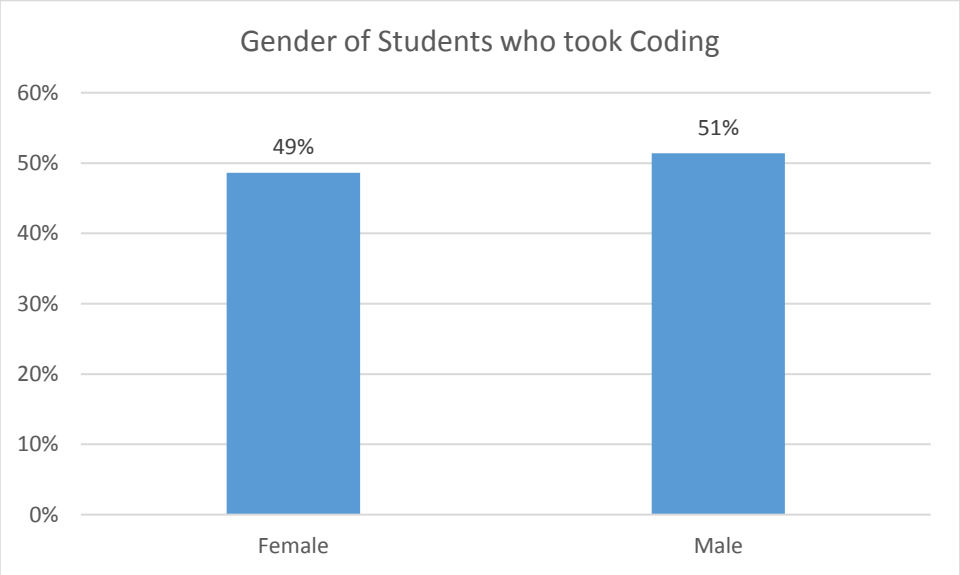

Fig 5: Gender of students who undertook Coding (n=395)

Of the 395 respondents, the balance of male and female students was very much equal.

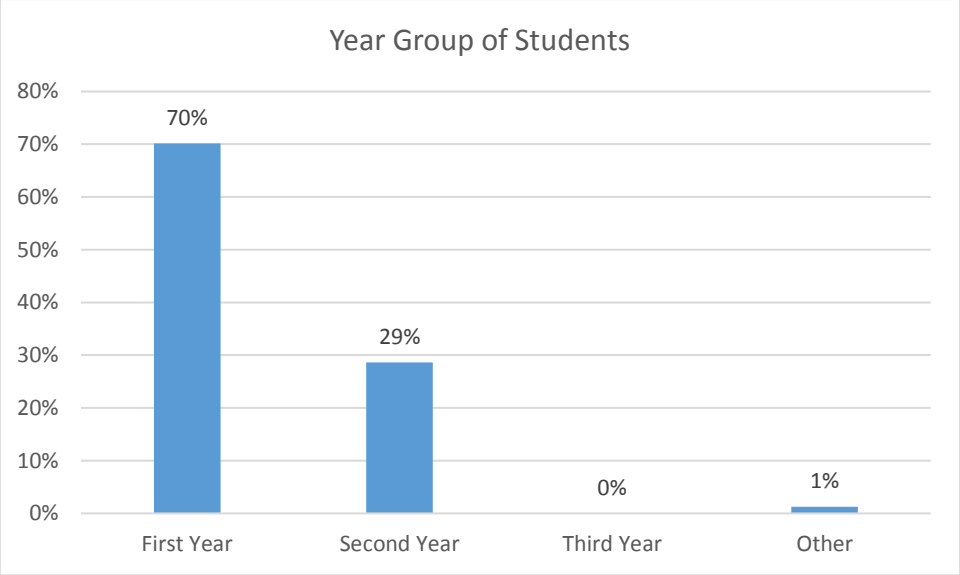

Fig 6: Year group of students who undertook Coding (n=395)

During this small-scale initiative, the student who participated were predominantly in First Year (70%) or second year (29%). Some schools trialled aspects of the short course with transition year students

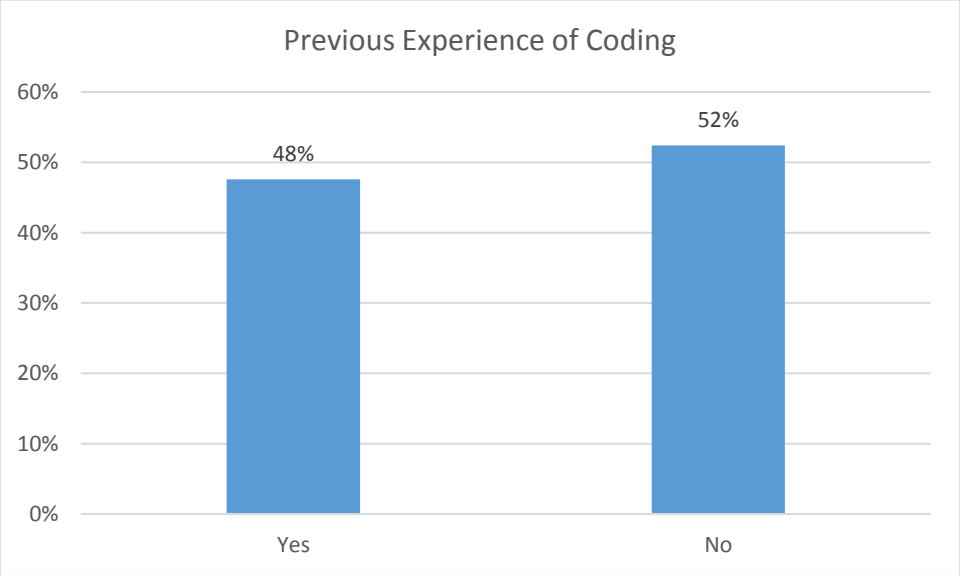

Fig 7: Previous experience of students who undertook Coding (n=395)

When asked if they had experienced Coding previously, nearly half of respondents (48%) had experienced coding previously.

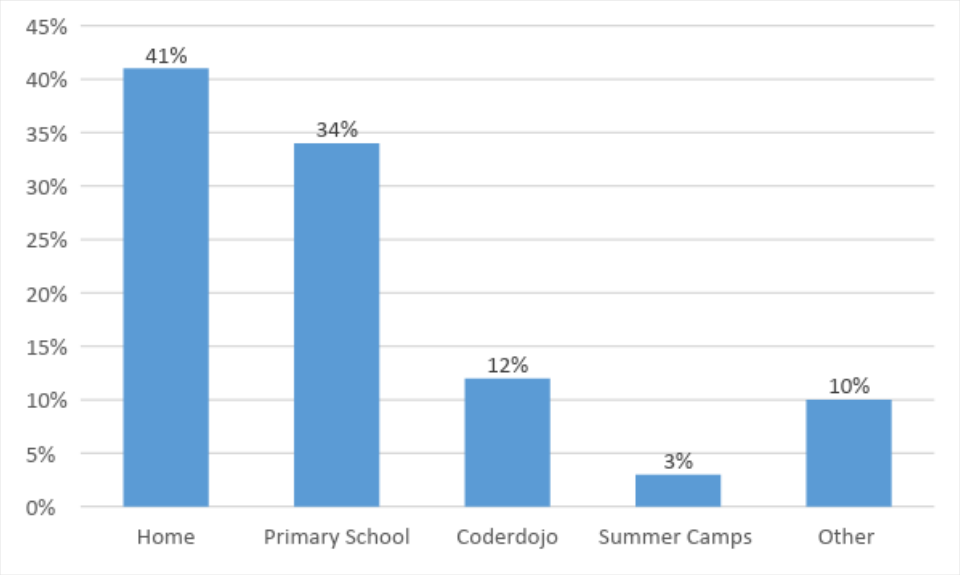

Fig 8: Location where previous engagement occurred for those students who had engaged with Coding previously (n=198)

Of those who had previously engaged with Coding(n=198), over two-fifths had experienced Coding at home (41%), another one third (34% had experienced Coding in primary school, while 12% reported engaging with a local Coderdojo.

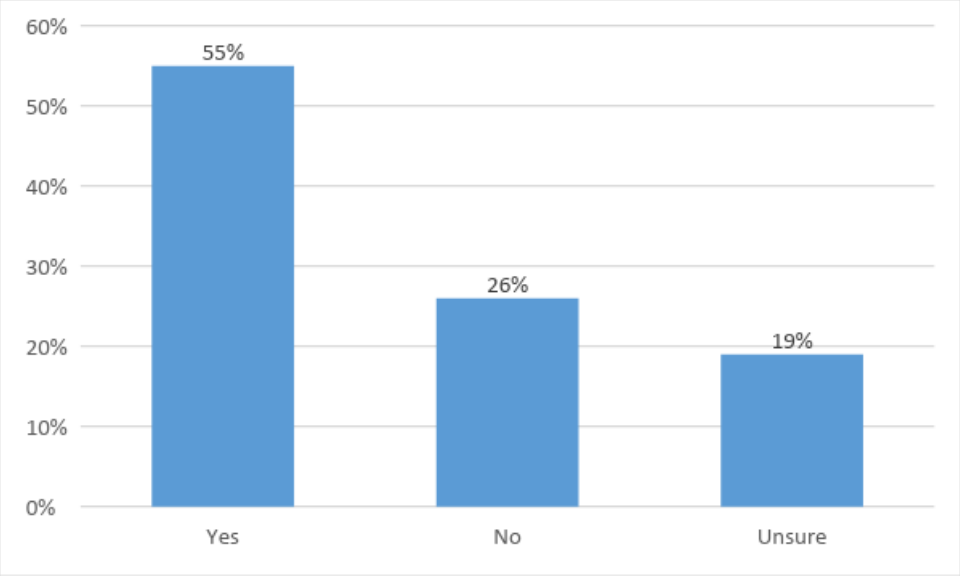

Fig 8: Degree to which students indicated if they enjoyed Coding class or not (n=395)

When respondents were asked whether they enjoyed Coding class, over half (55%) report that they did, with a quarter (26%) stating that they did not enjoy Coding class. One in five (19%) were unsure.

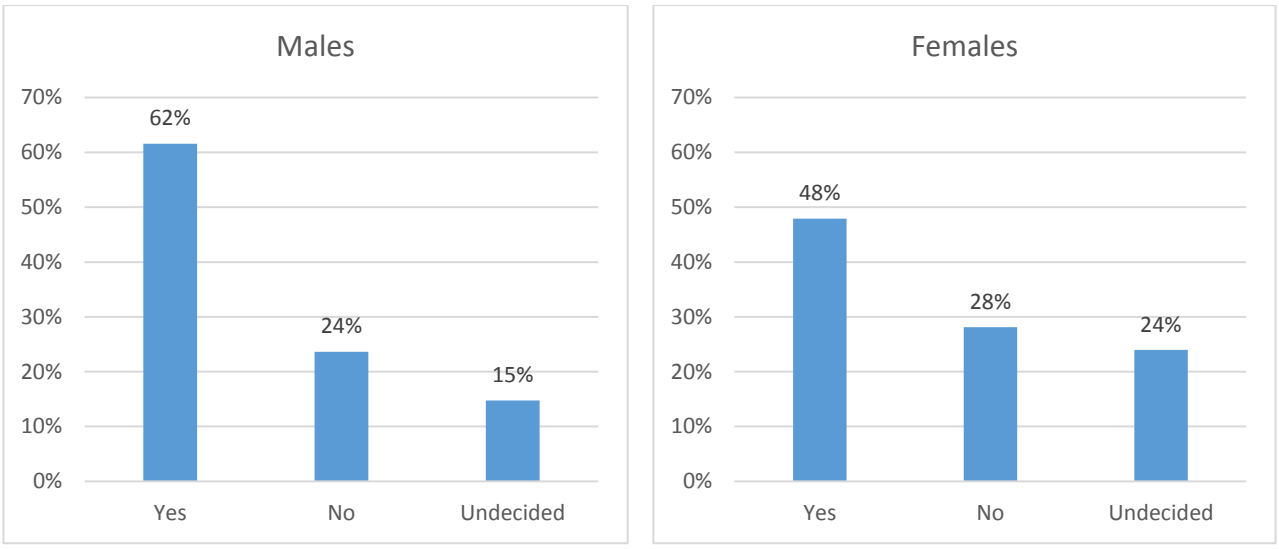

Fig 9: Degree to which students indicated if they enjoyed Coding class or not, by gender male and female. (n=203, n=192)

A greater proportion of males (62%) than females (48%) reported enjoying a Coding class, while numbers for those who did not enjoy coding were slighter higher for females by 4%.

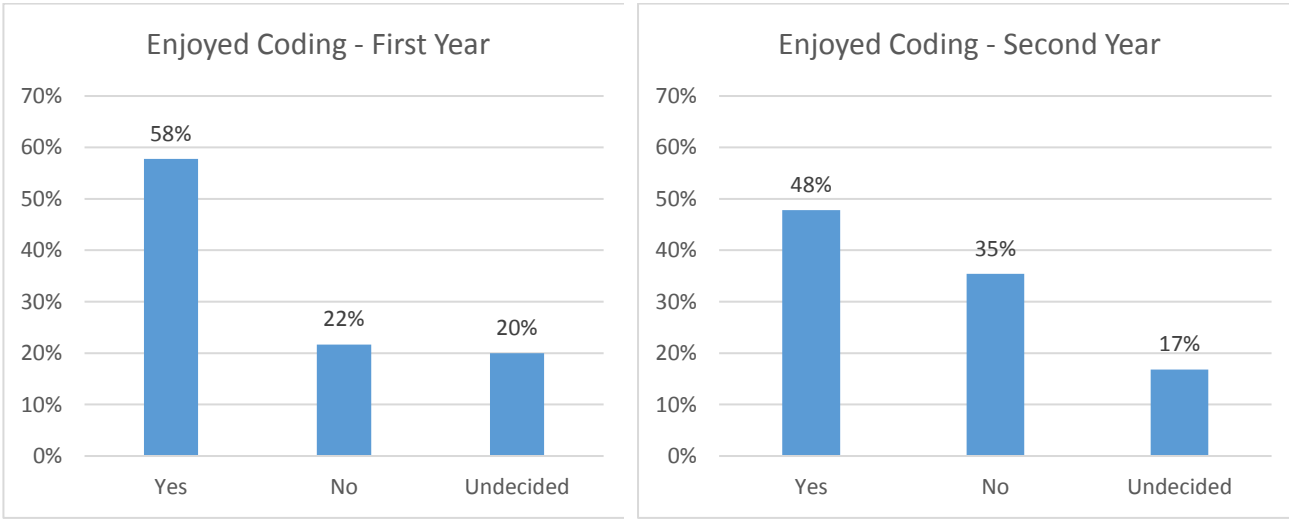

Fig 10: Degree to which students indicated if they enjoyed Coding class or not, by year group 1st Year and 2nd Year. (n=277, n=113)

Also, a greater proportion of First Year student (58%) compared to Second Year students (48%) reported enjoying coding class, while the number who did not rose from 22% in First Year to 35% in Second Year.

Those students that did like Coding reported that it was fun, interesting and different. When asked what they liked most about Coding, students indicated that they like the freedom to create or make websites and games. Others simply reported that they liked the code itself and found that interesting.

Those students who disliked Coding indicated that they found it boring, difficult, confusing and/or hard. When asked what they liked least about Coding, students responded that they did not have enough time and that it can be complicated and hard. Some mentioned how frustrating it is to always remember the particular commands to use.

When students were asked how it compares to other subjects, there was a wide variety of responses. Most common amongst these were that Coding involved a lot of group work, with little writing. Many students reported that working on computers is a fun way of learning.

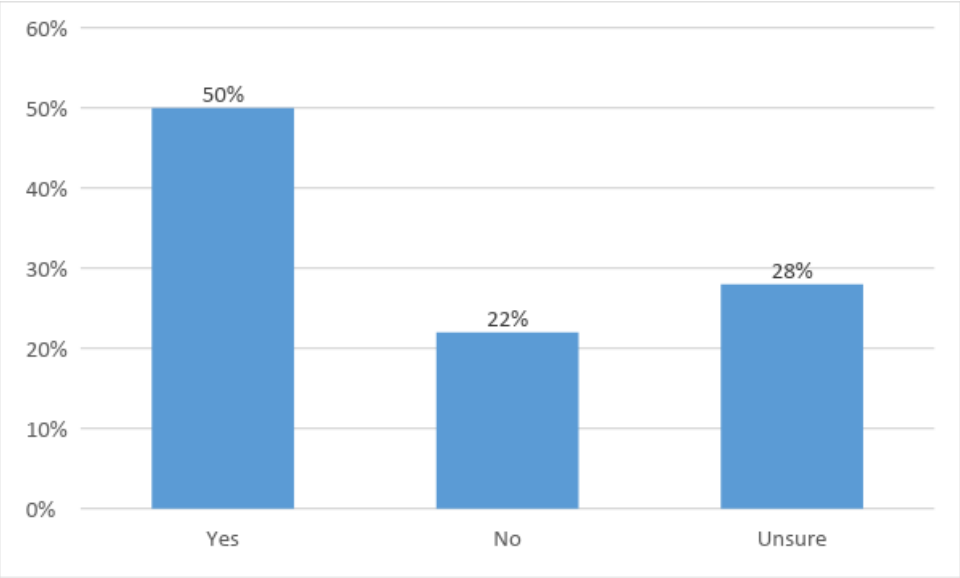

Fig 11: Degree to which students felt would they encourage their friends to undertake Coding class (n=395).

When asked whether they would encourage a friend to undertake Coding class, half of the students reported that they would, while one in five (22%) reported they would not.

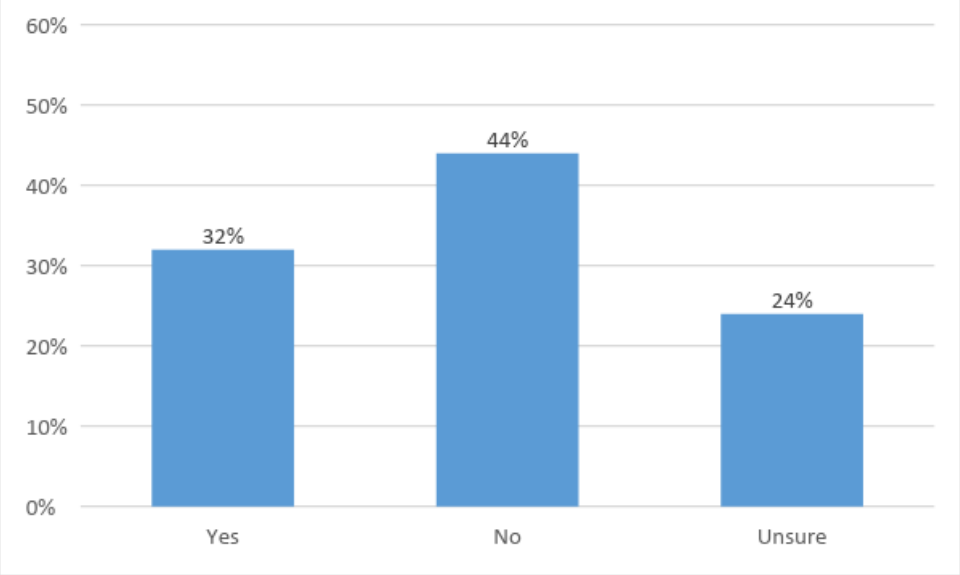

Fig 12: Degree to which students felt they would like to undertake Computer Science as a Leaving Certificate subject, if available (n=395)

Looking beyond junior cycle, when asked whether they would undertake Computer Science at Leaving Certificate level, just under one in three (32%) reported that they would, while nearly a half (44%) reported they would not.

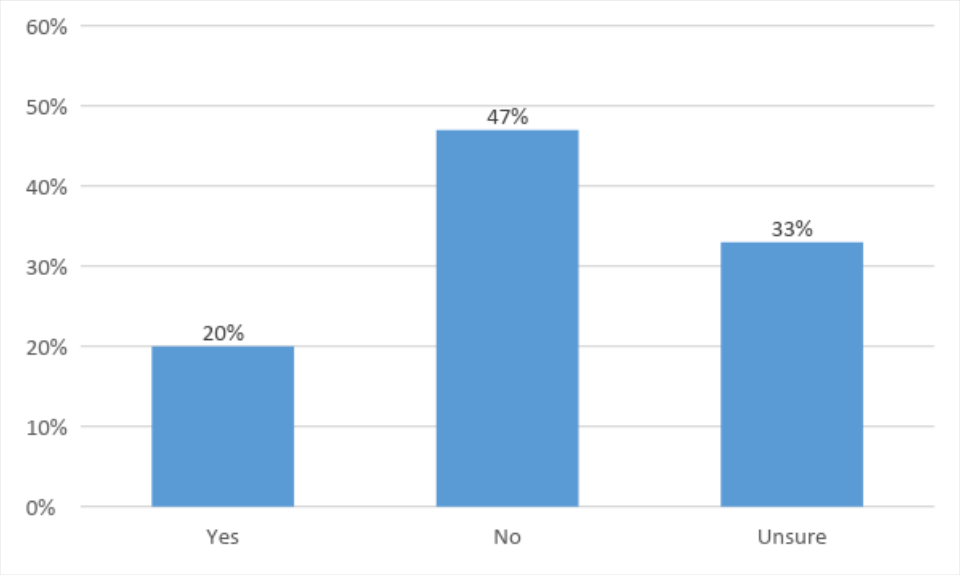

Fig 13: Degree to which students felt they would like to undertake Computer Science as a Third Level college course (n=395)

When asked whether they would undertake Computer Science as a third-level college course, just one in five reported that they would, while nearly a half (47%) reported they would not. Obviously, at this stage in their education, many students were undecided (33%)

4.6 The use of electronic devices to support student learning

A small number of schools had utilised the Galileo Gen 2 boards in the initial stages of the project. The majority of schools had decided to concentrate initially on an introduction to computer science, and perhaps utilise the development boards at a later stage to support student learning.

Many teachers felt that they needed more support and training to gain experience and confidence in working with this technology before utilising it in the classroom setting.

Of the few schools that did used the boards, the response was very positive in that:-

- The hardware boards allowed students to observe physical and practical uses of code away from the computer screen.
- Some students had a particular interest in and aptitude for working with hardware. Teachers facilitated this by allowing students to work independently or in small groups with the development boards.
- There is a very practical application within junior cycle technology as students can integrate the technology within junior certificate projects.
- In some schools, there is existing practice in hardware programming from engagement in competitions such as Young Scientist, SciFest and CanSat

A number of schools have utilised the Galileo boards outside of the junior cycle setting. Two schools reported using the board with transition year modules and identified their potential use to support learning within senior cycle engineering.

One school have very successfully shared the resources with a local Coderdojo to support students in the extra-curricular opportunity.

Section 5 Conclusion

As we conclude this initiative, it is critical to acknowledge the efforts of the teachers and principals within the participating schools. Developing practice and leading learning in an innovative and new area of learning like *Coding* is a challenging task. The openness of teachers to contribute to the research element of the project to inform the pathway for other schools is hugely appreciated.

Significant progress was made in cooperation with 22 schools over the course of 12 months. We will conclude by outlining some highlights.

1. There was a significant demand to participate in the programme. 128 schools expressed an interest to participate. This is approximately 17% of the total number of Irish post-primary schools, and the Exploring Coding initiative, therefore, supported approximately 3% of Irish post-primary schools. Almost 75% of participating schools are currently offering the Short Course in Coding or planning to offer it in September 2017 with the required timetable allocation in place.
2. The project was successful in its goal of establishing a support for teacher professional development and building capacity in the system in the area of Coding, commensurate with the level of experience of participating teachers, and practice within schools. It is evident from our findings that experience differed greatly from teacher to teacher, as well as the practice from school to school.
3. By offering the short course schools were meeting the needs and interests of a particular cohort of students. Also, many schools felt, and communicated, they were addressing the calls from parents and the wider community. A smaller number of schools referenced their wish to support the growing computer science industry needs within their geographical regions.
4. At the midway point of the initiative, the DES announced the introduction of Computer Science as a Leaving Certificate subject from Sept 2018. As result, many schools acknowledged the need for a long-term approach/pathway for coding/computer science in their schools.
5. Schools identified several challenges. These included the timetabling of the new curricular component such as the Coding short courses on a school curriculum. Schools also offered serious consideration as to whether the short course should be offered to *all students* as a core feature of the curriculum, or to *some students* who may elect to undertake the short course as an elective feature within the junior cycle curriculum. Also, many felt that as well as computer science skills, the student experience required engagement with digital media skills and that a balance is needed between both.
6. Over the course of the project, there were several opportunities to progress the status of coding within participating schools and with a broader set of stakeholders. For example :
    a. Participating teachers established departments within schools by communicating and collaborating with colleagues who were tasked with delivery of the short course. This, in turn, raised the profile of Coding in the school.
    b. There were a number of opportunities for the CPD team to promote this project and endorse the work undertaken by participating schools. This included participation by the team in presentations/panel discussions at the CESI conference[16], Cracking the Code and Excited[17] events. There was comprehensive press coverage in over 40 publications on the February CPD day at Intel and the initiative in general.
7. In terms of gender diversity, the balance of male (51%) and female (49%) students were very much equal.

[16] http://www.cesi.ie/conference/

[17] http://excited.ie/

8. A community of practice is now established. This community has shared existing practice through CPD face to face engagement and through an online platform and website.
9. The very fact that a research strand is tracking the experiences of these pioneering schools, as well as the effectiveness of the CPD is a very positive feature. The incorporation of a significant research component into the project allow all collaborative partners to evaluate the progress of the project and identify teacher's needs and requirements within and beyond the initiative.

Section 6 Recommendations

We have a number of recommendations for the next phase of this project.

There was a significant call for further training and support. The programme should be expanded or reconfigured over the course of 2017/2018 to include more schools and provide support over a more sustained two-year timescale. The expanded programme should build on the pilot initiative and focus more explicitly on planning, assessment within teaching and learning, and reporting specific to the learning outcomes within the Junior Cycle Short Couse in Coding. Providing increased support for up to 10% of all second-level schools (75 schools) would be an appropriate increase. Any further initiative would need to:

a. Offer a programme that will meet the needs of new schools. This will include providing a CPD programme for teachers that have very little experience in teaching coding.
b. Offer a programme that will meet the needs of schools that are more advanced and that have considerable experience in teaching coding in schools. Many of this cohort will be more focused on teaching methodologies and assessment practices rather attaining fundamental coding skills.
c. Be resourced adequately
d. Continue to be collaborative in nature, and based on carefully-aligned research, in such a time of development in the area of Coding/Computer Science in Irish post-primary schools. There is a need to continue with research that will evaluate existing activity and inform future practice.
e. Be aligned with developments in Leaving Certificate Computer Science and link with the key stakeholders providing support to schools in the context of the introduction of the subject from Sept 2018.
f. Incorporate not only an awareness and support for gender diversity but also socio-economic diversity.
g. Address key issues highlighted by schools, such as timetabling of short courses, consideration of *Coding for all*, or *Coding for some*, and the consideration of the balance between Coding and Digital Media Literacy.
h. Base CPD opportunities on a consistent approach to planning, with an increased focus on features of the Junior Cycle such as Classroom-Based Assessment (CBA) and Subject Learning and Assessment Review (SLAR).
i. Provide on-site supports (school visits, support of departments) as these can support schools regarding their context-specific.
j. Continue to be flexible and responsive to the needs of teachers and schools.
k. Expand the communities of practice. Scope exists to link further with industry (following discussions with Apple, Microsoft and Google), universities and institutes of technology, (who may be offering/planning to offer local undergraduate or post-graduate opportunities for teachers in this area), the NCCA (in the refinement of the Guidelines for the Classroom-Based Assessment and the development of examples of student work. This will build on the strong links already forged with CESI and MIDAS.
l. Continue to promote and showcase the work of the CPD initiative and the work of participating schools to the wider educational community and beyond.

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Appendix 1

There is sometimes confusion over the use and meaning of the terms computer science, information technology, digital literacy, etc.

The definitions below from the Royal Society (2012) may assist you in your understanding of the various terms throughout the report:-

> Digital literacy (DL): should be understood to mean the basic skill or ability to use a computer confidently, safely and effectively, including: the ability to use office software such as word processors, email and presentation software, the ability to create and edit images, audio and video, and the ability to use a web browser and internet search engines. These are the skills that teachers of other subjects at secondary school should be able to assume that their pupils have, as an analogue of being able to read and write.
>
> Information Technology (IT): should be understood to mean the assembly, deployment, and configuration of digital systems to meet user needs for particular purposes.
>
> Computer Science (CS): should be interpreted as referring to the scientific discipline of Computer Science, covering principles such as algorithms, data structures, programming, systems architecture, design, problem-solving etc.

The Royal Society (2012) *Shut down or restart? The way forward for computing in UK schools*. Available from: https://royalsociety.org/~/media/education/computing-in-schools/2012-01-12-computing-in-schools.pdf.

Appendix 2

Letter and Brochure issued to schools in December 2015 as a call for expressions of interest in the Exploring Coding Initiative

4 December 2015

Dear Principal

Junior Cycle for Teachers (JCT), a Department of Education and Skills schools' support service, continues to provide high-quality professional development opportunities for schools and teachers in the context of the implementation of the *Framework for Junior Cycle* (2015).

I wish to thank all those schools that have engaged in the various aspects of our continuing professional development (CPD) programme. Early in 2016, our service plans to initiate a small scale CPD programme relating to the new Junior Cycle short course in *Coding*. This programme will offer the potential for some schools that have existing practice in the area of Computer Science and/or Information and Communications Technology (ICT) to trial aspects of the *Coding* short course and it will run until December 2016. We are delighted to have both Intel Ireland and LERO – The Irish Software Research Centre – collaborating with us on this innovative programme.

There is a limit on the number of schools that will participate in this initial phase of the programme. In order to participate, a school must complete an online 'Expression of Interest' form and provide details of two teachers that might wish to engage in the initiative. This CPD programme may be of particular interest to teachers of S T E M subjects (Science, Technology, Engineering and Maths), but it is important that participating teachers have experience/expertise in the area of Computer Science and/or Coding. The relevant online form can be accessed at **http://www.jct.ie/shortcourses/shortcourses.php.** The closing date for expressions of interest in respect of this Coding CPD initiative is **Thursday, 17th December 2015**.

Further details of our *Coding* CPD initiative is included in the attached information leaflet. A copy of our monthly short courses newsletter 'Short Courses in the Spotlight' is also included. Any queries relating to this initiative should be emailed to: info@jct.ie.

JCT looks forward to engaging with you and your staff as we deliver the various aspects of our national Junior Cycle CPD programme. As always, if you have any feedback please don't hesitate to contact us.

Yours sincerely,

Director, CPD for Junior Cycle

Introduction

This collaborative initiative is designed to support schools and teachers in exploring innovative options provided under the *Framework for Junior Cycle 2015.* The initiative involves trialling the new Junior Cycle short course in Coding. Students and teachers will engage with new resources, develop their expertise and share their experiences. The initiative is supported by Intel Ireland.

Teachers will:

- Participate in two initial CPD events to share current practice and explore the new Coding short course
- Attend a CPD event in the Intel Ireland Campus in Leixlip
- Contribute to an online community of participating teachers
- Share their experiences with the JCT short courses team, thereby informing the development of further supports for teachers

Aims

This initiative seeks to;

- Examine the current provision within schools for ICT-related curriculum components at Junior Cycle
- Collate resources which can support the implementation of the new Coding short course
- Capture the experiences of schools in their trialling of the new short course
- Explore further options to support schools and teachers in their implementation of the short course in Coding

Application Process

A small number of schools, preferably with existing practice in terms of Computer Science/Coding and Programming at Junior Cycle level, and wishing to pilot aspects of the new short course in Coding, will be offered the opportunity to take part in the initiative. Each school will be requested to nominate two teachers to get involved.

In order to apply, a school must complete an online 'Expression of Interest' form and provide details of the two teachers who wish to engage in the initiative. The online form can be completed at:-http://www.jct.ie/shortcourses/shortcourses.php The closing date for expressions of interest is 4.00pm on Thursday 17th December 2015.

Criteria for Participation

Schools will be identified for participation using the following criteria:

- Schools that have engaged with the short course in Coding via NCCA consultation meetings and/or Network Schools.
- Schools that have engaged in previous LERO initiatives
- Schools that meet the following criteria:
  - Schools that possess existing practice and/or teacher expertise in the learning area of Computer Science/Coding
  - Schools that currently provide curricular time at Junior Cycle for Coding / Computer programming.

A collaborative initiative involving

Note:

1. All ETB schools are currently being notified and offered the opportunity to apply to participate. While only a small number of school can be accommodated within this initial phase, further opportunities will become available for schools.
2. Additional hardware resources to those being provided may be required to support student learning in the initiative. A specification for these materials will be provided to participating schools.

Indicative Timeline

Monday 7th Dec. 2015	Schools are informed regarding participation
Thursday 17th Dec. 2015	Closing date for schools to express interest in participating
Week of 11th Jan. 2016	**CPD Event 1** – Regional Sharing of Practice This evening session will take place in a nominated education centre
Friday 22nd Jan. 2016	**CPD Event 2** – Introduction to the Coding Short Course This will be a full-day event and substitution will be provided for participating teachers
Saturday 6th Feb. 2016	**CPD Event 3** – Introduction to Electronic Devices This full-day event will take place in the Intel Ireland campus in Leixlip, Kildare
Week of 11th Apr. 2016	**CPD Event 4** – Regional Progress Meeting This evening session will take place in a nominated education centre
Week of 5th Dec. 2016	**CPD Event 5** –Conclusion of Pilot Initiative This evening session will take place in a nominated education centre
Jan. 2016 - Dec. 2016	**Ongoing Online CPD Support**

JCT Coordinator

Michael Carey
Team Leader, Short Courses
michael.carey@jct.ie

Junior Cycle for Teachers (JCT) Support Service
A Department of Education & Skills Schools' Support Service

Administrative Office:
Monaghan Education Centre
Armagh Road
Monaghan Tel.: 047 74008

Director's Office:
LMETB
Chapel Street, Dundalk
Tel.: 042 9364603

Exploring Coding: The new Junior Cycle Short Course

Short Course Coding Specification for Junior Cycle

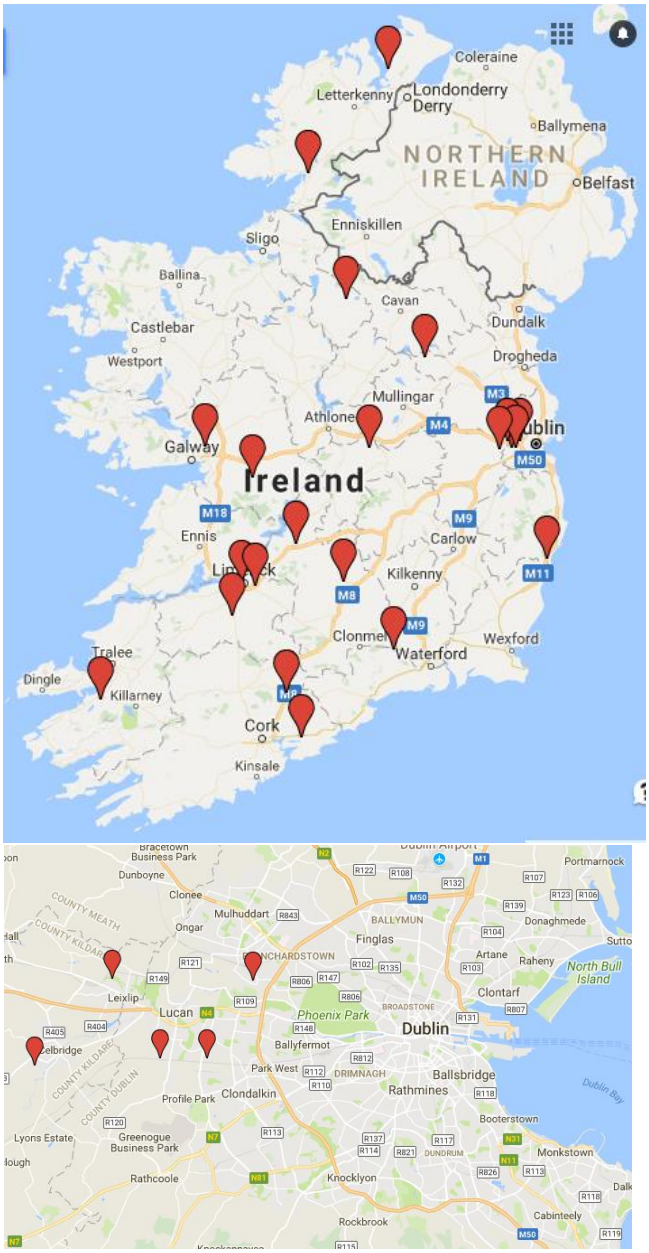
A Coding CPD initiative involving the use of electronic hardware devices

Appendix 3

The list of schools that participated in the 'Exploring Coding' initiative are:

Abbey Vocational School, Donegal Town, Co. Donegal*
Adamstown Community College, Co Dublin
Ard Scoil Chiarain Naofa, Clara, Co. Offaly
Ballinamore Community School, Co. Leitrim*
Castleknock Community College, Dublin 15
Castletroy College, Co Limerick
Celbridge Community School, Co. Kildare
Coláiste an Chraoibhin, Fermoy, Co Cork
Coláiste Bhaile Chláir, Claregalway, Co. Galway
Colaiste Chiarain, Croom, Co. Limerick
Coláiste Mhuire Co-Ed, Thurles, Co. Tipperary
Comeragh College, Carrick-On-Suir, Co. Tipperary
Confey Community College, Leixlip, Co Kildare
Crana College, Buncrana, Co. Donegal*
Glenart College, Arklow, Co Wicklow
Killorglin Community College, Co Kerry
Kishoge Community College, Lucan, Co. Dublin
Nenagh Vocational School, Co Tipperary
St Brigids Vocational School, Loughrea, Co Galway
St Colman's Community College, Midleton, Co Cork
Thomond Community College (formerly St. Nessan's Community College), Limerick
St Oliver Post Primary, Oldcastle, Co. Meath

***These three schools joined the project in May 2016**



Appendix 4

Photos of participating teachers and schools can be accessed here…