Coding in Action– An initiative to support the Junior Cycle short course Coding 2017-2019.

Final Report – November 2019

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About The Authors

Junior Cycle for Teachers (JCT) is a school support service, which was established in 2013 to assist schools in implementing their Junior Cycle (JC) programme through the provision of high-quality continuing professional development (CPD) opportunities. The short courses team within JCT were tasked with supporting schools in relation to short courses.

Lero, the Irish Software Research Centre, brings together Ireland's leading software researchers, industry partners and experts in the area of computer science and software research in coordinated centres across Ireland. Lero is an internationally recognised centre of excellence in software research, headquartered at the University of Limerick, and involving seven Universities and two Institutes of Technology. This initiative is directly aligned with Lero's Education and Public Engagement Programme, whose goal it is to challenge, inform and effectively engage the public and stakeholders in the discipline of computing/software.

Clare McInerney is the Education and Outreach Manager in Lero the Irish Software Research Centre. She has managed Lero's engagement with the Irish Education system, founded the Scratch programme in 2007, and was the instigator behind the collaboration between Lero and JCT. In addition to this Lero was commissioned by the National Council for Curriculum and Assessment (NCCA) to write the specification for the Coding short course in 2014, and McInerney was involved with the Exploring Coding initiative and the Coding in Action initiative, which this report examines.

Úna Fleming is a researcher investigating educational reforms in the area of computer science in Ireland. Her research is under the supervision of Prof Merrilyn Goos (Epi*Stem), Dr Oliver McGarr (School of Education, UL) and Clare McInerney (Lero). This research is funded by Science Foundation Ireland (SFI) and is a collaboration between Lero, the Irish software research centre and Epi*Stem, the national centre for STEM education, both of which are located at the University of Limerick.

Epi*Stem, the National Centre for STEM education, is a research centre which was set up to address national priorities in STEM teaching and learning. It acts as a hub for an impressive suite of programmes, projects and collaborations, and at its core is the advancement of science, technology, engineering and mathematics (STEM) at primary, post-primary, and third level. It hosts researchers from around the world and seeks to deepen understanding of learning through the latest scientific research and examination of international best practices in STEM education.

Acknowledgement

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Acronyms and Abbreviations List

CAO	Central Applications Office
CBA	Classroom-Based Assessment
CPD	Continuing Professional Development
CESI	Computers in Education Society of Ireland
CSO	Central Statistics Office Ireland
DEIS	Delivering Equality of Opportunity in Schools
EPE	Education and Public Engagement Programme (Lero)
Epi*Stem	National Centre for STEM Education at the University of Limerick
ETB	Education and Training Board
Forfás	The Irish national policy advisory board for enterprise, trade, science, technology and innovation
ICT	Information and Communication Technologies
IT	Information Technology
JC	Junior Cycle
JCT	Junior Cycle for Teachers
JCCiA	Junior Cycle Coding in Action
Lero	Irish Software Research Centre
NCCA	National Council for Curriculum and Assessment
SFI	Science Foundation Ireland
SSD	Solid State Drive
STEM	Science, Technology, Engineering and Mathematics
UL	University of Limerick

Executive Summary

This report examines the Junior Cycle Coding in Action (JCCiA) initiative which was coordinated by the Junior Cycle for Teachers (JCT) to support the introduction of the Junior Cycle (JC) Coding short course. The JCCiA initiative ran between September of 2017 and June of 2019. The Coding short course was designed to develop students' ability to code while allowing them to learn and develop skills in the area of computer science at JC level.[1] According to the specification document, the course aimed to:

> "...*develop the student's ability to formulate problems logically; to design, write and test code*
> *through the development of programmes, apps, games, animations, or websites; and, through*
> *their chosen learning activities, to learn about computer science.*"
> (National Council for Curriculum and Assessment, 2016, p. 5)

The introduction of Coding to JC is an essential educational development, given the crucial role played in the early introduction of students to Science, Technology, Engineering and Mathematics (STEM). The context of the course was strategically designed to allow all students an opportunity to develop skills which they can use in the future. This report outlines the supports offered by JCT and the successes and challenges of bringing the short course specification to life in schools and classrooms across the country.

Figure 1 Overview of JCCiA

It is hoped that the information which is presented within this report will be used to inform stakeholders of the impact of JCCiA and be utilised in the development of future CPD programmes, in this and other subject areas. The layout of the report is as follows:

- Introduction and Context
- Overview of JCCiA
- Impact of JCCiA
- Conclusions
- Recommendations

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[1] NCCA (June, 2016) *Short Course Coding Specification for Junior Cycle*. [online] Available at:
https://www.curriculumonline.ie/getmedia/cc254b82-1114-496e-bc4a-11f5b14a557f/NCCA-JC-Short-Course-Coding.pdf

Overview of the Initiative

In 2014, the National Council for Curriculum and Assessment (NCCA) developed nine short courses which schools could include in their JC programme. These short courses represented an innovative and optional curriculum component within the Framework for JC. The following are the primary developments, which took place, in the lead up to JCCiA.

2014 • Lero was commissioned by the NCCA to write the specification for the Coding short course.

2015 • Framework for Junior Cycle was published in 2015 by the Department of Education and Skills.

2016 • In June 2016, the Coding specification was published.

2016 • The Exploring Coding (2016 – 2017) iniative was piloted with **22 schools** taking part.

2017 • JCCiA Phase 1 (2017 – 2019) saw **52 schools** engaging with the initiative.

Figure 2 Overview of Developments

The selection of schools to JCCiA was a difficult and challenging task, which was conducted with the utmost care and without prejudice towards any particular type or location of the school. Almost two hundred schools applied to JCCiA. From this cohort, 52 schools were selected to take part in JCCiA. Figure 3 presents a brief breakdown of the selected schools. This diversity of applicants was reflected in a variety of successful participants, 35% of the successful schools were iPad schools, and one in every three schools had a current DEIS (Delivering Equality of Opportunity in Schools) status.

Two Coding teachers in the school

59.5% Coding for All students

Coding Teachers: 44% Female 55% Male

52 Schools

Coding Students: 58% Male 42% Female

35% iPad schools

1/3 DEIS Schools
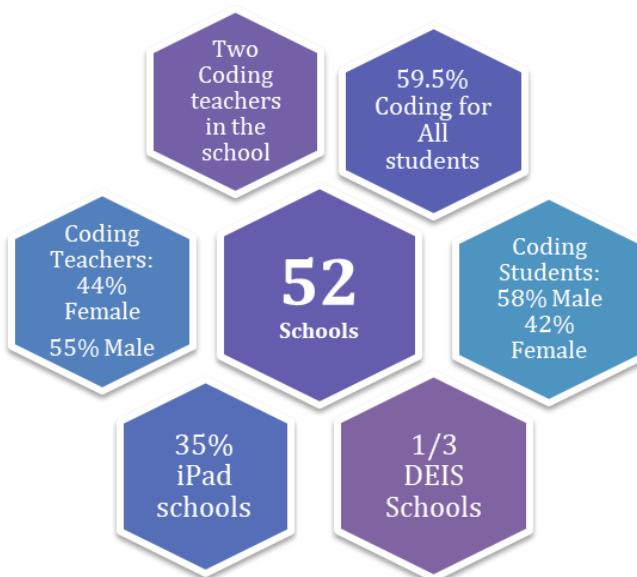
Figure 3 JCCiA Schools

The findings from this report highlight the progress which has been made by the students, teachers, schools and all involved in the introduction of the Coding short course. The JCCiA initiative has had a profound impact at the classroom and school level. Successful schools were given a range of supports, an overview of which can be seen below.

Figure 4 Overview of JCCiA supports

Impact of JCCiA

The initiative has facilitated student learning and helped to develop a deeper understanding of Coding and Computer Science within post-primary schools. Students who took part in coding classes developed programs, apps, games, animations, or other unplugged activities and these experiences caused them to think creatively about problems and to develop 21st-century skills. Below we can see the breakdown of students by year group and the feedback from one teacher who felt that JCCiA had a profound impact on students:
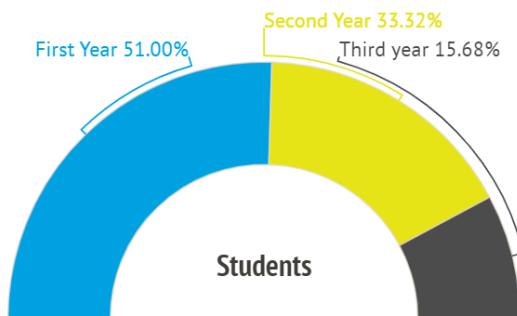
Figure 5 Students

During school visits, teachers were asked what they felt were the greatest challenges and successes of bringing the short course in Coding into their classrooms and their schools. 89% of teachers felt that JCCiA has had a positive impact at a school and a classroom level, with teachers adopting new approaches to teaching and assessment, one stating that their Coding lessons were "...less teacher-led, incorporated more discovery & facilitation". Another teacher felt that having engaged with JCCiA, they have "...gained confidence and

knowledge, enjoyed the collaboration and the extra ideas…[and]… unpack the learning intentions". Below we have given a breakdown of the areas where teachers felt the greatest impact, with student interest and engagement having the greatest impact on the school at 53%, and student learning and skill development being noted as the primary impact of JCCiA on the classroom by 42% of teachers.

Figure 6 Impact on Classroom and Whole School

Impact on Teacher skills and approach

The initiative had allowed teachers to foster stronger relationships amongst colleagues within their schools and to meet outside experts and educators, who encouraged, inspired and supported them. During CPD Day 4, feedback was gathered from teachers about their development since the commencement of JCCiA, one of the teachers responded with the following:

"As teachers, we've come out of our comfort zones & come away from teaching the basic MS office skills. The staff skill set has expanded, but also the teacher-student dynamic has changed as we have grown in our learning together."

(CPD Day 4, Teacher Feedback)

The advancements which have been made over the past two years have been made possible because of the supports provided by JCT[2], and the decision by the Irish government to invest 50million euro in ICT equipment for schools under the Digital Strategy for schools[3]. This initiative has and will enable these schools to continue to expand their ICT infrastructure.

This report would like to conclude with ten recommendations, divided into seven general recommendations and three project-specific recommendation. The recommendations of this report are of interest to those involved in providing educational supports to teachers, including the JCT as well as the broader education and research communities. The recommendations have been shaped by the feedback which was gathered from the

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[2] http://www.cesi.ie/pw/junior-cycle-coding-in-action-jccia/
[3] https://www.education.ie/en/Press-Events/Press-Releases/2019-press-releases/PR19-03-04.html

teachers who were part of JCCiA and the students who were part of the short course in Coding. Following extensive analysis of the findings this report outlines the following recommendations:

General recommendations:

1. Effort should be made at a school and a national level to recognise the Junior Cycle Profile of Achievement (JCPA).
2. Teachers should be supported, through continuity of timetable allocation and development of Computer Science teaching capacity within the school.
3. An outline of the structure of CPD events should be circulated to teachers and schools in advance of the commencement of CPD activities in order to ensure schools and teachers have time to prepare.
4. The environmental impact of reforms within education settings should be considered, and efforts should be made to move away from paper administration towards online/ digital tracking, and collaboration in all government-supported CPD. In conjunction with this, teachers, schools, and ETB's should be encouraged to make efforts to purchase equipment, which has the best possible energy rating.
5. Efforts should be made to build learning and understanding of Computer Science and technology within the broader communities.
6. The aims and applicability of both the hard and soft skills, which can be developed through engagement with the short course in Coding should be communicated to the general public.
7. In line with this, it is recommended that research continues and that this research is shared with the broader community.

Project-specific recommendations:

1. In future, the scope of JCCiA should be broadened to allow for greater online collaboration and sharing of practice among teachers, through an online collaboration tool such as Microsoft Teams or Slack.
2. Unplugged elements should also be incorporated into JCCiA events, and teachers should be encouraged and supported to develop resources which can be adapted to classrooms where computers may not be accessible, and to engage learners to develop computational thinking skills.
3. Educational leaders, stakeholders and the government should celebrate the work being done by students, teachers and schools in the area of digital short courses, especially Coding and the JCCiA National Symposium should be repeated for JCCiA Phase 2 schools.

Introduction and Context

Over the last decade, the Irish government, along with *Forfás*, the Irish national policy advisory board for enterprise, trade, science, technology and innovation, and Science Foundation Ireland (SFI) have highlighted the importance of developing skills in STEM. The JC was introduced in its present form in 2015. It includes a variety of assessment methods, including Classroom-Based Assessments (CBA) for the first time. A motivating factor for this was to meet the need from industry for graduates who possessed 21st-century knowledge and skills[4].

Students in Computing and Technology

In Ireland, although some progress has been made in attracting students to STEM subjects at primary and post-primary level, a skills shortage in the labour market remains, particularly in the area of Information and Communication Technologies (ICT). On 6th May 2017, the Expert Group on Future Skills Needs, published its report *Vacancy Overview 2016* which found that 35% of all "…difficult to fill vacancies…" in October 2016 were in the ICT sector and mainly for professional roles in computing and software development.

Despite this, the number of students applying to computer science and software engineering courses at third-level has not increased to a proportion which reflects this differential. A statistic of concern is the decrease in applicants to Level 7/6 courses in ICT and Technology; over ten years, a drop of 2.7% took place.

The Central Statistics Office Ireland (CSO) figures released following the 2018 Central Applications Office (CAO) application, shows that there was a 16% reduction in the numbers of these students listing an ICT course as their top preference for Level 8. These numbers are concerning considering the need for graduates in this area. In 2018 there were 77,000 applications made to the CAO; this represents an overall reduction of 4% to the total number of requests to the CAO when compared to the previous year. According to the most recent CAO figures, in 2019 there was a further reduction with the number of applicants to the CAO to just over 73,000[5].

These numbers are concerning considering that computer science still has some of the lowest progression rates, with 16% of all full-time undergraduate students not making it into their second year of study. This issue is undoubtedly multidimensional. However, this trend is one which the Department of Education and Skills (DES) is hoping to address by introducing computer science at post-primary level[6].

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[4] https://www.curriculumonline.ie/Junior-cycle/Junior-Cycle-Subjects/English-(1)/Assessment-and-reporting/Classroom-Based-Assessments

[5] https://careersportal.ie/careerplanning/story.php?ID=2501203387

[6] STEM in schools, p.4 Available at: https://data.oireachtas.ie/ie/oireachtas/libraryResearch/2017/2017-08-25_stem-in-schools-the-introduction-of-coding-and-computer-science-ict-to-the-curriculum_en.pdf

To address this and to encourage students to have a greater understanding of the opportunities and practicalities of studying computer science courses: Lero was commissioned to write the specification for the JC Coding short course[7]. The Coding Short Course was a revolutionary step forward for Ireland's post-primary Education. The change meant that for the first time, computer science formally appeared in Irish post-primary schools. The presence of computer science meant that students could receive a formal introduction to, and acknowledgement of their achievement in this area of learning.

On the 18th of February 2019, the Minister for Education and Skills, J. McHugh T.D. and Minister for Business, Enterprise and Innovation, H. Humphreys T.D. launched *Technology Skills 2022*: *Ireland's Third ICT Skills Action Plan*. Within the report, they reviewed that annual job openings are forecast to increase from 11,594 in 2018 to 17,795 per annum by 2022. According to the press release, "the ICT sector is of vital strategic importance in Ireland", in terms of employment and economic growth. The plan is designed to focus on expanding and encouraging the development and expansion of skills in the ICT sector.
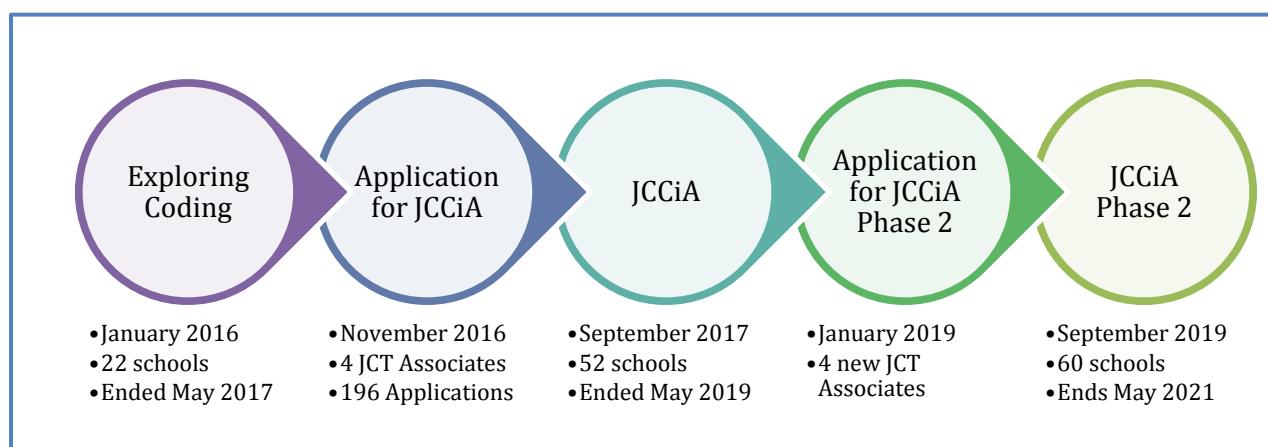
Figure 7 JCT initiatives which support Coding

JCT Short Course Team and Lero

The JCCiA initiative is a collaborative partnership between JCT, a support service for schools and teachers, and Lero, the Irish Software Research Centre. In 2013, JCT was established to assist schools as they began implementing JC reforms. A team was established within JCT dedicated to short courses; this team was tasked with the responsibility of supporting schools during the rollout of the Coding short course.

The partnership between the JCT and Lero began in 2016 when they began collaborating on the pilot project Exploring Coding in 2016.

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[7] Exploring Coding (2016) Available at: https://www.jct.ie/perch/resources/shortcourses/interim-report-exploring-coding-181016.pdf

The Exploring Coding initiative

The short course in Coding specification was made available to schools in 2014 and revised further in 2016. In order to assist schools and teachers, a collaborative CPD initiative was established by JCT, Lero and Intel Ireland. The first iteration of focused CPD for the Coding short course was called Exploring Coding; it was set up to assist and support schools across Ireland, to introduce the short course. Also, it was hoped that Exploring Coding initiative would examine, document, and explore the implementation of Coding in schools. As part of the Exploring Coding initiative programme twenty-two, post-primary schools took their first tentative steps into JC Coding. JCT allowed teachers to explore, engage, discuss, and gain an enhanced understanding of JC Coding through CPD days and school visits, under the umbrella of Exploring Coding. The Exploring Coding initiative ran for twelve months between January of 2016 and January of 2017. Once this programme came to an end, the JCCiA initiative was introduced to follow on from its predecessor and to develop on the recommendations which were generated from the Exploring Coding final report[8].

The Application Process for JCCiA

On the 6th of March 2017, a letter was sent to the Principals of Irish secondary schools, seeking their engagement and participation in the JCCiA initiative[9]. This initiative was designed to support schools who were committed to introducing the Coding short course within their JC programme. There was an extensive application process with strict criteria for participation. The initiative was available to all schools. During the application process, schools were required to commit to the introduction of a new JC Coding short course. Schools also needed to demonstrate:

➔ sufficient timetable allocation to introduce the short course,
➔ existing practice in terms of Coding/Computer Science at JC level,
➔ the existence of relevant teacher expertise in the learning area of Coding,
➔ and each school had to nominate two teachers to engage in the initiative[10].

In order to apply, each school had to complete an online 'Expression of Interest' form and provide details of both teachers whom the school nominated to engage in the initiative. The relevant online questionnaire was available on the JCT website, and the closing date for expressions of interest was the 28th of April 2017[11].

Schools seeking to engage with JCCiA were asked to participate in a two-year CPD programme. Two teachers were nominated from each school; they were expected to access and attend six core CPD days. These nominated

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[8] McInerney, Carey and Power (2016). Exploring Coding [online] Online: JCT. Available at:
https://www.jct.ie/perch/resources/shortcourses/interim-report-exploring-coding-181016.pdf [Accessed 2 Oct. 2018].
[9] Appendix 1. Also Available at: https://www.jct.ie/shortcourses/resources
[10] Junior Cycle Coding in Action: Coding Brochure. Available at: https://www.jct.ie/perch/resources/shortcourses/coding-brochure-web-120317.pdf
[11] https://www.jct.ie/shortcourses/resources

teachers were also given the option of attending elective CPD events, access to an online forum and the JCT short course coding associates for the duration of the programme. It was hoped that by following these guidelines, teachers and their schools would be best equipped to successfully implement the JC Coding short course in these schools.

Key Observations from Applications of Interest

During the summer of 2017, the responses to the expression of interest forms were examined to ensure that the schools best equipped to take on the JCCiA initiative were selected. In total, 196 schools registered an expression of interest, and these schools transcended all divisions of gender, region and ethos. Schools were selected for participation using the following criteria:

- Schools that engaged with Exploring Coding or other Coding Events;
- Schools that showcased existing practice;
- Teacher expertise in the area of Coding or Computer Science; and
- Schools who were currently providing curricular time at JC in this area of learning.

The response to the expression of interest form completed by schools was positive, with many schools requesting further information and stating their intention to engage with the JCCiA initiative. This interest was reflected in the unprecedented level of submitted applications to JCCiA. In order to ensure the quality of the programme was maintained, participating schools were screened to ensure that their staff had the appropriate programming and, or, computing skills to be able to teach JC Coding, that the schools had a track record of engagement or interest in coding/ computer science, and that they were willing to commit to JCCiA.

The expression of interest process provided an overview of the practice in Irish schools of Coding/computer science. Information was gathered which was used to consider which schools would be part of the JCCiA initiative as well as inform the content of the CPD days and the resources which schools and teachers might require from JCCiA. The data also provided a fascinating snapshot of the current landscape of Coding and computing in post-primary education. Of particular interest where:

1. Profile of nominated teachers
2. Existing practice of Coding/computer science
3. The schools' rationale for the development of Coding at the JC level.

Profile of nominated teachers

The number of teachers enrolled in the programme did not exceed amounts which would compromise the integrity and success of the programme. CPD days would assist and equip teachers with information on the framework of the new course, pedagogical content knowledge, and strategies for the teaching, learning and assessment of the JC Coding short course.

There was an almost even split between male and female teachers who were nominated to spearhead the JCCiA initiative within their schools, 45% of the teachers who were put forward as the Coding teacher within the school were female, while 55% were male. The teachers had a wide breadth of experience and knowledge and came from a variety of subject disciplines. Most teachers, almost 64%, were listed as already teaching ICT or Coding within their school. The next most popular subjects were in the Technology suite (which included Materials Technology (Wood), Metalwork, Technical Graphics and Technology) at 40% and Mathematics with 35%. It is interesting to note that while they were fewer in number, there were teachers of subjects such as Science, Business Studies, Art, Irish, Geography, History, English, French and German. Teachers, on average, selected 2.3 subjects.
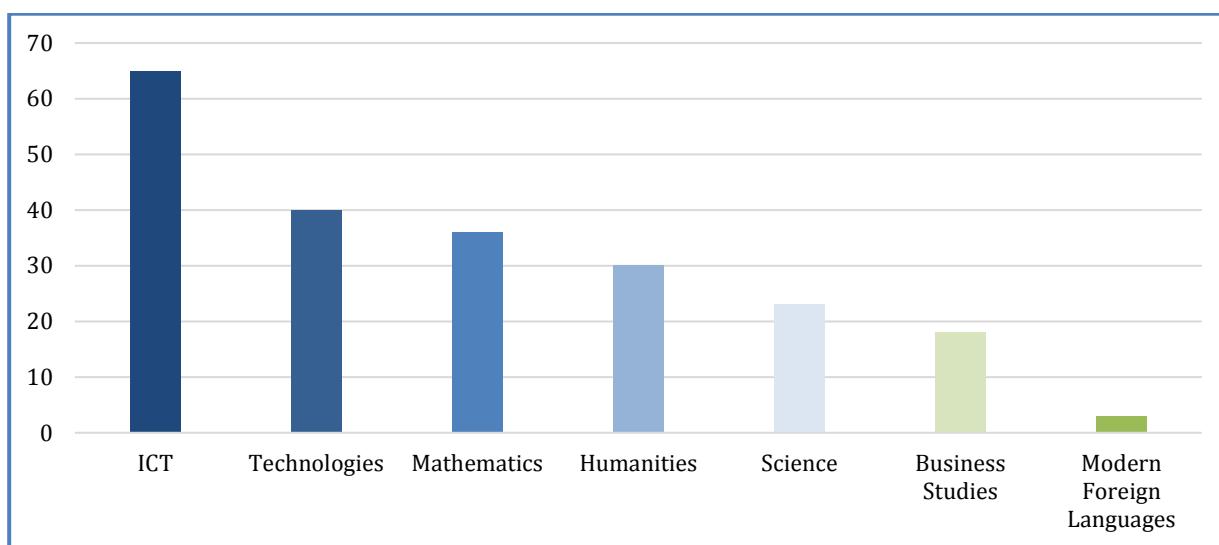
Figure 8 Teacher Subject Selection

Existing practice about Coding/computer science

School selection was an arduous task which was conducted with the utmost care and without prejudice towards any particular type or location of the school. This diversity of applicants was reflected in a variety of successful participants. The successful schools were a mixture of Community, Comprehensive, Secondary, and Education and Training Board (ETB) schools, from across the country.

Each of the schools selected was committed to offering the Coding short course to their JC programme within the years ahead. While most of the schools (70%) had not been involved in the Exploring Coding initiative, 30% of JCCiA had taken part in the Exploring Coding initiative. As discovered by the information gathered on teacher's subjects, most teachers already described themselves as an ICT teacher.

Of the almost two hundred schools who applied to JCCiA, 25% stated that they were iPad schools. Out of the 52 schools who successfully secured a position on the programme, 35% of the schools were iPad schools.

Figure 9 indicates the number of schools which offered either none, 1, 2, 3, or 4 classes per week in each of the years of Junior Cycle. As can be seen, most schools offered at least one class per week to their students in the first and second year, however by third year there is a large proportion of schools who were not including 'Computers' or 'ICT related learning' as part of their timetable.
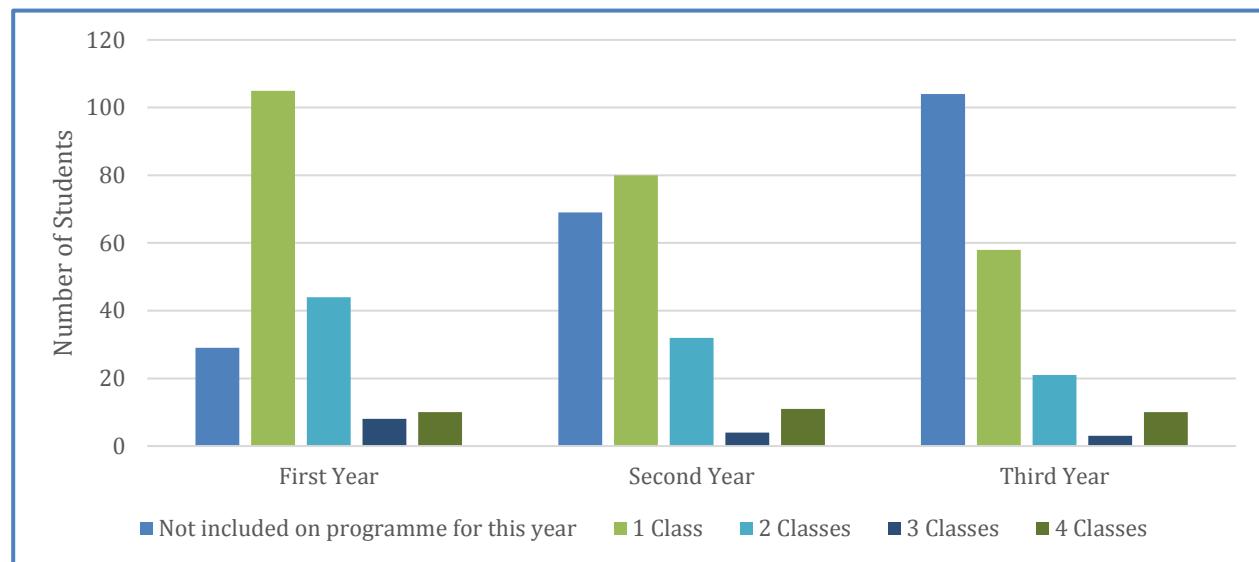
Figure 9 Number of Classes per week for Students

The schools' rationale for the development of Coding at the JC level

The schools who were successful in their endeavour to be part of the JCCiA initiative were from across the Republic of Ireland as the Map in Figure 10 shows. These schools were selected because they were able to satisfy the requirements which had been set out in advance. All schools had a proven track record of ICT within their schools and were able to nominate teachers who possessed the appropriate skill set and experience.

Figure 10 Map of JCCiA Schools

As the above map shows, the schools were spread over a large geographical area. The majority of the schools involved in the JCCiA initiative were ETB Schools, with almost 65% of the schools within the ETB sector. The remainder of the schools were a mixture of Community School 8%, Secondary School 23% and Comprehensive School accounting for less than 4%. The reasoning for the high proportion of ETB Schools is multifold. In part, it is due to the history of ETB schools in Ireland. There are 16 statutory regional education authorities (ETBs) in Ireland, and they were established by the Education and Training Boards Act 2013 following the amalgamation of 33 regional Vocational Education Committees[12]. Of the 717 post-primary schools in Ireland,[13] almost 300 are ETB schools[14]; accordingly, they represent a large proportion of post-primary schools. Also, ETB schools represented 45% of applications for participation in JCCiA. Of the total number of schools who applied to JCCiA, 26.13% had a current DEIS (Delivering Equality of Opportunity in Schools) status, of these schools, 36.95% were successful in their applicants and joined the initiative.

In Ireland, DEIS is a national programme aimed at addressing the educational needs of children and young people from disadvantaged communities (www.education.ie, 2019). Delivering Equality of Opportunity in Schools (DEIS) the *Action Plan for Educational Inclusion*, was launched in May 2005 and has remained the

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[12] Characteristic Spirit and ETB schools. Available at: https://www.etbi.ie/wp-content/uploads/2016/07/ETBI-News-Summer-2016-web.pdf

[13] Data on Individual Schools. Available at: https://www.education.ie/en/Publications/Statistics/Data-on-Individual-Schools/

[14] https://www.etbi.ie/all-etb-schools/

Department of Education and Skills policy instrument to address educational disadvantage. The action plan focuses on addressing and prioritising the educational needs of children and young people from disadvantaged communities, from pre-school through post-primary education (3 to 18 years). DEIS provides for a standardised system for identifying levels of disadvantage and an integrated School Support Programme (SSP). There were 896 DEIS status schools in Ireland in the 2018/19 school year. These comprise of 698 primary schools (339 urban/town schools and 359 rural primary schools) and 198 post-primary schools (www.education.ie, 2019).

Following extensive examination and deliberation, the final list of 52 schools was selected to join the JCCiA initiative; this was done to reflect the interest in the JCCiA programme as well as to ensure the cohesion of the programme. This figure marks a significant increase from the twenty-two schools who took part in the *Exploring* Coding initiative. Throughout two academic years, from September, JCT worked with each of these schools.

Overview of JCCiA

The JCCiA initiative seeks to build on the experience and to learn from the pilot CPD initiative - Exploring Coding, to capture the experiences of schools, and collate resources which can support their introduction of the Coding short course. It also intends to share the above experiences and resources to inform the broader community of schools who wish to introduce the Coding short course and agencies who seek to support schools in this work. During the JCCiA initiative, schools and teachers who were successful in their applications were given an opportunity to:

- Participate in six core CPD events, which were designed and facilitated by JCT Advisors and Associates, in regional locations across the country.
- Receive an optional school visit from a member of the JCT short course team, a JCT associate, and a member of the research team.
- Access online school term 'Sharing of Practice' webinars.
- Share their thoughts, knowledge and experiences with fellow teachers and JCT Associates.
- Participate in a range of optional elective events.
- All JCCiA teachers and their school management were invited to attend the JCCiA final event which took place in the Hudson Bay Hotel, Athlone on Friday the 1st of March 2019.
- All schools received a certificate of participation following the completion of the programme.

Figure 11 Overview of JCCiA Supports

Timeline of CPD Events

Great care was taken to ensure adequate contact time with subject experts and facilitators of the programme. A full outline of the schedule of the events which took place in phase one of JCCiA can be found below:

CPD Day 1 – October 2017	
Presentation	

Session 1	Introduction & Overview
Session 2	Introduction to teaching and learning using learning outcomes (LO).
Session 3	Participants develop a Unit of Learning based on LOs from the specification.
Industry Workshop 1 **Apple** – Nov 2017 [Swift Programming]	
CPD Day 2 – November 2017	
Presentation	
Session 1	Skills Development: Scratch.
Session 2	Pedagogical Principles: Formative Assessment & Reflective Practice.
Session 3	Skills Development: HTML
Industry Workshop 2 **Microsoft** – December 2017 [Micro: bit]	
Industry Workshop 3 **Intel** – January 2018	
CPD Day 3 – February 2018	
Presentation	
Session 1	Skills Development: Key Coding concepts Unit of Learning - Game Design
Session 2	Assessment guidelines - specification
Session 3	Assessment Practice: Simulate subject learning and assessment review.
CPD Day 4 – October 2018	
Presentations	
Session 1	Skills Development: Python
Session 2	Sharing Practice: Coding Developments in School template
Session 3	Sharing Practice: Discuss implementation labs equipment etc.
CPD Day 5 – November 2018	
Presentation	
Session 1	Python Turtle Graphics LO 3.5, 3.6, 3.7 Unit of work
Session 2	Assessment: Profile the learning
Session 3	Skills Development: Unplugged
Industry Workshop 4 **Google** – November 24th 2018	
Industry Workshop 5 **Microsoft** – December 8th 2018	
CPD Day 6 – February 2019	
Session 1	'New Teaching Resources' Éanna Ó Brádaigh, Apple
Session 2	'Computer Science Education in Ireland' Claire Connelly Google
Session 3	'The Future of Coding in Schools', Stephen Howell Microsoft Ireland
Interactive Workshops	
Numbers Everywhere Dr Chris Exton, University of Limerick	
Creating Apps for Android with Appinventor Pamela O'Brien, Limerick Institute of Technology	
Short Course Coding Classroom-Based Assessment - Supporting Teachers and Students Gwen Campbell and Tadhg O'Connell, JCCiA	
Scratch Dr Jake Byrne, Trinity College Dublin	
Digital Citizenship Dr Nigel McKelvey, Letterkenny Institute of Technology	
Introduction to Making with Micro: bit and MakeCode Stephen Howell, Microsoft	

Figure 12 CPD Timeline

The calendar of the CPD events, elective events, online support, and an overview of 6 CPD days during the two years of JCCiA, was designed to give teachers the maximum opportunity to engage in impactful and informative professional development. It was also hoped that the diverse nature of the content and contact would cause the least amount of disruption to students, teachers and schools.

Over two years, teachers were expected to attend six CPD day events; these are listed above as CPD Events 1, 2, 3, 4, 5, and 6. They also had optional elective events and a school visit which would be utilised to enhance teacher's subject knowledge and support teachers and schools in their implementation of the JC Coding short course.

CPD Cluster Days

All six of the CPD cluster days, were designed with a clear focus, and it was hoped that they would introduce the teachers to the programme, facilitate a sharing of practice and networking, and offer an opportunity to discuss with teachers the core issue of planning, with respect to learning outcomes, and units of learning. The attendance at all CPD event was very good with most schools enrolled in JCCiA being represented by one or more teachers at the regional events.

The Department of Education and Skills provides schools and teachers with a comprehensive programme of CPD to support schools in implementing the new Framework for Junior Cycle (2015). JCT support service provided this CPD.

Given the large number of schools involved in JCCiA, the model of CPD provision is the Cluster model with teachers travelling to five different sites around the country (Education centres in Cork, Sligo, Dublin West, Navan and Lero at the University of Limerick). In a bid to minimise disruption to teaching and learning at the school level, the JCT short course team operated out of the same centre where possible.[15]

Elective CPD Days

Another element of the CPD which teachers were offered were elective CPD events. A series of elective days were held around the country by industry partners. A brief overview of each of the five elective events is outlined below.

In November of 2017, the elective event was an introduction to the range of Coding supports offered to teachers by Apple. During the day, Apple showcased its *Swift Playground;* they explained some of the code used. At this event, they introduced iOS App development using the Swift programming language (Apple). This event took

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[15] https://www.jct.ie/perch/resources/publications/cluster-day-leaflet-aug-17.pdf

place in Apples European HQ in Cork. Apple collaborated with and supported the work of the JCCiA team both before and during this event so that the day was a success.

In December of 2017, the elective event which took place was designed to introduce a range of Coding supports designed by Microsoft to teachers. During this event, teachers were allowed to engage with Kinect, Microbits, Minecraft, and to write code. This event took place in Microsoft Ireland in Sandyford Industrial Estate, Dublin. JCT and the teachers involved expressed thanks to Microsoft for their enthusiasm, work and support throughout the day. The teachers who attended the Microsoft elective day were given Microbits.

In January of 2018: An elective event, which was designed to support student learning using electronic devices took place in the Intel Ireland Campus in Leixlip, Co. Kildare. JCT and the teachers involved are grateful to Intel Ireland for their collaborative work and support. Teachers who attended the Intel Ireland elective day were kindly presented with Arduino 101 boards.

In November of 2018, an elective event was held by Google Ireland at Google Dublin HQ with the support of JCT. During the event, JCCiA teachers attended talks and workshops designed to help them to uncover resources which they can use in their Coding classroom.

In December of 2019, the final elective event was held by industry. This final workshop focused on Microsoft supports and provided teachers with resources and practical tips which they can use when storing students work online and designed creative and engaging lessons and projects.

The elective events were spread throughout the country so that teachers had an opportunity to visit events which were taking place in a diverse range of locations, while not all sites were close to all teachers, many made efforts to attend more than one elective CPD event. In March of 2018: The Computers in Education Society of Ireland (CESI) Conference took place, it was called 'Shaping Tomorrow Today' and was located on the Dublin City University St. Patrick's Campus. CESI was very helpful and worked collaboratively with JCT and the team at Lero; they gave their support and guidance to the teachers enrolled in the JCCiA programme.

School Visits

In April 2018, a subset of the schools who were taking part in the JCCiA programme was visited by members of JCT short courses team and Lero. The visits were conducted to discover what progress was being made within the schools. The school visits were designed to provide support to teachers and school management for schools enrolled in the JCCiA programme. As evident in Figure 10, the schools enrolled in the JCCiA initiative were spread out across a vast geographical area. During these visits to over half of JCCiA school, feedback was gathered, and the data were analysed to conclude the impact of CPD activities, the findings of these are outlined in chapter three and four.

Webinars

As part of the ongoing support, monthly webinars were held in many topical areas. As part of the initiative, this was also an opportunity for teachers to share their practice during these online sessions. In general, webinars took place between 7.30 pm – 8.30 pm, this time was deemed to be the most suitable as it allowed teachers ample time to complete their daily tasks before the webinars began. The online and informal nature of these webinars was used to increase teacher's participation and engagement. Invitations for these online events were issued in advance via email so that teachers received advanced notice and a direct link to connect with other JCCiA teachers and the webinar facilitators. On most occasions, a flipped approach was used, whereby a video was issued to teachers one week in advance of the webinar. This video was then discussed during the evening webinar, with the focus being on responses and questions relating to the video. All participants had access to the online discussion forum that could be used at any time to pose questions and share ideas.

Impact of JCCIA

As stated above, during each CPD event and the school visits, feedback was gathered from the teachers involved in JCCiA. Each CPD event was designed so that it would be closely aligned with a vision of teachers as lifelong learners. This lifelong learning is necessary for the STEM disciplines, to update and improve both subject knowledge (the 'what' of STEM teaching) and pedagogical knowledge (the 'how' of STEM teaching). A high quality, sustained, coherent, and supportive model of CPD has the potential to incentivise and support teachers throughout their teaching life and to harness existing and potential links between formal and informal CPD providers. The aim of the CPD events, which took place in the two years of the JCCiA initiative, was to support the teacher and their schools as they introduced the Coding short course. Also, it sought further, to facilitate actively engaged discussions between JCCiA teachers and to assist them as they developed resources, deepen their knowledge of the assessment and to foster growth in their confidence.

Throughout the process, it was of the utmost importance that the project received regular feedback from the teachers involved. After each CPD day, the feedback was gathered either informally through discussion or formally through written responses.

Teacher Involvement

Schools were asked 'How many teachers are active members of the short course in the Coding department within your school?' 76% of teachers stated that there were two or more teachers actively working within their Coding teams in their school.

Teacher Feedback on CPD Days

During the regional CPD days, teachers were asked for their feedback on the sessions and what they would like the CPD days to address moving forward. Some of this data was gathered informally, and the information was utilised in real-time. To collect data which could be shared and analysed the decision was made to ask teachers to respond to two questions during CPD Day 3, which took place in the first week of February 2018. The questions asked were:

What one aspect of this year's CPD programme was of most benefit to you (The Star)?

What one aspect of CPD do you feel should be covered in future events (The Wish)?

The responses to these questions were extraordinarily varied due to the open-ended nature of the question. To understand the responses of teachers, the data was read in its totality and analysed to find themes which were emerging in the responses. The data was then coded under headings, which included the value of the classroom resources, units of work, assessment, etc. The extensive list of topics can be seen in Figure 13 below.
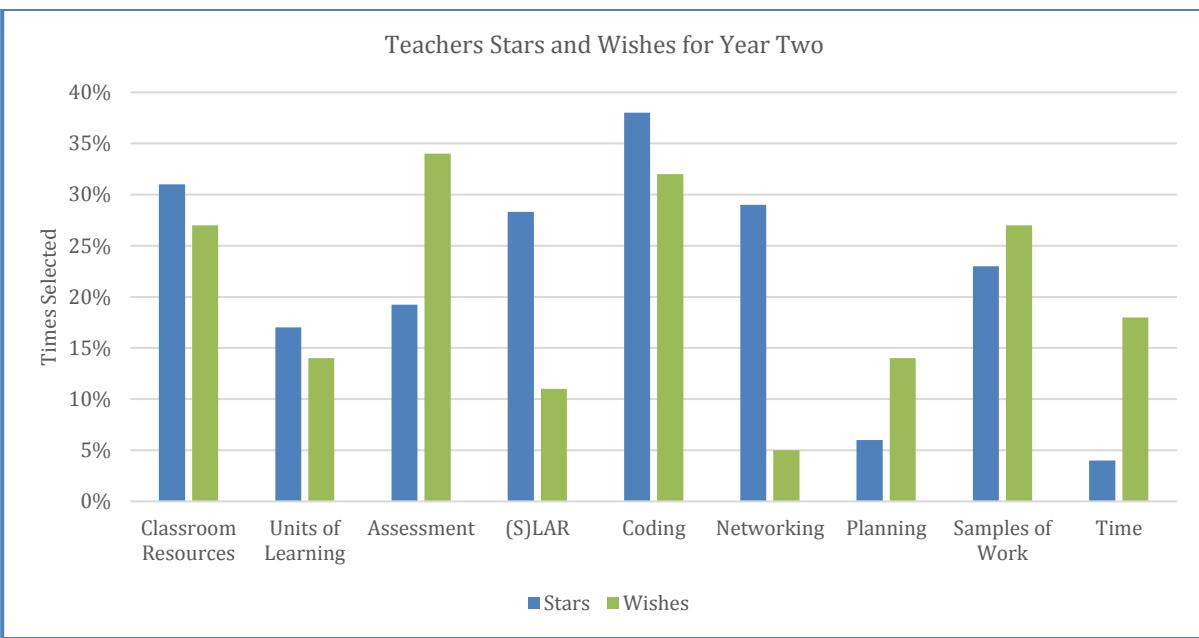
Figure 13 Stars and Wishes

As Figure 13 shows, most teachers stated that one of their stars from the CPD day was the Classroom Resources which were developed during the day, while the element which they would most like to see included in future CPD days was Assessment. Teachers stated that they would like "Some additional guidance and help on CBAs - suitable/unsuitable projects", "A comparison of current assessment methods v the new CBA etc. systems (side-by-side)" and "Looking at CBAs in more detail by using sample work so that a better understanding of the standards and requirements are achieved".

At CPD Day 5, teachers were asked a series of questions in order to explore the emerging pedagogical content knowledge of teachers of the Coding short course. Teachers were asked to select one of the twenty-five learning outcomes and then examine how students achieve this learning outcome, as the new subject was designed to allow students to develop skills rather than replicate or memorize code.

All but two of the learning outcomes were selected, with most learning outcomes being chosen by two or more teachers. The most popular learning outcome was "2.4 build a website using HTML and CSS to showcase their learning", this was selected by 34.8% of the teachers.

The first question explored how teachers know when their students were learning. The question read "Besides the completion of the code or assignment, what evidence do you draw on to determine whether students have achieved the learning outcome you selected above?" Teachers stated that they used a variety of methods. Their responses are outlined in Figure 14.
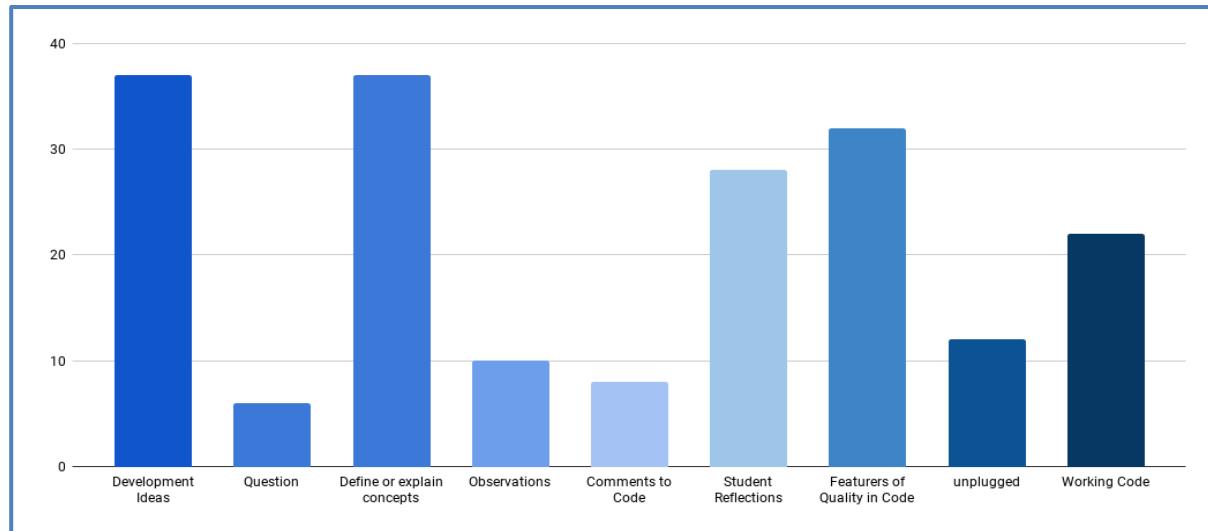
Figure 14 Assessment of Learning

Teachers were then asked, "How do students know that they have met the requirements of this learning outcome?" The response to this question showcased the innovative and creative assessment methods through which the students were assessed. This was an open-ended question, and teachers often wrote about two or more ways that students know that they had achieved this learning outcome. The responses were reviewed and coded, with some conventional approaches emerging, the most popular method was that students were given a marking rubric (28%). This was followed by the view that students know based on the feedback or ability to answer the teacher's question (18%). The third most common view was that students should understand that they have achieved the learning outcome when they are able to write working code (15%). While these are reflective of traditional approaches, there were some innovative approaches which were utilised; these were categorised and ordered in descending order of preference as follows:

- Students know that they have achieved success by reflecting on their work (14%);
- Students can Adapt Code (10%);
- Peer Feedback on and discussion of the Code that they have written (8%); and
- Students Can Work Independently (7%).

Teachers were then asked to write down "What challenges do students face in achieving the success of this learning outcome? How did it come to your attention that students faced this challenge?". The teachers acknowledged that like most subjects, the primary challenge for students was in securing knowledge and competency with subject-specific content (20%). There were also many other challenges which students faced, including the literacy, the difficulty of directing their learning (15%) and access to content and organisation (11.5%). In response to the second part of the question, teachers relied on verbal, as well as non-verbal

feedback and responses from students, and this further emphasises the need for consistency and healthy relationship between the teachers and students to ensure that students are reaching their potential.
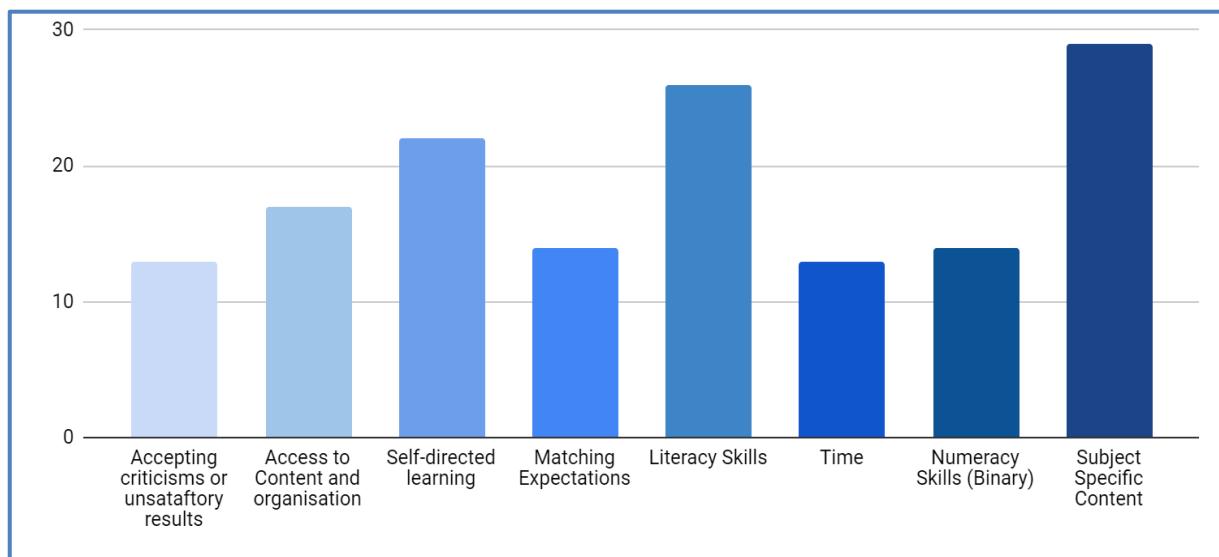

Figure 15 Challenges for Students

In the final part of the survey, teachers were asked, "What changes if any they would make if they were going to teach this learning outcome again to students?" The responses were categorised into the following:

1. Adapt the content which they use or redesign the resources which they used, the majority of these teachers wanted to incorporate unplugged activities (31%).
2. Clearer communication and description of the task before students begin the assignments (27%).
3. That they would spend more time planning and focus on collaborating with fellow teachers (25%).
4. Focus on students interests and encourage them to use their interests to engage in Coding (11%).
5. Incorporate and increase the amount of peer work (6%).

The teachers had gained a great deal of perspective with almost all of the teachers developing ideas on how to adapt lessons. While the responses were analysed to uncover themes, the responses of these teachers showcase the unique range of experiences, their knowledge of the subject, and their care for the students in their classroom. As one teacher stated:

> *…I feel that the biggest struggle for students is connecting assignments inside the classroom to real-life issues in the real world. They are putting limitations on themselves and do not realise the full potential of what they are learning and the applications of it.*

*(*CPD Day 5, Additional Feedback)

 The final question of the survey asked if teachers would make any additional comments while most teachers, 67.3% stated that they had no further comments, 32.7% did expand on their earlier feedback. Some of these teachers wanted to give feedback on the challenges of teaching Coding while others focused on the CPD which

they had attended. One teacher stating that "…this work while challenging, has been made more accessible and informed with the work that was done with the facilitators on the CPD days …" (CPD Day 5, Additional Feedback).

While another teacher discussed not just the benefits of the CPD which they received but also the complexity of ensuring an even playing field for all students:

> "*CPD with Conor, Gwen, Thomas and the team has been fantastic, great help and resources. We are developing a strong community of practice. Student access to technology at home is also an issue in completing work/documenting work at home.*"

<div align="center">(CPD Day 5, Additional Feedback)</div>

While other teachers discussed the learning that this activity had on them, one teacher concluded that the task had, "…really made me consider the LOs [learning outcome] from a student perspective" (CPD Day 5, Additional Feedback).

Progress within Schools

During JCCiA, teachers and schools were given an opportunity to engage with a dedicated team of professionals whose aim it was to assist them as they brought the new JC Coding short course their students. As mentioned above, there were several CPD opportunities for teachers, as well as support visits to schools. A final survey was conducted at the end of year one of JCCiA, in which teachers were asked to reflect on their current practice and to discuss their plans and aim for their future practice.

Within the survey, teachers were asked about the success and challenges which they faced during the first year of the programme. They were also asked about:

- The numbers of hours each year group receives in Coding?
- If Coding is offered to all or some within their schools, student experience of Coding?
- For their opinion on the successes and challenges since the introduction of the Coding short course into their schools.

This section will discuss teachers responses to these questions and drawing on all the information which has been gathered during JCCiA produce a set of recommendations for Coding and computer science education moving forward.

Advances in Coding

At the end of year one, a survey was sent to all schools involved in JCCiA. Teachers were asked about the nature of the rollout of Coding and whether they offered Coding to all of their students as a core component of the JC curriculum or as an optional component of the JC curriculum. The response to this question was very interesting, with 59.5% of schools stating that they currently offer Coding to all students. When schools were

asked what they intended to do in the future the number of the respondents who indicated that they would offer Coding to all fell to 52.4%

In addition to this, schools were asked if they wished to continue to participate in the JCCiA CPD initiative in the next academic year. The response to these questions was overwhelmingly positive, with only one respondent stating that they did not wish to continue.

Schools were asked about their position regarding student certification for Coding. 34% of schools have already brought a group of students to certification in 2019, 40% of schools will bring students to certification in 2020, and the remaining 21% hope to bring schools to certification before 2022. Only 5% of the schools involved in the initiative were unable to provide us with information regarding student certification.
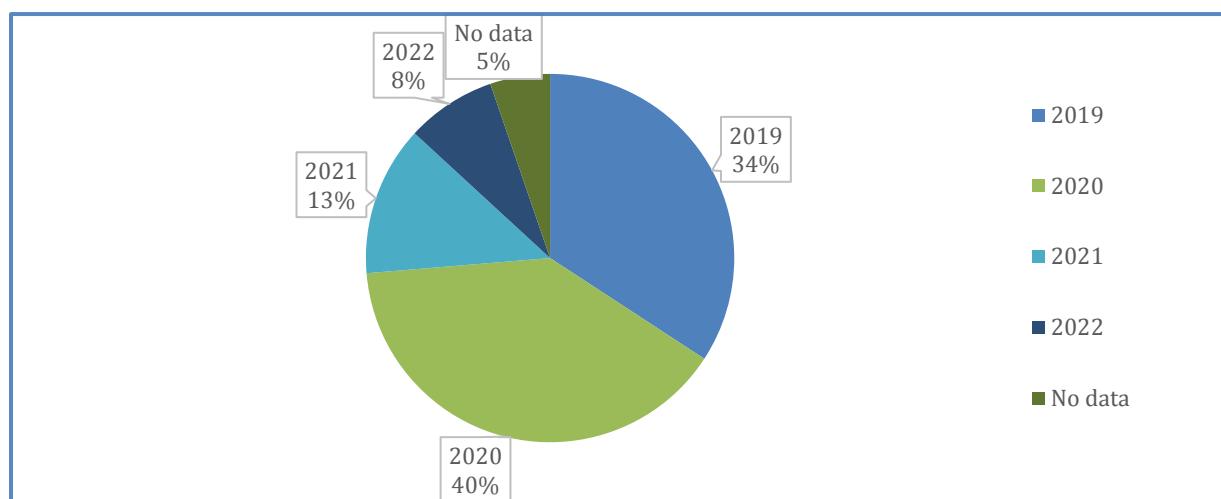
Figure 16 Schools bringing students to certification

All schools involved in JCCiA are offering the 100 hours of classroom time to their students. Data showed that for schools new to JCCiA, the majority of this time is timetabled for first years. The general trend is that all schools are offering more than the required number of hours.

Success and Challenges of JCCiA

Teachers were asked about their most significant success and challenges at both a school and a classroom level since they began JCCiA. The responses to these questions were varied. However, themes emerged within the answers, and these will be discussed below.

Successes of JCCiA

Teachers identified the wide range of achievements within the classroom and the school following year one of JCCiA. The comments of teachers were examined to find commonalities and themes. Following the completion

of the examination of teacher's responses, five key areas of success were most common, as outlined in Figure 17.

Student interest or engagement

Student interest and engagement in the JC Coding short course was reported to be very high. 40% of teachers referenced the positive student interest in Coding directly as the key success of JCCiA. Several teachers stated that both parents and students were excited by the course and that because of their inclusion in JCCiA, their school had received increased interest and attention. One teacher stated that:

> "The degree of parental and student interest that has been communicated to us. At a recent school awards event, we showed a short clip of students engaged in Coding and interest from parents increased as a result. Students have expressed a good deal of satisfaction in their progress in Coding."
>
> (CPD Day 3, Feedback)

The second part of this teacher's comment, which relates to student satisfaction with their progress, was echoed by many other teachers, who noted an "…increased interest in Coding in first year…", "…the interest from students in Coding has increased…" and the programme has led to a "…wide interest in Computer Science…". Another teacher commented that "…students are very enthusiastic [about Coding]…" and that they received "…very positive feedback from the parents at the parent-teacher meeting".

Students learning and skill development

40% of the comments from teachers can be encapsulated under the umbrella term of student learning and skill development. One teacher wrote, "…students have become more confident in Coding. They have learned the importance of resilience…". Another teacher stated that the success of JCCiA has seen " …almost all students achieve a level of success in the various aspects of Coding. Making it fun & interactive for them…" With this kind of positive feedback from teachers, it is clear that many feel the success of the programme has been a student's acquisition of skills and increased learning in this area. A number of teachers commented on how the use of differentiated tasks, during CPD days, allowed them to facilitate and adapt planning for the needs of all students within their classroom.

Teaching Methodologies

The JCCiA gave teachers the security to develop and adapt their teaching methodologies to an entirely new subject area. One teacher very eloquently stated:

> "*As teachers, we've come out of comfort zones & come away from teaching the basic MS office skills. The staff skill set has expanded, but also the teacher-student dynamic has changed as we grow in our learning.*"
>
> (CPD Day 3, Feedback)

Relationships with external and internal people

Thirteen percent of comments were focused on the positive impact which JCCiA, had on the development of relationships within schools, with fellow teachers, with JCT Associates and with external people who had been introduced during JCCiA events. It was clear from the respondents, that "…learning together…" was a key component of JCCiA. The community and sharing of practice was being mentioned by many: one teacher said that for them the success of JCCiA was that within their school they became "…a team sharing knowledge and resources" and "…planning together…". Another teacher spoke about the support received during the CPD events, adding "…working in pairs and peer support helped me to feel like part of a team". As a result of engaging in this external CPD course, the skills obtained lead to increased teamwork which helped teachers to engage in "…sharing of resources and ideas…".

Use and knowledge of ICT/IT

While it is the smallest subsection, it is still important to mention the comments of teachers who saw a positive impact on students use and knowledge of ICT. It may have been possible to incorporate this into the skill development subset. There was a distinction made by teachers to highlight student competence within the area of ICT and Information Technology (IT) skills that students had developed by engaging in the short course. One respondent stated that students "…competency and confidence using IT have greatly improved". Another claimed that "…some students came with no experience in IT… [but, that following completion of the short course, they had] …a huge advantage over their peers". Another stated that they had seen a noticeable, "…Improvement in ICT skills, Computational Thinking & Problem Solving". Many teachers noted that hardware, such as desktops, Arduino Uno boards, Lego Mind storms and Vex robotics are being used within their classrooms.
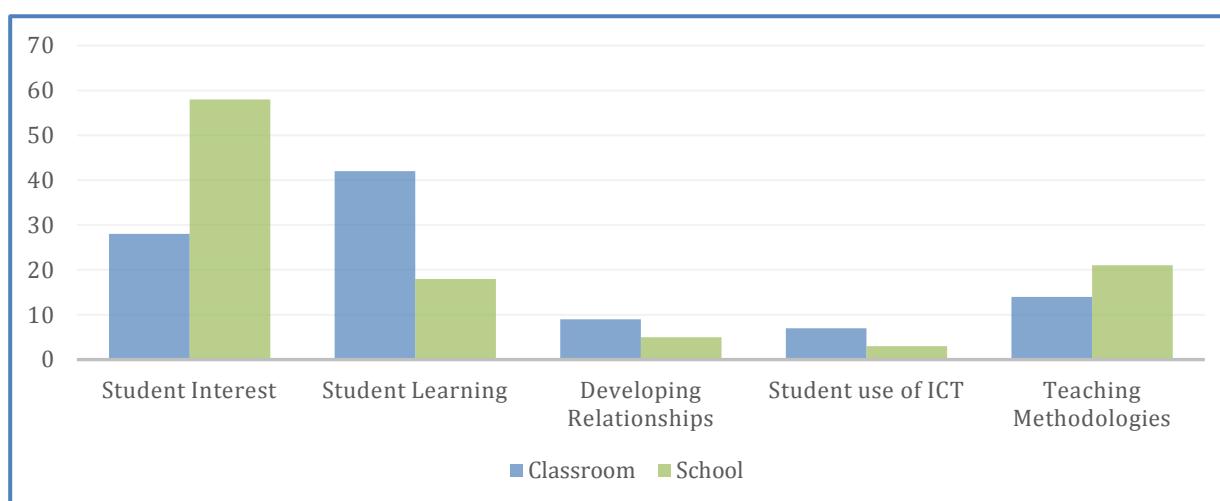

Figure 17 Success of Introducing the Coding short course

To incorporate Coding, and indeed computer science, as a part of the curriculum, the vast cohort of participating teachers identified the need for further training, support, and the development of resources. It was mentioned that these should support learning and teaching, and provide clarity, particularly in the area of pedagogical approaches and assessment.

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 classroom specific expertise was called for. A number of teachers felt it essential to explore, the possibility of receiving Teaching Council recognition for the engagement in numerous CPD events.

There were also some general issues which were brought to light during the first year of the JCCiA initiative, and these can be seen in Figure 18.

Time

20% of teachers stated that timetabling posed the most significant challenge at a classroom level, and 29% stated that it was the most significant challenge at the school level. At a classroom level, teachers said things like "…students wanting to take more Coding classes". Another noted that a single class each week "…does not aid retention of subject materials…", in conjunction with this, absenteeism among teachers and students was noted as a significant disruptor to the single class structure.

At the school level, teachers stated that it was challenging finding time to meet with fellow members of their "…Coding team to cover schemes and planning…". Also, in relation to timetabling "…pupil ratio…" and "…class size…" were mentioned as challenges which JCCiA teachers faced.

Resources

At a classroom level, 26% of teachers said that resources were the most significant challenge they faced. Resources were mentioned by 49% of teachers when they were asked the same question about the school level. The issues with regards to resources were varied, with some teachers writing lists of resources which they felt would improve students learning, while others simply writing one word, "Wi-Fi".

One teacher stated the need to have "…an appropriate learning space, e.g. somewhere that facilitates group work and unplugged tasks (rather than a computer room)". Another specific need which was uncovered was the need for "Resource's in Irish".

An additional, issue which many teachers noted was their struggle with "…broken and old PCs…", "…no book/materials available…", and "Laptop issues - windows, flash updates, etc.". Others stated their desire to purchase new equipment for their students and "…lack of money to buy equipment…" as the most significant challenge. One teacher offered a solution to these issues by stating that, "Coding should have a dedicated yearly budget, just like other subjects to allow us to build up resources".

Student Skills

Student skill was something which was mentioned by 20% of teachers at the classroom level; however, it was only mentioned by 3% of teachers as having significance at the school level. In the classroom, the variation of student's ability was a contentious issue, exasperated by the above factors, with teachers stating that they were struggling "…to manage that within a single period in the computer room" and to "managing the different abilities in the classroom as regards basic skills". For others, the issues around student skills were focused on digital illiteracy. One teacher stated that in their school, the "level of digital literacy from students starting the first year is much lower than anticipated".

With regard to student skill, bridging the digital divide was mentioned as one teacher said:

> "*Some students have significantly less computer literacy. Managing the large deviation in student Coding ability".*

Student coding and logical thinking skills were an issue for some, with one teacher stating that they felt "the weaker students sometimes struggle with it" and another that "the logical thinking part of coding is not suitable for all students". The opinions of these teachers are important to note, as it is critical that the rhetoric around this new area of learning be inclusive for all learners. Some teachers had the opposite view; one stated that "ASD (Autism spectrum disorder) students, in particular, have had great traction with this initiative".

Teaching Methodologies

Teaching methodologies comprises the principles and methods used by teachers to enable student learning. It accounts for 23% of classroom level and 21% of school level most significant challenges. These strategies are designed to merge subject content and student learning. Teachers noted the tremendous amount of time which they had to dedicate to "Making up the course… [using the] … guidelines from workshops…" as a reference point. From a number of responses, it was clear that teachers were becoming increasingly tired of the demands of this, one teacher stated: "…trying many approaches, methodologies and techniques and watching the best-laid plans go up in smoke has been a real challenge". Their opinion was echoed by others who commented for them that the most significant challenge was, "…designing successful teaching methodologies that grab the student's interest and align with the JC Coding learning outcomes."

For teachers, this juxtaposition between improving their "…own knowledge…" while designing and delivering content which is accessible and engaging for all proved to be a significant challenge. As one teacher said, the greatest challenge for them was:

> "*I feel I'm not an expert at it yet so continually trying to make it relevant, realistic & interesting for them while upskilling my knowledge to do so."*
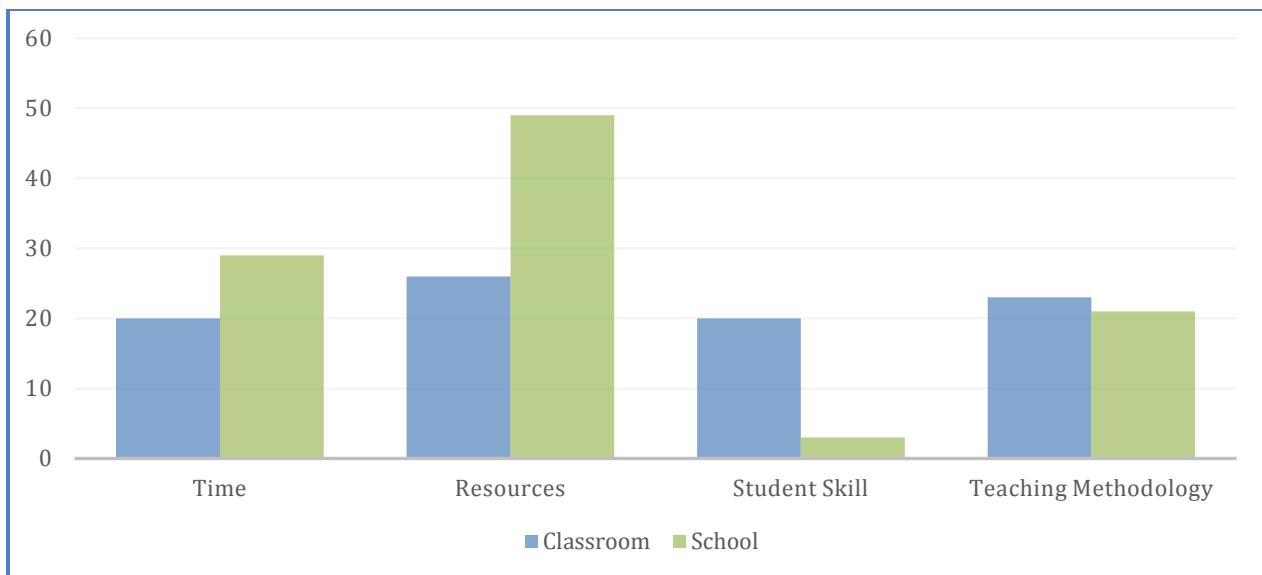
Figure 18 Challenges of Introducing the Coding short course

From the data and feedback, it is clear that the JCCiA initiative has had a positive impact on teachers, students and the schools involved. Progress within the schools has been highlighted by many involved.

Conclusion

As the role of computers in our everyday lives expands, we will need to adapt and grow our skill set to be prepared for the challenges and advantages which these technologies present. It is becoming increasingly clear that education systems will have to equip young people with the skills that they will need to enter the changing world of work. According to the renowned physicist Stephen Hawking, "…whether you want to uncover the secrets of the universe, or you just want to pursue a career in the 21st century, basic computer programming is an essential skill to learn"[16]. Within the last five years, great strides have been made to progress and update Ireland's Education system; all subjects at JC will experience changes to their structure. A strong emphasis has been placed on students acquiring skills in STEM, as part of this drive computer science is now being brought to the post-primary setting.

In the Irish government's *Action Plan for Education* 2017, one of the commitments made was to the acceleration of a digital agenda in schools; this was to be achieved through a JC Coding short course and the Leaving Certificate *Computer Science* programme[17]. The JCCiA initiative was designed to support schools and teachers in their introduction of the JC Coding short course. Students and teachers were asked to engage with innovative coding-related resources, develop their expertise and to share their experiences[18]. JCCiA aimed to capture the experiences of teachers and students to assist with the further development of resources around the teaching, learning and assessment of the JC Coding short course.

Following the first phase of JCCiA, there is now a clear plan in place for the next phase of the initiative, with all stakeholders being aware of the specific targets and the timeline of assessments (CBA). There is also a structured timeline for JCCiA Phase 2, which will be delivered over the next two years (2019-21).

Findings of JCCiA

During phase one of JCCiA, there was an uptake in the number of students who were introduced to Coding, with approximately 5,000 students being impacted by the programme.

It was reassuring to see that the most explicit developments were made in the second year of the initiative. The reasoning behind this can be attributed to the time that students, teachers and schools have had to feel confident with the new short course system and the nuances of this new area of learning.

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[16] *Leaders and trend-setters all agree on one thing*. [online] Available at: https://code.org/quotes
[17] Action Plan for Education 2017, p.81. Available at: https://www.education.ie/en/Publications/Corporate-Reports/Strategy-Statement/Action-Plan-for-Education-2017.pdf
[18] Junior Cycle Coding in Action: Coding Brochure, p.2. Available at:
https://www.jct.ie/perch/resources/shortcourses/coding-brochure-web-120317.pdf

Teachers found the exemplars of assessments and simulations of a LAR meeting to be very helpful towards their classroom practice. It was of great value to all schools involved to have a sharing of practice where teachers could discuss and share the different approaches which they have taken to the Coding Short Course. Teachers requested planning tools to help them as they prepared for the delivery of the Coding in the second year of the scheme. Accordingly, the decision was taken to offer teachers further opportunities to plan and develop relevant resources and organise the planning needed. Each of the teachers involved stated that they felt the CPD days helped them to build and develop confidence of the learning outcomes in the JC Coding short course specification.

Work within the schools during JCCiA

Of course, there were some areas where schools and teachers had to work hard to ensure that the Coding short course was a success for both the students and the school community. Teachers, school management and staff, faced three main challenges during the first school year. These challenges were:

1. Greater administrative workload: Timetabling of the short course within the school timetable. Schools had to decide not just who was going to teach Coding but who was going to study Coding (all students or some students) and ensuring that all who did would receive recognition by completing the 100 hours). Many schools incorporated a short course into their timetable for the first time and additional time for management and the secretarial staff was needed to do this.

2. Students adapting to JC reforms: There were considerable changes to assessment, with CBA being introduced. Students in particular felt these changes as they saw changes to their timetable and assessment as well as the dynamic of classes (move towards projects work, collaboration and student presentations). In some schools, this means additional training meetings, (S)LAR meeting. and greater communication to the students and staff on technologies, resources and assessment practices.

3. Teachers training time: Almost all teachers engaged in formal CPD training, but many also actively sought out additional training and upskilling. There is no doubt that these training days were needed. However, it is essential to acknowledge the support and understanding of schools these days. It is always a challenge to schools when teachers are released for off-site training. However, it was wonderful to see the commitment of both teachers and schools to attend CPD events and to encourage the acquisition and development of the skill among staff who were involved in JCCiA.

Creating Sustainable Change

In light of Ireland's obligations under EU laws and various international agreements, including the 2015 Paris Accord on climate change, the environmental impact of Ireland education system needs to be examined in further detail. As the research team were working closely with schools and teachers, they have compiled a

shortlist of areas where energy consumption and equipment might be considered. It is of the utmost importance that the technology changes and advances made towards the adoption of more environmentally sustainable school practices be adopted nationwide. This report would like to outline the following be considered:

1. Power supply - The impact of the power supply on electricity usage within the school is enormous, and the cumulative impact of power supply. This choice could go a long way towards reducing schools, electricity bills and meeting our targets. (https://www.velocitymicro.com/blog/what-is-psu-efficiency-and-why-is-it-important/).

2. Single-board computers - allow students to have more significant interaction with the hardware and GPIO. (Allow more computers to be purchased as they are much more economical price point per computer) Raspberry Pies can be used as a programming interface as well as a device to interact with the GPIO.

3. Solid State Drives (SSD) – these are smaller and faster than the alternative hard drives. They would also see considerably faster on and off booting of machines which makes it suitable for the school environments. From production and a delivery standpoint, the SSD is also much more sustainable.

4. Finally, a strategy which could be adopted in every school is to have clear guidelines on when to turn off the machines — energy conservation and understanding.

Response to the Interim Report

The interim report, which was published in February of 2019, concluded with ten recommendations these have all been addressed and responded to by JCT and the schools involved. This report would like to document and recommend that:

- In March of 2019, application for a phase two of JCCiA was sought and the second phase of JCCiA is set to commence in September 2019. This will allow more schools to engage with the structured CPD designed explicitly for this unique short course.
- In addition, JCT has created a dedicated online platform where teachers can upload and share resources, discuss their experiences and knowledge that they have acquired while teaching the Coding short course. Teachers are able to discuss the work which they are doing within their classrooms with the wider educational community.
- Great strides have been made with school management considering the importance of continuity, as well as teacher knowledge, and Coding experiences when deciding on which teachers are going to teach Coding within the school next year.
- In addition, it was great to see the support of principals and schools at the Attending the JCCiA National event in March of 2019.

- At the same event, the teachers and their schools received formal recognition of their commitment to JCCiA.
- Following the JCCiA National event, the Computers in Education Society of Ireland (CESI) conference took place in Athlone. This was an excellent opportunity for teachers to share resources, knowledge and stories within the teaching community, and it was great to see that teachers attended in very high numbers.

Recommendations

Perhaps the most challenging dilemma facing teachers today is the extent of the change in their professional lives. Recent developments across the education continuum in Ireland see a move away from the understanding of content towards a learning outcome and skill-based approach to education. In the area of the JC short courses, for the first time, teachers are attempting to develop and deliver content, which will inspire and engage students in developing 21st century skills while learning about computer science.

This report would like to conclude with ten recommendations which are of interest to those involved in JCCiA and the broader education community. These recommendations have been shaped by the feedback which was gathered from teachers, students and broader educational research. Following extensive analysis of the above finding, this report makes both general and project-specific recommendations, which can be found below.

General recommendations:

1. Effort should be made at a school and a national level to recognise the Junior Cycle Profile of Achievement (JCPA). In particular, this report recommends that schools set aside time to award students their JCPA.

2. Teachers should be supported, through continuity of timetable allocation and the incorporation of team teaching and development of Computer Science teaching capacity within the school.

3. An outline of the structure of CPD events should be circulated to teachers and schools in advance of the commencement of CPD activities in order to ensure schools and teachers have time to prepare.

4. The environmental impact of reforms should be considered, and efforts should be made to move away from paper administration towards online/ digital tracking, and collaboration in all government-supported CPD. In conjunction with this, teachers, schools and ETB's should be encouraged to make efforts to purchase equipment, which has the best possible energy rating.

5. Efforts should be made to build learning and understanding of computer science and technology within the broader communities. As one teacher stated:

> "…schools are hampered without Parental… opportunity, access & awareness of computer science, which further widens the gap between the schools & students in different geographic & social settings."
> (CPD Day 5, Additional Feedback).

6. In conjunction with this, all efforts should be made to communicate with the public around the aims and applicability of both the hard and soft skills, which are developed through engagement with the short course in Coding.

7. In line with this, it is recommended that research continues and that this research be shared with the broader community.

Project-specific recommendations:

1. In future, the scope of JCCiA should be broadened to allow for greater online collaboration and teacher sharing of practice, through an online collaboration tool such as Slack or Microsoft Teams.

2. Unplugged elements should also be incorporated into JCCiA events, and teachers should be encouraged and supported to develop resources which can be adapted to classrooms where computers may not be accessible, and to engage learners who may not have access to technology at home.

3. Educational leaders, stakeholders and the government should celebrate the work being done by students, teachers and schools in the area of digital short courses, especially Coding and the JCCiA National Symposium should be repeated for Phase 2 schools.

The findings of this report highlight the work which has been done by JCT, teachers of the Coding short course and the schools who have taken the courageous step of offering the Coding short course to their students. The reforms to computer science education have achieved a number of objectives, namely promoting and facilitating student learning in this area. The patterns of the compulsory or optional nature of the Coding short course show significant variation across school contexts and showcase how this additional area of learning can be tailored and incorporated into all schools.

The introduction of JCCiA Phase 2 by the JCT, along with the government announcement of 50million euro of funding for ICT equipment for schools under the Digital Strategy for schools go a long way towards addressing these constraints which schools may face when bringing the Coding short course to their students.

Figure 19 JCCiA Phase II Supports

The findings of this report highlight the importance of providing students with an opportunity to engage in Coding. The additional supports crucial for student decision-making, particularly relating to guidance counselling, must be available to students across all school contexts. The perceived status of short courses within the school and the demoralisation of students acquiring life skills rather than achieving grades suggest the need for greater public discussion on the rationale behind the short course.

Finally, the results indicate that the Coding short course has had a positive impact on the teachers, schools and students involved, and it is hoped that the success will be seen again in JCCiA Phase 2.

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Appendix

Appendix I: Letter to Schools

6 March 2017

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).

In 2015, we commenced a CPD initiative called *Exploring Coding* with 22 schools. This proved to be very successful in supporting these schools in their initial work with the new short course in Coding.

Building on the success of our Exploring Coding project, we are now launching a new two-year initiative, entitled *Junior Cycle: Coding in Action.* This new initiative is designed to support schools who are committed to introducing the short course in Coding within their Junior Cycle programme. We are delighted to have both Intel Ireland and Lero – The Irish Software Research Centre – continuing to collaborate with us on this follow-on innovative initiative.

There is a limit to the number of schools that can engage in this initiative. In order to participate, a school must complete an online 'Expression of Interest' form and provide details of two teachers that will engage in the initiative. The relevant online form can be accessed at **http://www.jct.ie/shortcourses/shortcourses.php.** The closing date for expressions of interest is **4.00pm on Friday 28th April 2017**.

Further details on the initiative are included in the attached information leaflet. Any queries can be emailed to **info@jct.ie**.

I look forward to hearing from you.

Yours sincerely
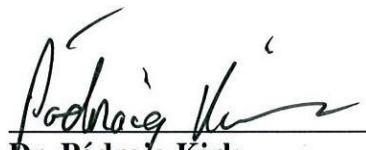
Dr. Pádraig Kirk

Director, CPD for Junior Cycle

Timeline

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

Project 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 Ed. Centre
Armagh Road
Monaghan Tel.: 047 74000

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

Exploring the Short Course in Coding

Short Course Coding Specification for Junior Cycle

A research project involving the use of electronic hardware devices

Introduction

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

Intel Ireland has donated 1000 electronic hardware devices and 60 development kits to support this project. These small electronic devices enables students to develop prototype applications in engineering and computing, or other simple activities such as controlling a robot or controlling lighting systems from smart phones. This technology can enable students to create solutions for the good of society, or simply for the fun and challenge of being involved in innovation.

Project Aims

This project seeks to;

Participating schools and teachers will:

- Receive 60 electronic devices and 4 development kits per school
- Participate in two initial CPD events to share current practice and explore the short course in Coding.
- Attend a unique CPD event in the Intel Ireland Campus in Leixlip
- Contribute to an online community of participating teachers
- Share their experiences with the short course, the use of the electronic devices and inform the development of further supports for teachers

Application Process

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

- Examine the current provision within schools for ICT-related curriculum components at Junior Cycle.
- Collate resources which can support the implementation of the short course
- Capture the experiences of schools in their trialing of the short course
- Capture successes and challenges in the use of the electronic devices
- Explore further options to support schools and teachers in their implementation of the short course in Coding

Project Design

Approximately 14 schools – preferably that have existing practice in terms of Computer Science/Coding and Programming in their Junior Cycle programme and that wish to pilot aspects of the short course in Coding – will be offered the opportunity to take part in the project.

Each school will be requested to nominate two teachers.

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:
  - Possess existing practice and/or teacher expertise in the learning area of Computer Science/Coding
  - Currently provide curricular time at Junior Cycle level to trial aspects of the short course in Coding.
  - School location to support the feasibility of this research project.

A collaborative project involving:

An tSraith Shóisearach do Mhúinteoirí
Junior CYCLE for teachers
(intel)
Lero

Appendix III: List of JCCiA schools

The list of participating schools in the 'Coding in Action' initiative are:

School Name:	School Address:
1. Abbey Vocational School	The Glebe, Donegal Town
2. Adamstown Community College	Station Road, Adamstown, Lucan, Co.Dublin
3. Athy College	Athy, Co. Kildare
4. Bandon Grammar School	Clonakilty Road, Bandon, Co. Cork
5. Breifne College	Cootehill Rd Cavan
6. Carrick-on-Shannon Community School	Carrick-on-Shannon, Co. Leitrim.
7. CBS Thurles	Rossa Street, Thurles
8. Central Technical Institute	Clonmel, Co. Tipperary
9. Celbridge Community School	Moortown, Celbridge, Co Kildare
10. Colaiste an Chraoibhin	Duntahane Road, Fermoy, Co. Cork
11. Colaiste Bride Presentation Secondary School	New Road, Clondalkin Dublin 22
12. Colaiste Chiarain	High Street, Croom, Limerick.
13. Coláiste Dún an Rí	Kingscourt, Co. Cavan
14. Coláiste Mhuire Johnstown	Johnstown, Co Kilkenny.
15. Coláiste Muire Ballymote	Ballymote, Co Sligo
16. Coláiste na bPiarsach	Ros Muc, Co. na Gaillimhe
17. Coláiste na Carraige	An Charraig, Dún na nGall
18. Coláiste na Coiribe	Gaillimh
19. Coláiste na Mí	Johnstown Educational Campus, Johnstown, Co. Meath
20. Confey College	Leixlip, Co Kildare
21. Crana College	Buncrana, Co. Donegal
22. Elphin Community College	Elphin, Co. Roscommon.
23. Errigal College	Windyhall Letterkenny Co. Donegal
25. Fingal Community College	Seatown Road, Swords, Co. Dublin

26. Gaelcholáiste Charraig Uí Leighin	Tigh Pháirc an Uisce, Carraig Uí Leighin, Co. Chorcaí
27. Gaelcholáiste Luimnigh	Meal Sior Anraí, Luimneach
28. Gaelcholáiste Mhuire A.G.	An Mhainistir Thuaidh, Corcaigh
29. Glenart College	Coolgreaney Road, Arklow, Co Wicklow
30. Grange Post Primary	Grange, Co. Sligo
31. Killorglin Community College	Langford Street, Killorglin, Co Kerry
32. Kingswood Community College	Kingswood Avenue, Tallaght Dublin 24
33. Kishoge Community College	Ninth Lock Road, Lucan, Co. Dublin
34. Le Chéile Secondary School	Hollystown Road, Tyrrelstown, Dublin 15
35. Marino College	14-20 Marino Mart, Fairview, Dublin 3
36. Mount Sion CBS Secondary School	Barrack Street Waterford
37. Naas Community College	Craddocktown Road, Naas, Co Kildare
38. Nenagh College	Dromin Rd, Nenagh, Co Tipperary
39. Ratoath College	Jamestown Ratoath Co Meath
40. St Aidans Comprehensive School	Cootehill Co Cavan
41. St Brogans College	Bandon, Co. Cork
42. St. Peter's	Passage West, Co Cork
43. St. Fanahan's College	Mitchelstown
44. St. Gerard's School	Thornhill Road, Bray, Co. Wicklow
45. St. Joseph's Secondary School Rush	Convent Lane Rush, Co. Dublin
46. St. Mark's Community School	Cookstown Road
47. St. Munchin's College	Corbally, Limerick
48. Sutton Park School	St Fintans Road Sutton Dublin13
49. Tarbert Comprehensive School	Tarbert, Listowel, Co. Kerry, V31 WD66
50. Terence MacSwiney Community College	Harbour View Road, Knocknaheeny, Cork
51. Thomond Community College	Moylish Park, Limerick
52. Virginia College	Virginia Co. Cavan