DISSERTATION

Coding and Programming in Post-Primary Education in Ireland
Art Teachers are best positioned to fill the skills void

SUBMITTED AS PART OF THE REQUIREMENTS FOR THE DEGREE
OF
MSc IN WEB TECHNOLOGIES
AT THE SCHOOL OF COMPUTING,
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IRELAND.

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I hereby certify that this material, which I now submit for assessment of the program of study leading to the award of Master of Science in Web Technologies is entirely my own work and has not been taken from the work of others save and to the extent that such work has been citied and acknowledged within the text of my work.

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ABSTRACT

This research project proposes to take the learning from the author's past experience and career, and combine it with the skills and areas related to the MSc in Web Technologies, creating a unified piece of research.

STEAM (*Science, Technology, Engineering, Art, Craft, Design, and Maths)*, not STEM (*Science, Technology, Engineering, Maths)* is a key starting point of the research, and an assessment of how STEAM can be integrated into the post-primary school environment is something the research can do to unify both areas.

Theoretically, for truly effective coding and programming, knowledge of Art and Design is arguably essential; likewise, to be a creative artist, knowledge of mathematical logical intelligence and practices can enhance study or work.

Ireland at present is the epicentre of computing, Programming and Coding (from this point on to be referred to as P&C); often-dubbed the "Silicon Valley" of Europe, as well as the Taoiseach, Enda Kenny's mantra, "We are the best small country to do business in".

Ireland's current education system offers no formal Computing, Information Communication Technology, P&C, Digital Media Literacy or any facet of Computer Science as an examinable, awardable, certifiable element of traditional post-primary education, there are no department guidelines at all for how Computing should be taught. UCC's is quoted as saying: "It is part of the curriculum in other European countries and I believe that Irish children are being left at a disadvantage. Parents are screaming for it" (Bielenberg, 2014). Indeed, Bielenberg notes that both Estonia and England have introduced ICT Computer Science education into their systems. Due to this, the National Council for Curriculum and Assessment in Ireland (NCCA) has developed two short course syllabi for Junior Cycle, *Programming &Coding*, and *Digital Media Literacy*, with a view to more concrete *Computer Science* syllabi being drafted in the future, with further review or both Educational Cycles at post-primary level alongside other curricular review currently on-going at present, along with Leaving Certificate Art, which has been in place since 1971, and has been under review since at least 2004 – previous syllabus has now gone out of date, and a new, new-Draft Syllabus for Leaving Certificate is being considered. While up-skilling occurs for this eventual transition, it may be possible to bring STEM into the Art room via tools like Scratch, web and logo design, web layout, and film/video, as these are options on the current Junior Certificate (NCCA, n.d.).

The research will assess the potential of Art Teachers as a base for educators of ICT, due to measuring and instilling a need for STEAM (Science, Technology, Engineering, Art and Design, and Mathematics) methodology and practices, as opposed to STEM (Science, Technology, Engineering and Mathematics – solely, without Art/Design). Theoretically, using Art Teachers' methodologies and practices for instructing, adopting and teaching P&C in second level schools would be a better application of this.

The research will initially assess the P&C draft Syllabus, as this has the most relevance to the Master of Science in Web Technologies award. It was necessary to assess not just Art, but those in ICT teaching jobs, as well. Considering this, it may be sensible to measure results via aptitude tests as well, by testing a range of participants.

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ABBREVIATIONS

2D	Two Dimensional
A-Level	General Certificate of Education Advanced Level
ACD	Art, Craft, and Design
AJAX	Asynchronous JavaScript + XML
ATAI	Art Teachers' Association of Ireland
BA	Bachelor of Arts
BCS	British Computing Society
BSc	Bachelor of Science
CAD	Computer Aided Design
CEO	Chief Executive Officer
CESI	Computers in Education Society of Ireland
CoC	Convention over Configuration
CPD	Continuous Professional Development
CSO	Central Statistics Office
CSPE	Civic, Social, and Political Education
CSS	Cascading Stylesheets
DCG	Design and Communication Graphics
DES	Irish Government Department of Education and Skills
DfE	Department for Education - UK equivalent of DES
DRY	Don't Repeat Yourself
ECDL	European Computer Driving Licence.
ETB	Educational Training Board [Replaced VEC, work with SOLAS]
EU	European Union
FÁS	An Foras Áiseanna Saothair - Training and Employment Authority, Replaced by SOLAS and merged with the VECs to become ETBs
FIT	Fast-track to IT
GAMSAT	Graduate Medical School Admissions Test
GCSE	General Certificate of Secondary Education
GIS	Geographic Information System
HAML	HTML Pre-processor
HDip	Higher Diploma
HEA	Higher Education Authority
HETAC	Higher Education Training and Awards Council
HTML	Hyper-text Mark-up Language
IADT	Institute of Art, Design and Technology, Dún Laoghaire
ICS Skills	The Irish Computing Society Skills Centre. Responsible for promotion and training of ICT and Computing.
ICT	Information Communications Technology. A coverall term for computing education
iOS	Apple's mobile operating system, previously known as iPhone OS
ITE	Initial Teacher Education (Teacher Training Course)
IT	Information Technology
JADE	HTML Pre-processor
JCSA	Junior Cycle Schools Award
K-20	Sum of education from primary schooling to graduate education (PhD)
KS	Key Stage (UK National Curriculum)
LCA	Leaving Certificate Applied Programme

LCVP	Leaving Certificate Vocational Programme
LERO	Irish Software Engineering Research Centre
MAVA	Master of Arts in Visual Art Education
MIT	Massachusetts Institute of Technology
MSc	Master of Science
MVC	Model View Controller
NCAD	National College of Art and Design
NCCA	National Council for Curriculum and Assessment www.ncca.ie
NCI	National College of Ireland
NFQ	National Framework of Qualifications
NI	Northern Ireland
NQT	Newly Qualified Teacher
OECD	The Organisation for Economic Co-operation and Development
OS	Operating System
P&C	Programming and Coding
PAT	Programming Aptitude Test
PGDE	Post Graduate Diploma in Education
PGDip	Post Graduate Diploma
PhD	Doctor of Philosophy
PHP	Hypertext Pre-processor
PIACC	Programme for the International Assessment of Adult Competencies
QQI	Quality and Qualifications Ireland
RAD	Rapid Application Development
SaaS	Software as a Service
Sass	Syntactically awesome style sheets
SMART	Specific, Measurable, Attainable, Relevant, Time-Related Objectives
SOL	Statements of Learning
SOLAS	An tSeirbhís Oideachais Leanúnaigh agus Scileanna - Further Education and Training Authority
SPHE	Social, Personal, and Health Education
STEAM	STEAM stands for Science, Technology, Art (& Design), Engineering and Mathematics. It is contrary to STEM in that is adds Art and Design disciplines to create a broader scope and intractability between disciplines
STEM	STEM stands for Science, Technology, Engineering and Mathematics. It is a branch of specialisations that
SWOT	Strength Weakness Opportunity Threats
UK	United Kingdom of Great Britain and Northern Ireland.
UPC	Liberty Global Europe's telecommunications operation in Ireland
US	United States
USA	United States of America
VEC	Voluntary Educational Committee [Now ETB]
XHTML	Extensible Hyper-text Mark-up language
.xls/.xlsx	Microsoft Excel file format/Extensible Microsoft Excel file format

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1.1 Background

There is a major drive in Ireland at the minute for STEM graduates (Kennedy, 2012). STEM means Science, Technology, Engineering and Mathematics. Indeed in Ireland today, one could describe the country as the European Silicon Valley (Somerville, 2014). Major technology firms such as Google, Microsoft, Apple, LinkedIn, and Facebook have their EU headquarters based in Ireland.

> *"Trailing the trans-Atlantic moves of Apple, Intel, Google and Facebook, fledgling Silicon Valley tech start ups are opening offices in Ireland."* – (Somerville, 2014).

The IDA announced that there were 197 foreign investments last year (2014), up 20% on the 2013 figure, with the companies including online shopping giant Amazon, LinkedIn, Airbnb, PayPal and Johnson & Johnson(Bodkin, 2015), notably, only one of these is not an IT company.
The government have enabled jobseekers to retrain in ICT sector competencies via the Springboard programme, first brought in by the Department of Social Protection/Department of Jobs/Innovation and Enterprise, where it was set out to address some of the shortfall in qualified technology and innovation graduates.

> *"The springboard initiative in higher education offers free courses at certificate, degree and masters level leading to qualifications in areas where there are employment opportunities in the economy."* – (HEA, 2013)

1.2 Statement of Problem

Ireland has a lack of IT literacy, as highlighted by the PIACC/OECD "Skilled for Life?" report (OECD & Gurría, 2013). Building this knowledge, and indeed IT literacy ought to begin in school. Compared to international practice in education, the UK, in September 2014 adopted Computer Science as a compulsory subject from the age of five at Key-Stage 1, thus scrapping their existing ICT syllabi and replacing them with computer science courses. The then Education Secretary, Michael Gove MP in 2013, noting that it, at best, taught secretarial skills, deemed the previous ICT syllabi not fit for purpose (DfE & Gove MP, 2012, 2014). The new Computer Science curriculum in UK schools will permeate from primary education up though secondary, with strands going from the UK's Key Stage 1 to Key Stage 4 (Naace et al., 2012; DfE, 2013), the way Maths, English and Irish are taught in schools here. Referred to as "Computing in Schools", its rollout is part funded by the British Computing Society (DfE & Gove MP, 2014). In addition to this, there will be bursaries provided for those who wish to train to be Computer Science teachers, similar to Maths and Physics training in the UK (DfE & Gove MP, 2014).

> *"In February 2013 the DfE published a proposed National Curriculum Programme of Study for Computing. The new title, "Computing" is intended to embrace the existing strengths of digital literacy and information technology in the current ICT programme of study, alongside a new strand of computer science. The final version of this curriculum will become statutory in September 2014, at all four key stages KS1-4."* - (Naace et al., 2012)

Ireland at present does not have any formal ICT or Computer Science curriculum at second level (NCCA, 2014). At most, ICT education seems to be taught in an ad-hoc way, dependent on the skills of existing staff, as opposed to having dedicated staff members, as reflected in the survey response section. The NCCA has drawn up a draft syllabus in two ICT areas, but these are short courses (NCCA, 2013). There is a skills shortage in the area of IT (Kennedy, 2011, 2012). In her article *"Is it time for primary schools to get with the program?"* Kim Bielenberg explains how EU countries Estonia and England have now introduced computing into the primary syllabus, where as Ireland did not even have a proper ICT Syllabus. In the Hays' "Women in IT" report Sinead Caulfield, Business Support Director at Fujitsu Ireland is quoted as noting: "*I strongly feel that an IT class should be compulsory from an early age at school. Many schools don't even have the option until transition year and I feel it would be more beneficial to start earlier. Indeed, all teachers should have technical training as the area of IT is incorporated into all subjects and more importantly, all careers. Many schools are shying away from technology when*

they should be embracing it." A survey carried out by Hays, as highlighted in the document includes a very telling comment from one respondent *"Secondary schools need to be more supportive and get IT professionals to speak to students as I feel that teachers don't understand the industry and so don't give good advice"* implying that there is a lack of skill, level and knowledge of core IT fundamentals, among post-primary teachers, counsellors and administration (Hays, 2014). The report also calls for up skilling and training of Irish post-primary teachers to be able to teach Computer Science "*Of course an increase in IT on the school curriculum would require more training for teachers. Whilst the introduction of coding in the UK primary schools has been lauded, it has caused controversy because the teachers don't have the ability to teach it. Quality course content and first-class IT teaching in the Irish schools system are essential for it to be a success*" (Hays, 2014). This is addressed in Chapter two, where innovation by Irish teacher Seamus O'Neill created a course to help deliver training in Computers via scratch for UK, and hopefully Irish teachers.

Conversely, there are a number of qualified Art Teachers in Ireland, who cannot find work (Lowry, 2012; Kehoe, 2014). Art Teachers in Ireland qualify through two routes, either a concurrent Bachelor of Arts in Art and Design Education, only offered in NCAD, or a consecutive post graduate conversion course, previously either a Higher Diploma, Professional Diploma – which was replaced with a Professional Masters in Education in September 2014 (NCAD, n.d.), with changes to Initial Teacher Education course specifications introduced at that time – offered in Dublin, Cork and Limerick (see 7.3 Appendix C). Each year, up to one hundred graduates enter an over-saturated employment market, usually having only one subject to teach, (NCAD, n.d.; CIT, n.d.; LIT, n.d.; Kehoe, 2014). For this reason, this research aims to assess if there is a desire for teachers to up skill in another area and offer something complementary to their current skillsets. Art Teachers can enhance the IT industry with a STEAM based approach. The Hays' "Women in IT" report lobbies for a full IT syllabus, noting it is possible to be examined in Ancient Greek, Latin, Classical Studies and Jewish studies, yet the highly sought after, and the subject which would fuel one of the biggest growing industries in Ireland, is not represented. It cites that "A computer science course should be introduced at secondary level that complements the courses offered at third level. It needs to be examinable at Junior and Leaving Certificate levels. In addition, a process must be implemented to allow the courses to be nimble enough to change with the pace of technological developments" (Hays, 2014). This will be discussed in detail in Chapter 2.

P&C is not taught and assessed or certified at any post-primary level at present (NCCA, n.d.). The NCCA has drafted a short course syllabus but this is yet to be formally ratified. At the most, ECDL the European Computer Driver Licence programme is taught as a means to developing ICT literacy. The irony here is that it teaches secretarial skills, not hard computing skills, the ICS skills have set up two smaller ICT courses, where 50 schools around Ireland tested this in 2013 (ICS Skills, n.d.). This is also a time when the IT industry is booming, and a time when ubiquitous computing is making the skills traditional ECDL provides somewhat redundant, acknowledged by the announcement of new ECDL version 6 this year, with other modules, in image progression, and web layout being elements (ICS Skills n.d.), (see Chapter 2).

1.3 Area of Contribution

This research will focus on the areas of post-primary education, and computer literacy and ability. It will be necessary to assess the status of ICT in Irish post-primary education, while attempting to determine the role P&C plays as a skill in the Irish education system, if it plays any role at all.

The Irish technology industry is one of many parties, calling for a computing curriculum to be in place in post-primary education(O'Brien, 2014; Kennedy, 2012; Percival, 2013).

In 2012, the technology industry had 5,000 vacancies it could not fill, at a time of high unemployment nationally in Ireland. This was attributed to the lack of skilled graduates in the areas of ICT, P&C, with most non-IT graduates having no skills in that area at all (Kennedy, 2011, 2012). Multinational companies will either; stay in Ireland and grow – which requires skilled workers – otherwise, they might move overseas to where the skills gap could be filled.

1.4 Hypothesis

This study aims to substantiate the hypothesis that the majority of newly qualified teachers, as well as those teaching less than fifteen years, would be willing to up skill, learn and teach a new subject such as P&C as part of ICT Education, by incorporating STEAM methodologies. Further to this, it could be theorised that there is variety of skill in computer literacy, use and knowledge – among both Art Teachers and ICT Teachers. Some may be familiar with coding through use of programs like Flash, After Effects or through coding semantic HTML and CSS for web sites. Presumably, knowledge of coding paradigms and methodologies may be limited and in fact quite low, among both Art and ICT Teachers. It would be interesting to discover if teachers are already updating skills in this area through self-tuition or via Continuous Professional Development (CPD) programmes. The teaching of coding would also help to bridge the aforementioned skills gap in the IT industry, which demonstrates an already missed opportunity for people to have learnt programming skills that as a society we ought not to perpetuate. On the author's experience of studying the HDip and progressively, the MSc in Web Technologies, he noticed it was those, like him, who had come from an artistic or architectural background that did very well in a number of modules, which inspired the research.

1.5 Research Objectives

The overall aim of this project is to assess if Art Teachers are suitable for introducing, promoting and delivering P&C as a subject area in post-primary education in Ireland. Secondary to this is to determine if there is a desire among art teachers for such a move.

The specific objectives of this work are to:

1. Assess if art teachers are aware of Programming & Coding (P&C)/ICT at second level
2. Particularly, are Art Teachers aware of the NCCA Draft Syllabus in P&C?
3. Are ICT Teachers aware of the NCCA Draft Syllabus in P&C
4. Assess if Art Teachers have a desire to Teach P&C/ICT
5. What areas of ICT are currently taught in Ireland
6. If there is a remit for Art Teachers to engage in ICT education
7. Determine the aptitude of Art Teachers to engage in P&C.

2 Chapter 2 – Literature Review

2.1 Introduction

Compared to other countries, our ICT and in particular our coding skills are somewhat lacking. Many companies note a lack of available skilled Irish graduates for the roles they bring here (Percival, 2013). This could likely be attributed to the lack of any formal computing curriculum at second level in comparison to our international peers. Indeed, on the 24th May 2013, the Irish Examiner reported that there was a 'severe' lack of ICT skills in Ireland – as highlighted by 4,500 vacancies in the sector – due to the lack of skilled professionals here. This is only growing, and expected to reach full employment by 2018, according to Jobs Minister, Richard Bruton, ahead of ESRI numbers citing 2020 will be that year (Bodkin, 2015, 2014).

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> "*In its 'ICT Skills Audit', the non-profit training promotion agency, Fastrack to IT (FIT), estimates that there are 4,500 vacancies in Ireland's ICT sector. These are not being filled, because of "the severely limited supply of suitably skilled applicants". The study, based on a survey of 38 IT multinationals and SMEs, shows that many of the vacancies are at the intermediate-skills level, and could be filled after training programmes of six to 24 months."* – (Percival, 2013)

In 2014, the OECD drafted the "Skilled for Life?" report, an international survey conducted in 33 countries as part of the Programme for the International Assessment of Adult Competencies (PIAAC). This was the first comprehensive international survey of adults' skills, and about 5,000 people who were aged 16 to 65 took part. The findings were rather telling. The report comes to the conclusion that Irish adults are "lagging behind" in relation to key literacy, numeracy, and key ICT problem solving skills. In numeracy, out of 24 comparable countries, Ireland comes 19th. On top of this, 20% of Irish adults have poor literacy skills. This ratio is higher among the unemployed, caught in a low skills trap with poor levels of adult learning. (Burke, 2013; OECD & Gurría, 2013; Careersportal, 2013)

As mentioned in Chapter 1, there is a drive to endorse STEM in technology, economy and industry in Ireland, and this inevitably trickles down into the school system. It is important in many ways as it is a keystone of the Irish economy at the present, and will be in the future. The Irish government has invested heavily in training and up skilling for those out of work. In 2014, 6000 springboard places were offered, with a cost of €23 million (HEA "Springboard To Launch 6,000 Back Into Education and Jobs", 2014). The digital skills initiative, springboard courses, blue-brick courses, and momentum were created to up-skill many people either looking to change career, or transition from job-seeking to what was the one of the few areas of the Irish economy that experienced growth in Ireland in the height of the recession – the I.T. industry. Research carried out by Amarach, estimates 150,000 new jobs would be created by direct and indirect positions related to the Digital Economy by 2020 (Amarach, 2014).
In education this approach is also evident and relevant. STEM is further enhanced by a STEAM approach – incorporating Art and Design to the STEM equation, this type of work can be seen in the canteens and recreation areas of Multinationals like Google, or Facebook.

2.2 STEM and STEAM approaches in Education

There is a main drive for the promotion of STEM education at the minute – Science, Technology, Engineering and Mathematics education, with Junior Minister, Sean Sherlock announcing investment in this area via the launch of the STEM Education Review Group (Moroney, 2013). Minister Sherlock committed to "*The STEM Education Review Group will explore the potential of Research into STEM Education, particularly at primary and post primary level*" (Moroney, 2013).
The Group, chaired by Professor Brian Mac Craith, President of DCU, is also tied into Literacy and Numeracy in Ireland. It is believed that promoting and boosting these educational methodologies and competencies will help boost industry and effectiveness of the future workforces (Percival, 2013). Many Multi-national companies, and indeed many start-up businesses now based in Ireland come from the Technology sector, and as most business is online, the need for good

software engineers and web technologists is high (O'Brien, 2014), but as mentioned earlier, Ireland lacks the level of suitable graduate candidates for these roles.

Michelle Hennessey in October wrote an article on a report from the Committee on Jobs, Enterprise and Innovation, which had said that there is a need to boost the level of information and communications technology (ICT) literacy among teachers (Hennessey, 2014).
The article continues to state: *"The report found that there is a significant gap between the ICT skills which are taught in our schools and those that are required to take up job opportunities in the technology sector. According to a 2008 inspectorate report, only 25 per cent of post-primary teachers rated themselves as having intermediate or advanced IT skills"* (Hennessey, 2012), which may indicate, a skills boost for all teachers, in particular those teaching computing, is badly needed. Senator Deirdre Clune, in the article noted it will be "impossible to further the development of computing within schools unless we have teachers who are capable of showing their students how to engage with the creative tools of ICT" (Hennessey, 2012). The article stated there was then an estimate of 4,500 unfilled IT vacancies across the country (Hennessey, 2012). The key use of the word "creative" by Senator Clune indicates that we now more than ever **need** a STEAM based approach.

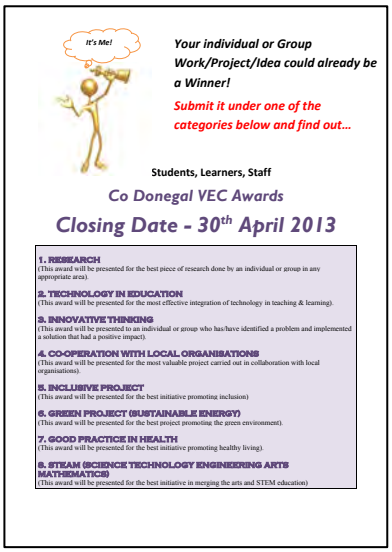

Figure 2-1 ***Source: http://goo.gl/OAuJ7r***

There is also another approach to STEM education – STEAM (Science, Technology, Engineering, Arts and Mathematics education). There are even some educational providers, such as Donegal ETB (ETB, 2013) who aim to pioneer and promote a STEAM based approach. It is thought that by using the Arts to enhance STEM education, you offer new perspectives and a creative problem solving approach, whilst addressing key literacy and numeracy competencies, while improving visual literacy. STEAM based approaches unite artistic and scientific endeavours, quantifying into a newly rounded perspective of creative coding. Knowledge of Art and Design practice can, in particular help with Usability Design – how a developer makes a site more user friendly and less likely to bounce (look and leave), User Experience – ensuring the user has the best and most clear navigation of the screen they are viewing it on, and User Interface which ensures that users can properly interact with content methodologies. Colour and light can effect mood and generate specific messages and target certain audiences more effectively than a blank canvas.

2.2.1 Pushing for STEAM

STEM to STEAM, is a movement, which aspires to help transform society for the 21st Century via Art and Design, in the way Science and Technology did in the 20th Century. Championed by RISD (Rhode Island School of Design), the main objectives of the STEAM education movement (Sharapan, 2011; RISD, n.d.), are to:

- Transform research policy to place Art & Design at the centre of STEM
- Encourage integration of Art & Design in K–20 education
- Influence employers to hire artists and designers to drive innovation

K-20 stands for kindergarten to PhD level, or more succinctly the entire education ladder (NFQ 1-10 here). Many companies and practitioners have adopted a STEAM approach to what they do. As noted on the Stem to Steam website, it is early photographer Charles Nègre (1820–1880), who RISD cite as a classic example of the combination of art and science in one creative personality. Nègre once wrote, "Where Science ends, Art begins". Nègre had trained as a painter, but was fascinated by daguerreotypes, the pre-cursor to photography. By analysing the chemistry and physics behind the photographic process, as well as the mathematics of the optics and engineering of the camera, he could be classed as an early pioneer of STEAM (Anon "Steamnotstem", n.d.).

In Ireland, there is a push to promote STEAM education in various institutions and educational authorities. Research suggests Donegal ETB (ETB, 2013) is one such authority pioneering STEAM, due to its close proximity to Derry City home of one of NI's fab lab's for innovation (NerveCentre, n.d.; MIT, n.d.). Derry is seen as a UK/NI base of innovation and creativity. Donegal ETB's staff is in an advantageous situation in that they can co-operate and co-create with their peers across the border in a different system, and learn from their innovations. Derry City hosted Digital Derry, as well as the location of the 2014 CultureTECH weeklong celebration of creative innovation, which took place September 15th to 21st 2014 (a weeklong celebration of creative innovation, 2014.culturetech.co, 2014).
Internationally Massachusetts Institute of Technology (MIT) has many facets of what is deemed STEAM friendly, notably "Lifelong Kindergarten" (LLK) and Logo, which Developed into Scratch (Anon, "Scratch MIT Education site", n.d.)

2.2.2 Potential Benefits to the Education System

Based on the theories behind STEAM, such an approach to education in Ireland could better benefit Literacy and Numeracy much more than pure STEM. An extract from Dáil questions on 20/02/2013, the then Minister for Education, Ruairí Quinn stated that Literacy and Numeracy is a national priority under the Fine Gael/Labour programme for government. He stated that:

> *"The Government is determined that all young people will leave school able to read, communicate orally, in writing and in digital media, and be able to understand and use mathematics in their everyday lives and in further learning."* - (Quinn, 2013)

It is important to note, digital literacy sits in with both literacy and numeracy, and has relevant skills pertinent to these areas. Minister Quinn stated that in the proposed Junior Cycle review, to become the Junior Certificate Schools Award (JCSA), replacing the current Junior Certificate, the Department aspires that new methodologies and practices, centred around ICT use and exposure, would revolutionise post-primary education – with a view to removing rote learning practices, and introduce more intrinsic educational goals, higher levels of Literacy and Numeracy through better involvement in learning with a greater emphasis on Maths, English, ICT (through P&C as well as an explicit course in Digital Literacy), and the Sciences.
While it is important to assert that the STEM initiative in Ireland, which in several respects acknowledges many of the same related matters, it could arguably and should, explore the possibility of closing the digital education gap – at least as a beginning – by turning toward the arts: specifically, art and design educators. Thus, considering a STEAM approach. This works amazingly in the USA. Toni Wynn and Juliette Harris note that:

> *"As children age, they become curious about mathematics, chemistry, and physics -- how squiggles on a page or screen tell us about the weather or how to make atoms collide. In conventional curriculum, high-level math is a solo effort. When science and math become entirely quantitative, there's a disconnect between math and real-world applications. The quantitative orientation is less interesting to those who lean toward art and right-brain-oriented areas. In an interdisciplinary collaborative environment, STEAM can make mathematics less threatening while maintaining its rigor. STEAM is a response to the question, "How do we encourage teaching that creates stimulating and inspiring classrooms, where students engage in problem solving and use their creativity and imagination to address interesting and important subjects, and where teachers push students to continue learning long after the exam is over?"* (Wynn & J, 2013).

An example of how STEAM benefits literacy, numeracy and combines STEM with Art and Design methodologies is the Scratch programming language, developed from its precursor, Logo, by the Lifelong Kindergarten group at Massachusetts Institute of Technology (MIT). Scratch is a visual programming language developed by MIT (as discussed in detail in section 2.6.2.3). It is used to teach the basics of programming like building blocks, with different code blocks performing different functions and tasks. Scratch was introduced here by both LERO and Coder Dojo, which will be discussed in more detail later on.

By using an artistic, creative approach, instead of a purely scientific mode, it is possible to teach to a variety of learning types, while engaging in a visual, more expressive way of developing outcomes. By channelling creativity into the sciences, and scientific methods into artistic ones, one can achieve more rounded outcomes that meet the statements of learning (Appendix J). By adding arts to the equation, a more rounded, enriched environment can be experienced in schools, and in progression society, similar to approaches in the UK (Kehoe, 2014). As evident in scratch, coding can be incredibly creative, and requires the use of abstract "out-the-box" thinking.

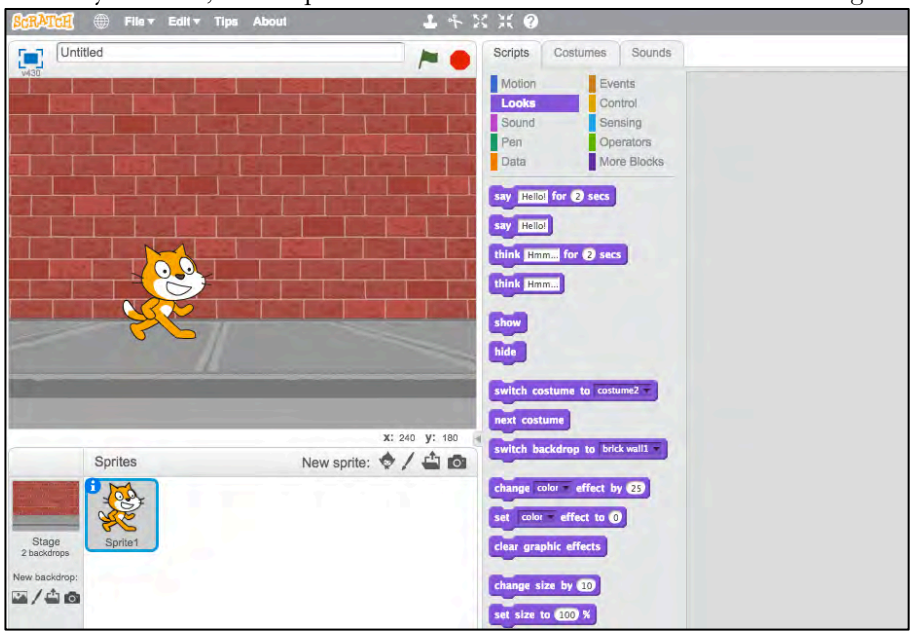

Figure 2-2 ***Source: scratch.mit.edu/projects/editor/?tip_bar=getStarted***

The Scratch Ed website, shares a lot of information and experiences of teachers and educators who use Scratch. It not only has application to motivate and inspire learners, but also engages them on another level. US based teachers Janice Mak stated "*I had my students design something for a kindergarten teacher in my district. She requested that they create an animation of a popular children's book in time for Halloween (note: real-world = timeframes and real deadlines!). They used Scratch and drew their own costumes and animated the story with the text. This experience inspired them and motivated them on a completely different level than a class task normally would*" (Mak, n.d.). Closer to home, in the UK, pioneered by Irish entrepreneur, educator, and trainer, Seamus O'Neill, creator of the website www.scratchfromscratch.com mentions on the CESI forum that:

"*You ask 'Are there any noticed improvements from the engagement?' Not yet. But between 12th and 21st January 2015(sic) there will be. Visiting a school in the top 5% in England, I asked myself, "What do you offer a school that has everything?" – Offer them something no one has ever seen until now! I've had instant success in bringing that unique something into that school. You can read their response above (cited)*

> *"Thank you for coming in yesterday to talk to me about your new Scratch and Maths adventure. I was very impressed with your ideas and the thinking behind what you have created and what you are planning on developing. The idea of the children coding and doing maths at the same time is great. The cross-curricular links you presented as possible were endless and I can see how it will be invaluable to schools to have these at hand for children and teachers to access. Planning would become a lot easier saving time for not just one, but also two and sometimes more subjects.*
>
> *We would be happy to host the training session with our staff on Friday 16th, Monday 19th and Tuesday 20th January. We would also be happy to host it through local learning partnership, too."*

The demand to have it was instant. You can see that above too. I've taken the same concept and my plan to disseminate it into other schools, in-service providers and even into a software development company… It's clear I have a solution that gives the teachers the confidence they lack. This is no accident. It's something I've been working on for over a year"(O'Neill, 2014). O'Neill mentions in particular that the course developed is in high demand, which is rather exciting. He also cites that "*In England, teachers' confidence in teaching Computing At School is non-existent. Computing At School is a new statutory subject on the curriculum since*

September 2014." With such an approach applied in Irish primary and post-primary schools, levels of literacy, numeracy and learning could be greatly boosted.

2.3 How Coding and Programming can aid Literacy and Numeracy

One of the key directives of the Department of Education is to improve the literacy and numeracy of people studying in the Irish education system. As mentioned previously, according to DES (Department of Education & Skills), 2010, p. 9).

Minster Sherlock, on the launch of the STEM Education review Group, stated of Literacy and Numeracy: "*The Literacy and Numeracy Strategy, published in 2011, has increased the amount of time devoted to literacy and numeracy in the classroom. There has also been significant investment in Continuing Professional Development (CPD) in order to fully implement the Literacy and Numeracy Strategy…I believe that further academic research into STEM Education along the primary/post primary continuum will help build upon these positive changes*" (Moroney, 2013).

2.3.1 Literacy

Literacy is not just the ability to read, it envelops much more than this. Literacy also refers to oral skills, the ability to converse and communicate something effectively.

> *Traditionally we have thought about literacy as the skills of reading and writing; but today our understanding of literacy encompasses much more than that. Literacy includes the capacity to read, understand and critically appreciate various forms of communication including spoken language, print, broadcast media, and digital media.* - (DES (*Department of Education & Skills*), 2010, p. 9).

2.3.2 Numeracy

Numeracy, not just refers to mathematical ability and the ability to use logical information to solve mathematical problems, but also refers to spatial awareness, and awareness of the world around you. This can be applied to both art, and skills related to coding (DES *(Department of Education & Skills),* 2010, p. 9*)*.

2.3.3 Fundamentals of Coding for development of Literacy and Numeracy

Coding and Programming offer a myriad of different skills that can enhance literacy and numeracy. A key element of programming is logical problem solving. This helps not only numeracy skills, but also helps to improve literacy by scanning code syntax for errors.

The Junior Cycle short course draft syllabus states:

> *Students develop and improve their numeracy skills by actively engaging in problem solving activities and exploring mathematical and computational ideas. As students create programs, they learn core computational concepts such as iteration and conditionals and mathematical concepts such as variables and random numbers. They learn how to think algorithmically and logically, how to abstract ideas and how to describe patterns and relationships during tasks and projects.*
>
> *Students develop literacy skills through discussion during class activities that include offering opinions, making oral presentations, writing reports and reflecting on the work in their personal learning journals. Students develop strategies for organising information so that they can understand it, incorporate it into their work and improve their capacity to search for information from different sources. - (NCCA, Draft Syllabus in P&C, 2013)*

2.4 Is it right to teach Programming and Coding at post primary?

Coding is arguably difficult. It is a skill taught and assessed uniquely at third level in Ireland. Some more conservative educators might feel that coding should be kept uniquely as a third level study *"The teaching of coding is something I think a lot about – Irish teachers don't necessary want to take on teaching code and the resources are not there"*(Kennedy, 2014).

Irish Maths Teachers' Association chair, Brendan Doheny, referring to joining Project Maths and Applied Maths with a Computing module, cited *"a number of reservations, however, including the inclusion of the computer science module which he said would be difficult to administer in the absence a major investment in equipment by the department of education. "The most sensible thing would be to drop that option," he said"* (Humphreys, 2015). This is the case in areas like Medicine, or Psychology, as it is a niche study

area, and therefore it could be argued that this should remain within the remit of the third level sector.

This viewpoint would be contrary to international practices, as well as the advent of movements like (open source) Coder Dojo in Ireland – co-founded by Bill Liao and James Whelton (CoderDojo, 2013), to assist young people to learn how to be creators' not just users, which has spread internationally. Similarly in the U.K. pupils studying in the school system now must learn compulsory Computer Science (DfE & Gove MP, 2014; DfE, 2013; BCS, 2013), which has replaced the previous ICT syllabus that existed before it. Pupils now learn the basics of coding from the age of five (DfE, 2013), therefore developing an awareness and appreciation of coding earlier on. People will be more literate in the area, as arguably programming or coding is somewhat abstract and alien to the general masses, as it is a relatively new area of study, unlike areas like Medicine.

There are many young Irish coders, with no "code schooling" outside Coder Dojo, who have developed simple applications, with amazing global results, such as Cork based app iOS developer/Coder Dojo aficionado Harry Moran, who at age twelve, developed PizzaBot gaming app knocking the ubiquitously popular "Angry birds" and "Call of Duty" off the top of the Apple App Store's charts. There is an ability to develop and to code at an early age, like learning any language or skill. - (English, 2013). Coder Dojo founder, James Whelton argues:

> *"I quickly saw the massive interest in programming from people my own age, younger and older. When we founded in mid December, we had 40 students show up to the first session, which grew over time. Basic programming and web development was taught, students were taught by other students who'd grasped things faster than others and it was an extremely lively environment." - https://coderdojo.org/who-we-are/* (CoderDojo, n.d.).

Other initiatives like the "Hour of code", a high profile, US led initiative where many celebrities endorsed P&C for Computer Science education week via the website csedweek.org. As mentioned above, Entrepreneur Seamus O'Neill states that in the UK, at primary level, Principals and teachers are very enthusiastic about the cross curricular potential of using a tool like "Scratch from Scratch" (CESI, 2014). This succinctly suggests that not only is Coding and Programming suitable for a post-primary audience, but also at primary level, via tools like ScratchJr in the article "*Can you teach a child how to code – even if they can't read yet?"* (Barry, 2014). "*Coding is and programming is arguably as difficult to learn as playing with Lego is, they all start off as blocks, its how you combine the, make patterns, and build*" (Whelton, 2012). It is all about how it is pieced together.

While it could be argued that students are taught using a variety of ICT tools and techniques, and this generation now grow up with technology, indirect learning by osmosis is not the best learning outcome. While it is generally observed that younger generations are much more adept with technology, as they grew up using it, one must consider that if they show such proficiency without tuition, this does not mean students know all they could, or should know in the area as highlighted in Mitch Resnock's Ted Talk video (Anon, "Let's teach kids to code", n.d.). The UPC/Amarach research discussed in the next section, adds more reasons why now is the time to embrace coding in our schools, if they are this good without formal schooling, how good *could* they actually be, by not providing proper education in this area?

Another startling statistic, as raised by Paddy Cosgrove, founder of the digital Web Summit, held annually in Dublin is that currently one in five computing graduates are unemployed. In face a computing graduate is three times more likely to be unemployed than graduates from other areas. On investigation of this startling statistic – occurring when demand in technology skills was at an all time high- he came to this conclusion:

> *"So why is unemployment so much higher for recent computing graduates compared to those of less practical courses like philosophy and religion, and almost every other course available in our third level institutions for that matter?*
>
> *There are numerous theories: teaching quality is below market need; student quality is below market need"* (Cosgrove, 2013).

This could be due to the fact that there is no foundation to build on from post-primary education; those in computing are likely only honing the skill for three to four years before entering employment. Compared to other countries, which teach computing related skills from a much earlier age, it could be argued that Irish graduates don't have the foundation skills necessary to be

of market quality. Teaching needs to be improved, both at tertiary level, but also introduced in post-primary.

2.4.1 Amarach Research for UPC and Coder Dojo

Amarach Research with UPC (UPC-PR, 2014; Amarach, 2014; Moynihan, 2014) set out to scope some research, based upon parents' knowledge and awareness of the Coder Dojo initiative. The results are interesting, in that they highlight a lack of knowledge within the general public about the initiative. It also, intriguingly brings awareness to the importance most parents would link the ability to code and future success of their children – in tandem recognising that it will be a major skill to have for future success.

The research showed that almost one-in-five people (17%) were aware of the Coder Dojo initiative. Depending on the part of the country, knowledge of the initiative varied slightly, but still at its highest, only one-in-five (20% in the Rest of Leinster) are aware of Coder Dojo (Figure 2-3). Age also played a part in this, with older respondents being more likely to be unaware of Coder Dojo. (Appendix B – UPC/Amarach National Survey Results).

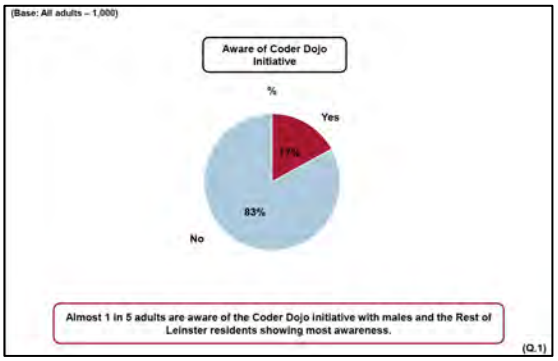

Figure 2-3 ***Source: UPC/Amarach research, Appendix B***

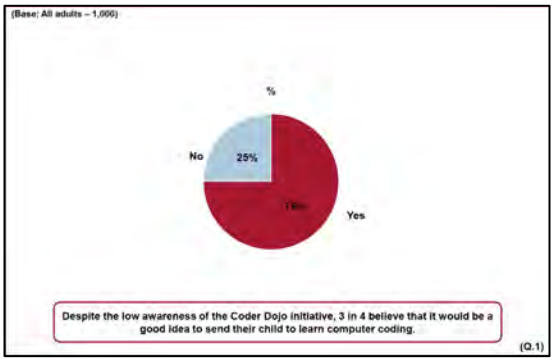

Figure 2-4 ***Source: UPC/Amarach research, Appendix B***

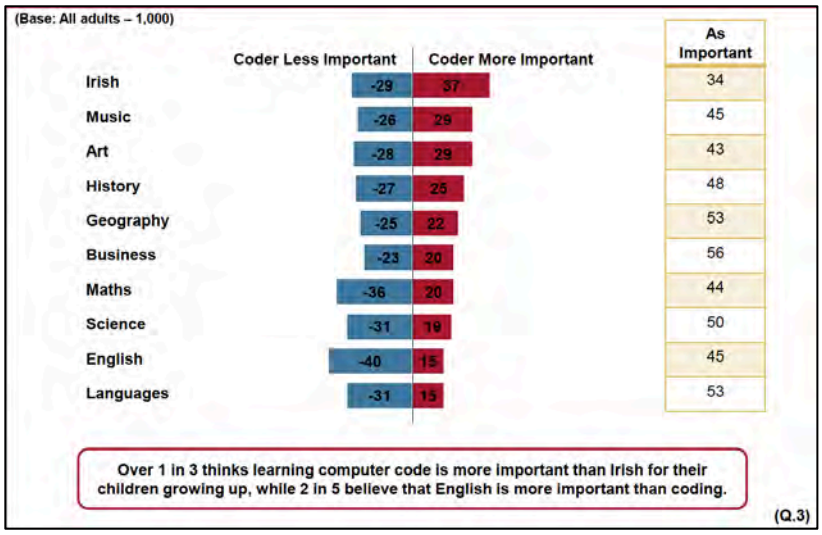

Figure 2-5 ***Source: UPC/Amarach research, Appendix B***

In stark contrast to this, three-in-four respondents thought it would be beneficial for their child to learn computer coding (Figure 2-4).

It was also interesting to discover what the respondents thought of Coding in relation to the mainstream post-primary subjects generally offered in schools as displayed in (Figure 2-5).

2.4.2 Overview of survey

Just under one fifth of survey respondents are aware of the Coder Dojo initiative. It is mainly people in Leinster, outside Dublin, and males aged 24-44 who have the highest levels of awareness of the initiative. Despite this low awareness, three in four respondents nationally feel it would be benefit their child to be sent to computer coding classes, with males, and surprisingly older respondents keener on the idea.

The majority of mainstream post-primary subjects are seen by the majority of respondents to be as important as computer coding for children growing up nowadays, with the exception of Irish, where one-in-three feel coding is more important to children growing up nowadays. Two-in-five believe that English is more important than coding, however (figure 2-5).

2.5 ICT Education internationally – The UK Example

In the UK, as of September 2014, a new compulsory Computer Science programme replaces the previous ICT syllabus (DfE & Gove MP, 2014; DfE, 2013; Naace et al., 2012). This is a scheme that will cover all primary and post primary levels in the UK, from Key Stage 1 to Key Stage 4. From age five, pupils will learn the fundamentals of coding and programming (DfE, 2013). The Education Secretary who enacted this, Michael Gove, aspires that such a change will enable UK citizens to be better able to deal with the changes and opportunities the booming I.T. sector offers (DfE & Gove MP, 2012).

In Northern Ireland, as reported on the U.tv website in June of 2014, the NI Digital Action Plan, which aims to create 20,000 IT jobs over the next five years, suggested that children in Primary education learn to code from age eight (UTV, 2014). The article suggests that this would help to both grow the local digital sector, as well as cope with the demand for skilled IT graduates, as the sector grows in both the Republic and north of the border. The Digital Action Plan was compiled by Momentum – the NI digital sector representatives – who worked with the Stormont administration to deliver this policy in the Momentum NI Digital Action Plan chaired by Rob McConnell, (McConnell, 2014).

2.6 Computer Education at Present In Ireland

According to Teaching Council of Ireland data, there are 579 registered post-primary Computer Skills (IT or ICT) teachers in Ireland, although not all of these teach computing, nor may they be teaching at all. The vast majority of these are teachers who have this as a secondary subject, or have qualified outside of Ireland, with ICT in their ITE qualification combinations (CESI, 2014). According to data from the Central Statistics Office (CSO), via the DES, there are 362 schools at Junior Cycle Level and 232 schools at Senior Cycle Level schools teaching in Ireland at post-primary. 50 schools teach IT to Junior Certificate level, but this is not offered to Senior Cycle Level (this is the ICS-Skills syllabus as presented in 50 pilot schools, as cited on the ICS Computing in schools website (Anon, 2013)).

2.6.1 Primary Education and ICT

Primary schools have some initiatives and policies (FitzPatrick, n.d.), though most of this is using ICT to enrich education, not teach ICT fundamentals. The main focus of ICT (skills) education at present happens in Post Primary level. Some school with staff that have an interest in the area promote initiatives like Coder Dojo, but this is done in an ad-hoc and often extra-curricular basis, and there is no formal curriculum for ICT (skills) education at primary level, despite calls for it to be put in place (Bielenberg, 2014).

2.6.2 Post Primary Education and ICT

Post Primary ICT education in Ireland to date has been somewhat minimal and vague. Computing is not a state-dictated compulsory subject, in the way other equivalent subjects are. "*Non-examination subjects at junior cycle include Physical Education, Social, Personal and Health Education and Computer Studies, while Religious Education is available both as an examination and non-examination subject*" (Halbert, 2005).

Most dedicated computer education happens in first year, or Transition Year, and usually follows the ECDL syllabus, or may incorporate some graphic design, but rarely, yet increasingly more common is the basic introduction of Coding programmes such as scratch or basic web design with

HTML. However some still focus on typewriting skills, touch-typing and the speed at which you type (wpm or words per minute), this is not to be confused with Typewriting, which is an examinable Junior Certificate exam subject with a syllabus. Currently, as seen in Table 2-1, 362 schools offer computer studies and Junior Cycle, and 232 at Senior Cycle. Schools in Ireland have recently started Minecraft clubs, following from the UK trend (Ludwig, 2013). Minecraft is a game/service now owned by Microsoft, which uses computer skills to build environments and create (Gilbert, 2014). Areas that are taught during tuition time, mostly in the Transition Year curriculum are outlined below. The demand for Minecraft in Ireland is huge, with an initial amateur conference selling out and being repeated in other areas due to demand as cited in the article "*This Irish mum set up a Minecraft convention*" (Freeman, 2014).
There is also an opportunity to develop short courses in specific areas of ICT with the Junior Certificate reforms via the JCSA (NCCA, n.d.; Quinn, 2014), although at Junior Certificate there is a non-examinable computer studies option, devised by the school, there is no NCCA syllabus listed. *"Non-examination subjects at junior cycle include Physical Education, Social, Personal and Health Education and Computer Studies, while Religious Education is available both as an examination and non-examination subject"* (Halbert, 2005).

Computer Studies in Schools						
Year	2009	2010	2011	2012	2013	2014
Junior Cycle						
Computer Studies	426	405	400	388	379	362
Senior Cycle						
Computer Studies	295	274	275	265	253	232

Table 2-1 ***Source: CSO/DES 2014***

2.6.2.1 Initial ECDL and Office style skills

During the late 90's there was a drive in schools (that had computer labs) to teach students how to effectively use Microsoft Office suite applications, like Word, PowerPoint, Excel. This led to the inclusion of ECDL as a module/subject over Transition Year or a number of years in school so that pupils had a computer qualification. As time went on, and pupils became introduced to technologies at an increasingly earlier age, the need to teach ECDL has waned. ECDL – or the European Computing Driver Licence (internationally ICDL) has seven modules (ICS Skills, n.d.). The modules teach and assess key office skills – Slideshows, Word Processing, Spreadsheets and Databases, as well as Using Email and the Internet, IT Security and IT user skills. Schools tended to offer basic ECDL (any 4 modules) or all seven depending on timetabling. Some schools do not offer the official ECDL certification, but follow the course content, as to award certification; the assessors/centre needs to have both ECDL, and several members of staff who can teach and test ECDL, which is not always practical or doable in a small staff room.

2.6.2.1.1 New ECDL

ECDL has since evolved due to the nature of the growth of people's ability to use technology, and how original ECDL is out of date (ICS Skills, n.d.), considering. ECDL now offers three strands. ECDL offers three learning profiles comprising various modules, which are individually certificated (Ecdl.ie, n.d.).

- Base (Computer Essentials, Online Essentials, Word Processing and Spreadsheets);
- Standard (Presentation, Using Databases, IT Security, Online Collaboration, Image Editing, Web Editing, Project Planning, 2D Computer Aided Design and Health Information Systems Usage);
- Advanced (Advanced Word Processing, Advanced Spreadsheets, Advanced Database, Advanced Presentation)

Some schools have now started to offer this new syllabus – as viewable and searchable (dependent on ECDL syllabus) via the ECDL from ICS Skills website (ics-skills.ie/ecdl/location.php), however this syllabus offers rudimentary computer skills, as opposed to coding and programming skills.

2.6.2.2 Digital CRE8OR - http://www.digitalcre8or.ie/

Digital CRE8OR is an international project, like ECDL, which was brought into Ireland and distributed as a course via IADT Dún Laoghaire's Fís department (FIS, n.d.). Digital CRE8OR sets out to build upon ECDL and introduce more cutting edge media based technology skills, linked to video, sound, motion, animation and other relevant digital communication modes. The Digital CRE8OR award is the equivalent of an NFQ level 4 (National Framework of Qualifications, QQI, n.d.).

> *"The award is given by the British Computer Society (UK) at GCSE Level 2, which is mapped to Level 4 on the Irish National Qualifications Framework by the National Qualifications Authority of Ireland (NQAI)."* - http://www.digitalcre8or.ie/awards.html *07/11/2014*

Some schools, through the Art Department and ICT departments deliver this course, as it can have applications to LCA and LCVP programmes, there are no concrete numbers on this, but it is somewhat lower than ECDL and other areas, as shown in survey analysis in section 4.2.9.

2.6.2.3 Scratch

Scratch is a visual programming language that makes it easy to create interactive stories, animations, games, music, and art and share these creations on the web. By using visual code blocks, learners are introduced to the basic functionality and formulations of code. From this, learners can and have grasp more complex code languages such as JavaScript, Objective-C, or PHP.

Scratch was developed by MIT labs in order to teach the basics of programming in a more visual way. In Ireland, LERO – the Irish Software Engineering Research Centre has been promoting and helping students to discover and learn about computing and software development via their Education and Outreach Program. *"The goal of the LERO Education and Outreach Programme is to challenge, inform and effectively engage the public and stake holders in the discipline of software engineering. Our goals are motivation and aligned with Science Foundation Ireland's 2020 vision and strategic goals"* (Anon, "LERO" n.d.).

LERO developed a range of lesson plans and schemes to help introduce software development to students via Scratch programming. To help further promote this initiative, LERO issue scratch participation certificates for those who successfully complete this course.

Scratch providers in several Coder Dojo venues now also are looking at teaching digital numeracy through Scratch (www.scratch.ie).

Some schools have developed short Transition Year courses incorporating Coder Dojo schemes, via Scratch and LERO's guidelines to promote P&C in schools. Scratch's STEAM based approach makes computing easier to digest and learn, and ties in with other areas without isolating them. The scratch language works because it is purely visual and artistic, using sound and motion to produce, learn and output a product, which is a program in the form of a game, animation or other tools (O'Connell, 2014). While LERO promote with STEM in mind, it is clearly, by its visual nature, a STEAM technology, more so, highlighting the creative potential of coding.

2.6.2.4 Transition year modules

Scratch programming lends itself beautifully to Art methodologies, by virtue of the fact that it is a visual programming language, and can create e-books, animations, games and other creative outputs, which could align to an art product. Scratch can also be used for the teaching of programming animations, interactive stories and games, and may be a unique vehicle to enable art teachers to develop basic P&C skills. With Scratch, anyone can program their own interactive stories, games, and animations — and share those creations with others in the online community – embracing the ethos of the open source movement.

Art teachers, while developing their skills may wish to teach this as a transition year cross-curricular project, combining animation and programming, or like US teacher Janice Mak, create an e-storybook for younger learners, passing on the power of learning and creating a visual outcome.

Transition year students have been traditionally offered ECDL or ECDL like skills training as well as some Digital Photography or basic HTML skills.

2.6.3 Subject Specific ICT

Some subjects have compulsory ICT elements (NCCA, n.d.; T4, n.d.), these include but are not exclusive to Typewriting at Junior Certificate level and Design and Communication Graphics (formerly Technical Drawing) at Leaving Certificate level, who according to CESI and TechnoTeachers websites, use SolidWorks or AutoCAD. The NCCA Policy (as found on www.ncca.ie) on ICT in Post Primary is as follows:

> *At post-primary level, the role of ICT in curriculum and assessment is a key focus of the on-going review and implementation of junior and senior cycle education. In revising subjects at both junior and senior cycle, syllabuses and associated guidance continue to be 'ICT proofed' establishing the role of ICT as a teaching and learning tool (e.g. dynamic geometry packages in Mathematics); as an integral part of the curriculum (GIS in Geography), or as an integral part of curriculum and assessment (e.g. CAD in Design and Communications Graphics, Music Technology in Music).*

In the review of senior cycle education, there is a particular focus on the role of ICT in the review of subjects and the development of short courses and transition units. Both the DES and NCCA that some of the short courses developed will have a significant ICT focus, for example Media Communications Technology, propose it. As transition units will be developed around current good practice in schools, it is envisaged by both the NCCA and DES that there will be many models of excellent ICT based transition units. Minister Quinn affirmed this in the announcement of the JCSA (Hogan, Quinn, 2013). The review of subjects will continue to be conducted within an ICT proofing framework to ensure that opportunities for integrating ICT into subjects are developed, where appropriate. The role of ICT in the recording of key skills encountered through subjects, short courses and transition units and in the assessment of subjects and short courses will be investigated in 2015 (NCCA, n.d.).

The role of ICT in the preparation and presentation of coursework for assessment purposes (second assessment components) is being investigated. The question of how student achievement in ICT would be recognised and rewarded is currently under discussion. One possibility is that of students developing a cross-curricular portfolio of work, prepared and presented using ICT in a range of subject areas for both day-to-day curricular activities and for work being presented for state examinations purposes (that is, second assessment components). The possibility of students re-using these items of work in the context of assessment of ICT is currently under discussion. The development of the Framework for ICT in Curriculum and Assessment provides opportunities for the assessment of ICT at post-primary level. Subjects like Design and Communication graphics, already use the SolidWorks program to let Leaving Cert students develop a portfolio to be assessed of digital work, which may be printed, though this is no longer a necessity (NCCA, n.d.; CESI n.d.; TechnoTeachers, n.d.).

2.6.4 Digital Content Enrichment and Social Media

Schools, particularly new ETB schools have adopted the use of Edmodo, Google Docs, or Moodle to distribute learning material. Resources are shared online, in the cloud and accessed by pupil's personal devices (The Differences Between Edmodo, Google Docs and Moodle, Williams, 2012).

Many teachers use the power of twitter to teach, create discussion and for example, One teacher uses twitter to boost use of French resources in her modern foreign language (Duckworth, n.d.); teacher Tom Barrett, who has used twitter, Skype and other technologies since 2008, via his blog "ICT in my Classroom" where twitter informs the bulk of his "personal learning network" (Barrett, 2008).

2.6.5 ICS Skills Pilot Scheme

In June 2012 a group of teachers and educators met, at the behest of ICS Skills (ICS Skills, "*Education solutions for Schools and Colleges",* n.d.), to start a process of creating a syllabus in computing for the Junior Cycle of Irish post-primary schools (separate to, but influenced by the NCCA Draft Syllabus). To this process members of the Syllabus Working Group brought their passion for the use of Information Technology in education in all its forms.

As a pilot programme ICS Skills ran two modules – Digital Media and Computational Thinking – in 45 second-level schools around the country between September 2012 and May 2013 (ICS Skills, "*Education solutions for Schools and Colleges",* n.d.),

Arising from pilot's success and the overwhelmingly positive feedback from schools ICS Skills is now offering an expanded version for September 2013. ICS Skills has developed a 50-hour course in Computing, incorporating both Digital Media Literacy and P&C. As a pilot scheme, it was taught in 45 schools nationally (ICS Skills, Education Solutions for Schools and Colleges, n.d.).

2.6.6 CODER DOJO

Coder Dojo is an initiative set up by Cork coder and entrepreneur James Whelton (Whelton, 2012), which sets up a base for children to learn P&C outside of school as an extra curricular activity. Coder Dojo is run on a voluntary basis as a means of promoting and developing a love of P&C among young people, both in primary and post-primary.

2.7 Outside of Post Primary Education

Outside of post primary mechanisms, there are a number of ICT training schemes, though primarily these do not involve coding or programming.

2.7.1 SOLAS/FAS/ETB

Currently, SOLAS who is the national training body, replaced FÁS (Wade, 2011; Walshe, 2013), now operated by the regional ETB's or Educational Training Boards (formerly VEC's or Vocational Education Committees). SOLAS offer a variety of web design courses such as Web Communication with Adobe Dreamweaver, as well as ECDL, Photoshop, and other similar program operation courses but none in practical coding, according to the training skills website. These are also available to anyone to partake in, though if one is in full-time employment, there is a fee (Fás website, n.d.).

2.7.2 ICS SKILLS

As aforementioned, Irish Computer Society's ICS Skills (ICS-Skills.ie, n.d.) is a computer training body. They currently partner with forty schools in a pilot programme to teach as a small short course, Information Communication Technology in second level schools, which is separate, but a pre-cursor to the draft junior Certificate Syllabus in P&C. They also offer courses outside traditional school environment, and administrate ECDL in Ireland. The main office is in Mount St in Dublin, but they have training centres nationally.

2.8 Springboard, Blue-Brick and Momentum and other courses

Currently, Third level and other short or privately run courses offer up skilling with introduction and development of P&C aptitude. The National College of Ireland (NCI) is currently one of the biggest providers of courses like this (ncirl.ie, n.d.). Several companies are also providing practical, hands-on courses. Such courses usually are a lower level on the NFQ. DevStream.io is a new company, currently training people in a variety of tech modes, such as Android and Java development, Rails Development, Front End development, and other I.T. skills. In conversation with CEO Liam Hurrell, he disclosed that there is high demand for courses like these, and very high success rates of people entering employment after successful completion of the courses.

2.9 Skills associated with P&C

Several skills are associated with Computer Science, P&C. There is a list cited in Appendix F – Skills Needed in Programming). The key skills as listed there include:

- Attention to Detail
- Stupidity, the ability to assume nothing, and think like a computer
- Good Memory
- Ability to abstract, think of several levels

2.10 Teaching Council

The teaching council of Ireland was established via the Teaching Council Act, 2001, and first came into being, and registered teachers in 2006, viewable on the "Irish Statute Book" (Anon, n.d.). To be able to teach you must be registered by the teaching council, under section 30 of the 2001 act (Anon, n.d.). It is a self-financed body, paid for by teacher fees stated on the Teaching Council Website.

2.11 Parallels between Art and Coding Methodologies

Art and coding have a lot of similar methodologies and skills associated with them. Art uses the art elements, which include: Pattern, Colour, Rhythm, Harmony, and Balance. These paradigms are also present in coding, albeit on a more calculated level. The ability to look at and create physical sequences and series, such as drop pattern designs can help one to understand more complex fundamentals of basic coding, such as loops, conditional statements and so on. There is a clear parallel.

Figure 2-6 Source: Coleman Group

Why art educators? Because increasingly the preparation college art students receive as they work toward degrees fosters digital literacy (NCAD, n.d.; DIT, n.d.; IADT n.d.) – in fact, multi-literacies.

From a pragmatic standpoint, Art Teachers are a segment of the education industry, which are underemployed, underutilised, and for example vulnerable because they tend to teach fewer courses than other regular, full-time staff, and may only have 6-hour contracts (Kehoe, 2014).

On top of this, there is a parallel between the artistic design process, taught at second level, and iterative software development approaches, like RAD or Agile. Group based problem solving is common to both methodologies as well. In the paper by James and Marjorie Bequette, *"A Place for ART and DESIGN Education in the STEM Conversation"*, the many corollaries between STEM and Art are highlighted and shown.

> *"The "cultural, pedagogical, and economic aims" of art education (Vande Zande, 2010, p. 248) will be best served when art educators communicate both within their field, and to a broader audience of educators working in the STEM disciplines, that design education as taught in art classrooms can be far more than compositional (i.e., the formalist arrangement of design principles and art elements). When visual arts teachers also approach functional design as part of the curriculum, the aesthetic nature of the design process is revealed in the products, environments, graphic design, information architecture, and interactive situations contemporary designers create. Teaching design in art classrooms is as much the business of art education as teaching the artistic/creative process"* (J. Bequette & Bequette, 2012).

While the 20th Century was about science and discovery, the 21st Century will be noted for its creative approach in developing ideas and realising outcomes *"yet clearly there is national interest in integrating the arts into science learning (Piro, 2010; White, 2011; www.exploratorium.edu; www.moundsviewschools.org). "Hands-on, imaginative approaches to science education, using many of the methods used in the creative arts, have been shown to attract and retain young people in the fields of Science, Technology, Engineering and Mathematics," opined organizers of an NSF-sponsored conference of scientists, artists, educators, business leaders, researchers, and policymakers in 2011 (www.artofsciencelearning.org). Attendees explored how the arts can be engaged to strengthen STEM skills and spark creativity in the 21st-century American workforce"* (J. Bequette & Bequette, 2012).

2.12 Art Teachers as a mode of Delivery

This research aims to look at initially, what may be an unconventional approach in relation to the group who could/should teach P&C at post-primary level. In Chapter 4, the discussion will analyse the findings of a survey of 104 Qualified Art Teachers, who were contacted via the Art Teachers' Association of Ireland (ATAI). Research done by MAVA Graduate Sharon Kehoe illustrates a variety of trends in Art Education, looking at what makes an Art Teacher employable, limited to Graduates of the NCAD from 2009-2014, within the Leinster region. The rationale for this is that under analysis, the majority of Art Teacher posts were in this region, and that the NCAD has a national remit in relation to Art and Design Education, and is the only third level institution in Ireland that trains both consecutive and concurrent initial teacher training. The study showed that a large number of art and design graduates fail to get employed, a trend on-going since the 1990's.

> *"A study of cross-graduate unemployment in the United Kingdom (UK) in the 1990's noted that "in most of the years for which data is available, unemployment among new Art/Design graduates has been significantly higher and more variable than among other Arts graduates, though Art/Design trends do not follow the general pattern closely" (Bee and Dalton, 1990, p.31, cited by Kehoe, 2014).*

Many of these graduates opt to engage in teacher training, along with the cohort involved in consecutive training via the four year Bachelor of Arts in Art and Design Education. Due to the numbers that are training nationally, there is a large number of trained teachers each year from all institutes in Ireland, as advised by the HEA – almost 100 graduate as Art Educators each year (Hyland, 2012; Kehoe, 2014)) *(see Appendix C).*

NCAD has this year changed their policy (NCAD, 2011; Kehoe, 2014), with the PGDE now a Professional Masters in Education (PME), and the Bachelor of Arts in Art and Design Education now becoming a joint course, numbers on those courses have grown, and in the case of the joint BA in Fine Art and Education or Design and Education, the numbers have trebled in intake compared to the 2013 number of 12 (NCAD, 2014). In year two of the course there are 33 students, in year one there are 36. This means that in 2017, there could be an additional 24 graduate teachers on top of the usual numbers. This may, however, offset the reduction of PME graduates, as there will be zero graduates of concurrent education in 2015, but this will return to an annual graduation number in 2016.

The HEA list does not include those who qualify in the UK and return to Ireland, or those qualifying in institutions in Northern Ireland. Art teaching graduates ought be aware of such statistics in other to make informed career choices. Currently, no third level training institution in Ireland that trains Art Teachers, qualifies them in a second subject (Teaching Council of Ireland, 2014).

> *"The question of what kinds of graduate are needed is paramount, and graduate unemployment rates provide a key indicator of any imbalance between demand and supply in the labour market*
> *(Bee and Dalton, 1990, p 31, cited by Kehoe, 2014)*

One of the main problems, as highlighted by Kehoe's research, and further illustrated by the survey carried out as part of this research (see Appendix A – 7.1.3), seems to be that Art Teachers tend to only be qualified in one subject. Those that teach a second subject tend to be CSPE/SPHE – subjects that do not need an additional qualification to be taught – and areas, which are usually reserved as timetable fillers, and younger/less permanent teachers tend to be timetabled with it, as well as those whose subject is in decline

> *"For some principals CSPE is assigned to teachers with unfilled slots in their timetable. "CSPE is allocated to teachers who have spare capacity on their timetable."*
> *"CSPE is a stand alone subject. Younger teachers appear to be timetabled for this more than senior established teachers. When timetabling is tight, CSPE is slotted in after other subjects requiring more time per week. (sic)" (NCCA Survey of Teachers and Principals on CSPE, 2002, p.10.)*

Hypothetically, Art Teachers are in a unique position, unlike other subjects, in that they could train to take on another subject, in theory ICT with P&C, based on the NCCA draft syllabus, could be a conduit and a solution to the skills shortage of teachers able to teach this area. According to Kehoe's research, those hiring teachers tend to have "a partiality for degrees in education" (Rutledge et al. 2008, p. 254; cited Kehoe 2014), so from either perspective, an additional subject would be beneficial to any teacher, to make them more employable.

According to Central Statistics Office/DES figures, at Junior Cycle, 672 schools offer Art, Craft and Design, while at Senior Cycle 288 schools offer Art with Design option, and 447 offer Art with Craftwork Option and schools can offer both options, one option, or neither. With the level of choice at Senior Cycle, it could be safely assumed that this number is lower than 672, but higher than 447, but there is no way to substantiate this without in-depth research. The study also shows numbers for the Design option falling, with numbers for the craft option growing. Notably, schools can offer both options at the same time.

Numbers of Schools Offering Art						
	2009	2010	2011	2012	2013	2014
Art, Craft, Design	-	-	679	674	671	672
Art with Design	343	324	319	302	297	288
Art with Craftwork	417	425	432	434	443	447

Table 2-2 ***Source (DES/CSO 2014)***

2.13 Multiple Intelligences theory

The benefit of STEAM can be further illustrated by looking at the multiple intelligences theory of Howard Gardner. Having an awareness of this theory can cater for multiple learning styles. Gardner developed the theory of the several types of intelligences that can be utilised in teaching and learning (Smith, Mark K. (2002, 2008) 'Howard Gardner and multiple intelligences', *the encyclopaedia of informal education*). These include:

LINGUISTIC INTELLIGENCE
Linguistic intelligence involves sensitivity to spoken and written language, the ability to learn languages, and the capacity to use language to accomplish certain goals. This intelligence includes the ability to effectively use language to express oneself rhetorically or poetically; and language as a means to remember information. Writers, poets, lawyers and speakers are among those that Howard Gardner sees as having high linguistic intelligence. In relation to ICT and P&C Linguistic intelligence is improved via learning how to correctly write computer code, and articulating how one does this.
LOGICAL-MATHEMATICAL INTELLIGENCE
Logical-mathematical intelligence consists of the capacity to analyse problems logically, carry out mathematical operations, and investigate issues scientifically. In Howard Gardner's words, it entails the ability to detect patterns, reason deductively and think logically. This intelligence is most often associated with scientific and mathematical thinking. Logical-mathematical intelligence is one of the key areas in which P&C and ICT education can greatly help to improve. By looking at functions and developing loops, learners can better understand simple logical problems and functions, increasing their ability to solve abstract mathematical problems in a greater way.
SPATIAL INTELLIGENCE
Spatial intelligence involves the potential to recognise and use the patterns of wide space and more confined areas. In relation to ICT, having and developing spatial intelligence can be fuelled through mapping, designing and planning a computer program, and envisioning how it will operate – via the design process.
INTERPERSONAL INTELLIGENCE
Interpersonal intelligence is concerned with the capacity to understand the intentions, motivations and desires of other people. It allows people to work effectively with others. Educators, salespeople, religious and political leaders and counsellors all need a well-developed interpersonal intelligence. The NCCA draft syllabus, which encourages teamwork, group exercise and collaborative work, which enhance this ability, and has implications for the world of work. "Teamwork is encouraged throughout all four strands. Students should collaborate, peer-explain, seek feedback, provide feedback and reflect on their work. Practical, hands-on learning activities should be in evidence across all strands of the course. Theoretical concepts can be reinforced through practical work and projects. " – NCCA Draft Syllabus
INTRAPERSONAL INTELLIGENCE
Intrapersonal intelligence entails the capacity to understand oneself, to appreciate one's feelings, fears and motivations. In Howard Gardner's view it involves having an effective working model of ourselves, and to be able to use such information to regulate our lives. Within the remit of post-primary education, and P&C as a taught subject area, intrapersonal intelligence would be developed by a self-reflective analysis, encapsulated in stream four of the syllabus.

Table 2-3

2.14 Statements of Learning (SOL)

As cited in Appendix J – Statements of Learning, there are numerous statements of learning now endorsed by the NCCA. By engaging with these statements thought a STEAM based approach, they can interact and reinforce one another.

By incorporating a STEAM approach, it could be argued that statements not related initially to curricular areas, could be blended into those subjects via a creative STEAM based approach.

2.15 Aptitude Assessment and Theory of Assessing Aptitude

Aptitude assessment is an important measurement tool to assess whether a person is adept in a particular area. A key marker of this in Ireland is school entrance assessments – as entrance exams were banned by the Department of Education and Science (as it was then called) in 1985 (Ó'Fátharta, 2014). These measure pupil aptitude in various logical questions, dividing them in classes for streaming purposes, based on their abilities.

Some third level institutions also assess ability through a variety of means (Central Applications Office, n.d.). Art colleges use portfolio assessment to ascertain an individual's ability to show a logical thought process, creativity, and skill in a range of media. Some colleges also have a drawing exam and interview, to ascertain if an individual is suited to the area in which they will be working on completion of the award. Some also issue a specific brief to be followed to gain entry, such as the NCAD portfolio brief. People applying to do post-graduate medicine have to sit the Graduate Medical School Admission Test (GAMSAT), a gruelling aptitude test quizzing the candidate on a variety of scientific and medical knowledge (GAMSAT-ie.org, n.d.).

2.15.1 Aptitude Testing in Industry

In the I.T. industry, many companies will issue a code test or an aptitude test to see if a developer has the skills needed to perform as required for the company/client in question. Sometimes the Berger Aptitude test (Anon, n.d.), will be used to indicate high ability, but this is tests knowledge, not potential.

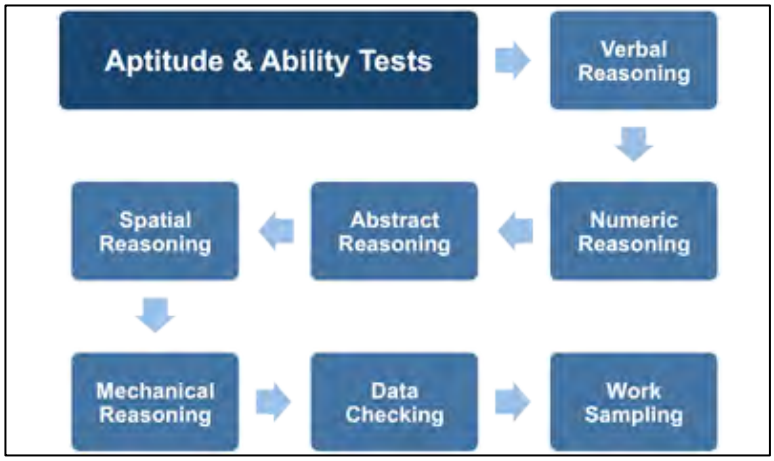

Figure 2-7 ***Source: http://www.psychometric-success.com/images/AA0104.png***

Internationally, there are tests used in education such as the Haberman Pre-screener and the Gallup Teacher Insight Survey, both of which aim to measure the future effectiveness of teachers, using multiple choice questions, covering a range of factors, subject knowledge, conscientiousness, extraversion, general efficacy and personal efficacy (Rockoff et al. 2008, cited Kehoe 2014). Tests can measure certain metrics: whether one can come to solutions quickly, measured by time; whether you have keen judgement skills in relation to a task or scenario, where there may be no "wrong" answer, but some answers are more correct than others. Aptitude tests, aptly assess different aptitudes and abilities of a candidate, mainly; verbal reasoning, spatial reasoning, abstract reasoning, numeric reasoning, mechanical reasoning, data checking, and work sampling (see figure 2-4). Depending on the industry field, some of these categories are more relevant than others, and in some fields, not at all relevant. While researching, the author came across many exemplars of programming aptitude tests. An excellent example of setting out how to conduct an aptitude assessment, and the rationale and benchmarking mechanisms put in place to ensure it is fit for assessing a standard of excellence within the target field is the paper *"Music Therapy Career Aptitude Test"* (Lim, 2011). Setting out to assess on a quantitative basis, Lim administered the test to those studying to become Music Therapists. The outcomes prove that the test was reliably high.

> *"The criterion-related validity was examined by comparing the MTCAT scores of music therapy students with the scores of 43 professional music therapists. The correlation between the scores of students and professionals was found to be statistically significant. The results suggests that normal distribution, internal consistency, homogeneity of construct, item discrimination, correlation analysis, content validity, and*

criterion-related validity in the MTCAT may be helpful in predicting music therapy career aptitude and may aid in the career decision making process of college music therapy students" (Lim, 2011).

2.15.2 What are the aims of an aptitude test

An aptitude test should be a rigorous but fair way of assessing someone's ability to complete a specific task, or gauge his or her ability to function in an environment. In relation to the assessment of P&C ability, one ought to be able to prove ability in a range of areas, related to this, such as problem solving. According to Stanley, "*Several employment tests are available to assist organizations in the selection process …(displayed* Table 2-4*)… Organizational life is more dynamic and complex than ever before. Hiring the right person for the job is essential, so it is vital that management use every effective selection method available. Cognitive abilities testing can make the employment selection process more successful (sic)*" (Stanley, 2004)

Employment Tests	
Job knowledge tests	Measures specific job-related knowledge.
Psychological tests	Attempts to measure personality characteristics.
Psychomotor tests	Measure a person's strength, dexterity and coordination.
Proficiency tests	Measures how well a person can do a sample of the work required.
Cognitive abilities tests	Measures knowledge base, ability to learn, and problem solving skills.
Polygraph tests	Records physical changes in the body as test subject answers questions.
Interest tests	Compares test subjects' interests with interests of successful people in a specific job.

Table 2-4

2.15.3 Types of Questions asked

There are a number of commercial aptitude test samples in Appendix K – Aptitude Test Questions, kindly provided by DevSteams.io. Several colleges also offer programming aptitude tests, for graduates as well as those hoping to come onto third level courses. The University of Kent has a very exhaustive set of examples that are available to try – they also explain the logic and rationale behind the theory. By incorporating a mix of the types of questions available both in commercial testing applications, as well as using the rationales used in tests, like the sample test from the University of Kent (Anon, n.d.).

These questions must also match up to the necessary skills in P&C, as seen in Appendix F – Skills Needed in Programming. It would also be beneficial for the test to match or represent the Statements of Learning as visible in Appendix J – Statements of Learning.

2.16 Conclusion

Art and coding have a lot of similar methodologies and skills associated with them. Art is assumed to be creative, however coding required its own creative approach to develop new ideas, tools and innovations. Art uses the art elements, included in this are Pattern, Colour, Rhythm, Harmony, and Balance. These paradigms are also present in coding, albeit on a more calculated level. The ability to look at and create physical sequences and series, such as drop pattern designs can help one/people/students understand more complex fundamentals of basic coding, such as loops, conditional statements and so on. There is a clear parallel, particularly evident when teaching elements like the Golden Ratio (J. Bequette & Bequette, 2012).

To ascertain one's aptitude in a specific area, the person or persons must be put through a battery of questions or tasks to ensure their ability to perform (Stanley, 2004). In the next chapter, it will be necessary to determine and analyse the most appropriate procedures for developing an aptitude test, and determining teacher attitudes and abilities.

3 Chapter 3 – Methodology

3.1 Introduction

Research will be conducted over a variety of means. Initially, an action research approach, conducting a general survey to get basic feedback was initiated. Action research applied to the art education industry will give a clean and concise view of what is required and what needs to be done to further direct the research. By further analysing results through testing and evaluation, a decision about what sort of application to develop can be ascertained.

By developing and delivering quantitative research from the author's focus body of Art Teachers (teaching and non teaching) from the ATAI's mailing list, with the potential reach to the 724 schools in Ireland (DES school numbers, 2014) via its' 250+ members as of October 2014. The research could focus solely on Dublin – where the majority of Computer Science Industry is based, arguably with potential for access to schools. This however would only offer a limited view, and in her research, focussing on Leinster, Kehoe got very limited response (Kehoe, 2014). It is arguable, that those outside Dublin are not given the potential to respond. The Greater Dublin area represents over two-thirds of the population of the state.

After completing the Literature review research in Chapter 2, the initial idea of developing a basic application catering to the needs of Art Teachers who wish to teach or learn P&C to teach, would be flawed without first assessing whether there is a need for this. Quantitative survey results are needed before deciding how best to progress. While delivering a skeleton application with teaching and learning functionality, it may be more feasible to create an application that can assess the potential for someone's ability to code. Based on survey feedback, an application will be developed to cater to this.

3.1.1 Personal Bias

The author is a qualified and experienced Art Teacher. Having gone through the learning process of the Higher Diploma in Web Technologies, and subsequently the Masters in Science in Web Technology, there is potentially an understandable bias towards this topic, yet it also fuels the desire to research this topic. Hypothetically, it could be assumed that Art Teachers are naturally capable of coding due to their skill sets. Several of the author's peers from the MSc in Web Technologies have an Art and Design background, which piqued an interest in this research topic.

3.2 Theoretical Framework - NCCA Draft Syllabus – SEC Framework

The NCCA have developed a draft syllabus in P&C. This syllabus is taught over 100 hours of contact, and has four stands. This will be a part of the framework towards data analysis, and be the basis of the quantitative analysis to be undertaken.

3.2.1 Aim of the course

The course aims to develop the student's ability to formulate problems logically, to design, write and test code, to develop games, apps, animations and websites and, through these learning activities, to learn about computer science. Each subject has its own "statements of learning". Those for P&C as set out by the NCCA are highlighted below.

Statements of learning (SOL)	
Statement	Examples of related learning in the course
The student devises and evaluates strategies for investigating and solving problems using mathematical knowledge, reasoning and skills. ***SOL 17***	Problem solving and computational thinking are central to this course. Students use their mathematical knowledge, skills and understanding when figuring out, evaluating and implementing solutions to particular problems.
The student describes, illustrates, interprets, predicts and explains patterns and relationships. ***SOL 16***	Students interpret and describe patterns and relationships as they solve problems and create projects using algorithms and programming languages.
The student brings an idea from conception to realisation. ***SOL 23***	Students engage in brainstorming and planning activities, move on to the design, development and test phases, culminating in the creation of a project solution to a particular problem.

Table 3-1 ***Source: Draft Syllabus NCCA P&C***

3.2.2 Computer Science Introduction

In this strand, learners will discover the digital world around them – the importance of computers in contemporary society and the lives of people day-to-day, around the world. They will then be introduced to the concept of being a coder in a step by step process; learning how to start programming and how to develop basic algorithms, using open source solutions.

3.2.3 Let's get connected

Connections are at the core of P&C, so in "Let's get connected" the emphasis is on how computers connect with one another, and how the Internet exists as files that generate pages online, as we see them in our browsers. The also look at how computers work, and store data in bits and bytes, with the potential for some logical development by investigating alternative numbering systems, such as binary, hexadecimal, octal etc…

3.2.4 Coding at the next level

This stream enabled learners to deal with more complex computational and programming paradigms. Documentation of work and analysing code is key in this stream, emphasising key literacy and numeracy skills. Computational operators that deal with code logic, such as Booleans, assignment and arithmetic are touched on here. Looking at data structures such as arrays and lists, as well as developing functions that combine logic and data structures.
Analysing code to assert issues or areas where code can be improved, thus touching on industry concepts such as DRY and COC.

3.2.5 Problem solving in the real world

Ideally, any syllabus should relate to real world practice. In this stream, participants will collate what they have learnt already and create a software project, incorporating learning from all previous strands, building a robust piece of software, going though a team based software development life cycle.

3.3 Research Design Methodology

The research will assess the potential of Art Teachers as a base for educators of ICT, due to measuring and instilling a need for STEAM methodology and practices, as opposed to STEM. Theoretically, using Art Teachers' methodologies and practices for instructing, adopting and teaching P&C in second level schools would be a better application of this.
The research will initially assess the P&C draft Syllabus, as this has the most relevance to the Master of Science in Web Technologies award.

3.3.1 Describe, analyse, interpret and evaluate the procedures

The main concept of the application supporting this research aims to assess the suitability and ability of a user to code and program based on P&C paradigms and logic tests. This has evolved from the initial idea, where a support forum would enable users to learn how to code, as well as guide learners how to do this. There are a number of very well created web applications that do this in a far more superior way than this research project could produce in the time allocated, in fact, there would be no benefit in pursuing such a roadmap.

3.3.2 UPC Amarach Research Study

In Chapter 2, the UPC/Amarach survey report was commissioned in order to determine awareness of Coder Dojo, as UPC committed to creating a Coder Dojo centre in its Sandymount head office. While doing this, Anna-Maria Barry, the co-ordinator of the project commissioned a survey of parents, in relation to their understanding of coding as a potential subject in schools, but also their knowledge in relation to the Coder Dojo initiative. The results of this study were telling.

3.3.2.1 Desire for Coding as a Subject in Second Level

Ireland at present is the epicentre of computing, programming, and coding, and has been dubbed the "Silicon Valley" of Europe (Kennedy, 2011, 2012). One third of parents think that Coding and Programming is more important than learning Irish, and three quarters of Irish parents think that Coding would be an important skill for their child to learn (Amarach, 2014).
Ireland's current education system does not formally offer Computing, Information Communication Technology, P&C, Digital Media Literacy or any facet of Computer Science as an examinable, awardable, certifiable element. The National Council for Curriculum and

Assessment in Ireland (NCCA) has developed two short course syllabi for Junior Cycle, *Programming & Coding*, and *Digital Media Literacy*, with a view to more concrete Computer Science syllabi being drafted in the future, with further review of both Educational Cycles at post-primary level.
In gaining a sample from Art Teachers throughout Ireland, a broad spectrum of opinion from a variety of age ranges can be determined. Equally, the differentials between career length, and a desire to up skill and add variety to what one can offer can be assessed.

3.3.3 Art Teachers as a mode of delivery

A STEAM based approach, as discussed in Chapter 2, would tie in greatly with the perspectives and methodologies of Art Teachers. Problem solving is not only a numerical, mathematical skill, but also a creative aesthetic ability, which is honed and developed through the methodologies of the artistic design process, which is not dissimilar to rapid application development. It is an iterative cycle, which assesses the progress of a project or artwork, and then looks at what route is best taken, outlining the key advantages and disadvantages of partaking a specific route, before art and design work is carried out. Art methodologies also encapsulate 21 of the 24 Statements of learning devised by the NCCA and DES (Appendix J – Statements of Learning).

3.3.3.1 Intrinsic Reasoning

It is important to develop a quality teaching force. The level and quality of education a country has, has a profound influence on a country's economic, social, and cultural development. Understandably, the level and variety of educational experiences a country provides can affect the quality of a country's workforce, and impacts on how nations meet the challenges in the world of the 21st Century (Kehoe, 2014).
Government and education policy focus on obtaining the best learning experiences for learners, therefore it is widely agreed that teacher quality is the most influential factor affecting student development (OECD, 2005; cited Kehoe 2014).
Rolf and Hobbs' UK survey of school vacancy advertisements found that there were precise stipulations of what job requirements specified. The top four were willingness to teach to the relevant age or ability, the ability to teach a second subject (something the majority of Art Teachers do not have), contribute above and beyond the requirements of their subject, and taking responsibility for a group of students (Rolf and Hobbs, 1999).

3.3.3.1.1 Learning Outcomes for Teachers Learning P&C

Teachers who wish to teach computer science skills will themselves gain a whole new skillset, while enhancing already existing knowledge. It will enrich problem-solving skills and enable better cross-curricular motivation. Extrinsically, it can boost the profile of the Art Teacher in the schools. Learning P&C, and teaching it can lead to interesting Art, Craft and Design projects, particularly when one considers the new Junior Cycle structure. As mentioned in Chapter two, US teacher, Janice Mak tasked her students with creating digital content for kindergarten level students, where a learning project not only influenced one group, but also had other outcomes for other areas of the education system.

3.3.3.1.2 Learning Outcomes and benefits for post primary students learning P&C

There is currently a study on the outcomes of using P&C in a school to boost digital numeracy and literacy. Seamus O'Neill, founder of Scratch from Scratch and co-author of ubiquitous maths text, Mathemagic based in Navan, Co. Meath is currently conducting research in this area, but it will not be ready until February 2015, which may be late for this research. As discussed in Chapter 2, the pilot schools in the UK have already come back with very positive feedback, in relation to not just student attainment, but also teacher engagement.
There are a number of concerns the DES has with the state of literacy with current post primary students, which is reflected in the results Ireland attained in the previously mentioned OECD PIACC report. A range of exposures best services post-primary students, so by engaging in coding could help increase levels in maths, English and so on.

3.3.3.2 Extrinsic Reasoning

As stated in 3.1, there is a personal bias that could be questioned in this research. Regardless of this, theoretically there is space in Irish education for a STEAM based approach – not solely a STEM approach – therefore utilising Art Teachers and their methodologies, and practices for instructing could be transformational for the adoption and teaching not just ICT in general but specifically P&C at post-primary level. The DES p-pod database states that there are 724 schools in Ireland (as of September 2014), and 672 currently offer Art to Junior Certificate according to the DES P-pod database. There are currently 1,594 teachers registered to teach Art, as shown in Table 3-3, which will be explored in detail in the next section.

3.3.3.2.1 Economic Value

Kehoe in her research discovered that American research conducted by Staiger and Rockoff, in 2010 illustrates the fact that increases in the effectiveness of a teacher results in higher achievement among students, with a monetary value to the government of $33,000 to $760,000 over a students' lifetime (Kehoe, 2014). This re-doubles as an intrinsic value, as *'teachers, and how they are educated to the core of the implementation of national programmes for sustainable economic growth and prosperity'* (DES, 2012, cited Kehoe 2014).

Kehoe reveals that international reports recognise the high levels of unemployed graduate teachers, (highlighted by OECD, 2005; Donaldson 2010; ASTI, 2012; cited Kehoe, 2014). Research indicates that teacher oversupply and reduced employment opportunities may reduce the number of high calibre candidates entering the field (NCCA/Sahlberg, 2012). The Scottish Government in 2011 suggested that those who train to teach ought to be taught transferrable skills, which would allow graduates to obtain employment in other areas outside of education.

As mentioned previously, there are 724 post-primary schools in Ireland at present, and 672 of those schools offer Art, Craft and Design as a subject. This number has dropped since 2011, when 679 schools offered the subject (CSO/DES, 2014). As this number is obviously dropping year-on-year, yet numbers of Art Teachers are growing, there is scope for an additional use for Art Teachers to be identified.

Art Teacher Growth Numbers							
	2008	2009	2010	2011	2012	2013	2014
National College of Art and Design	9	16	11	14	9	13	12
National College of Art and Design (Art)	16	20	20	18	20	19	25
Cork Institute of Technology (Art)	26	27	25	29	28	31	27
Limerick Institute of Technology (Art)	26	28	30	30	28	30	29
Art Totals:	75	91	86	91	85	93	93

Table 3-2 ***Source: HEA Review on ITE training 2012, Kehoe 2014***

As visible in the HEA report and numbers of those graduating as educators every year – see Appendix C – HEA ITE Numbers – those numbers are growing each year. *The Report of the International review panel on the Structure of Initial Teacher Education provision in Ireland*, chaired by P Sahlberg in 2012, the problem of matching supply to demand specifically in Ireland, with some universities not adhering to quota recommendations for those entering teacher training courses, also referred to as Initial Teacher Education. This would go against international best practice, according to (Hyland, 2012).

It is hard to gauge an accurate number of those Art Teachers who are not working, for one reason or another. Kehoe states that in 2012, only 10% of Post Graduate Diploma in Education graduates, secured full time employment after course completion. Only 27% of all second level teachers of not have full-time positions, forcing many of those to emigrate (ASTI, 2011; cited by Kehoe, 2014). The NCAD is currently researching the levels of Art Education Graduate employment nationally at this time, yet no figures or research is available yet.

3.3.3.2.2 The IT Industry needs skilled IT workers

The IT industry also has a major skills shortage. As discussed in Chapter 2, in 2012 there were 5,000 vacancies that needed to be filled from abroad, as Irish workforce did not have the skillsets (Kennedy, 2011, 2012).

The Teaching Council has seen a growth of registered Art Teachers in recent years. This has steadied off somewhat in 2014, however this could be due to larger numbers retiring, which there are no figures for, specifically for Art.

	2011	2012	2013	2014
Art Teachers registered to teach Art	1,221	1,368	1,593	1,594
Number of Art Teachers	TBC	TBC	TBC	TBC
Number of Teachers employed in post-primary Schools and paid by DES funds	26,185	25,808	25,374	25,626

Table 3-3 ***Source: Teaching Council of Ireland, CSO***

The total number of Art teachers teaching in the system is not collected by the DES at this time (see Appendix A – Correspondence) however NCAD collects data on Art Teachers in Dublin as part of its CPD programme. The numbers of Art Teachers and schools in Dublin was kindly shared by the administrator of the programme, Nuala McCarthy on behalf od Dr Patsey Bodkin, co-ordinator of NCAD CPD for Art Teachers. As it stands, there are "168 schools in Dublin with 267 art teachers. Note that there may be some other schools in Dublin that do not currently have art as a subject and this would not be included in the number above" (Appendix A). If one was taking this number to be analogous to the national trend in Art Education, (note Kehoe cites the majority of jobs are in Greater Dublin), this ratio works out compared to schools nationally who teach art to Junior Certificate, this is 25% of the countries school's being in Dublin, if you apply that to the 267 employed art teachers, which are state paid, or privately paid, it comes to 1,068. This is a somewhat optimistic and if Kehoe's research is accurate, and implies 33% of Art Teaching jobs are in Greater Dublin, then this number would only come to 801. Both numbers are far below the 1,594 people currently registered as certified to teach Art in schools in Ireland. Without ringing every principal in the country, there is no way to get an accurate number, but the true number is likely between 800-1,050, based on calculations from the numbers given by NCAD, and Kehoe's research.

3.3.3.2.3 Potential Teacher Skill Conversion Opportunity

While ICT is taught in post-primary schools, there are many who are teaching soft skills such as ECDL. Hypothetically, very limited levels of computer coding take place otherwise, the phenomenon that is Coder Dojo would not have started. Apart from coding, ICT also can offer Digital Media skills, Design and Communication skills and Digital Art skills, which theoretically could be already within the skillset of an Art Teacher.

It would be plausible, therefore to develop an ICT training programme that enables an already qualified teacher to be allowed to teach ICT, including P&C at second level, before the syllabus comes into place, without anyone skilled to teach it. By teaching ICT/P&C at post-primary level, we are introducing skills that will benefit not just learners, but potentially the economy, via the growing and booming IT industry here. A conversion course might work like a springboard PGDip or HDip in Web Technologies. As cited above, it is evident there is an oversaturation based on teaching council numbers and estimates of those in actual employment, equating to half those qualified being out of work up to one third being unemployed. Many of these contracts, as evidence by Kehoe's research, highlights that most of jobs which were advertised, were for part-time hours, of eleven hours contact or less (Kehoe, 2014). This coupled with the growth seen in registration in recent years, as well as changes to ITE programmes, a problem is surfacing in Art Education, and this may be one solution.

3.4 Data Collection Methodology - Selecting a qualitative group

Initial research was informed by means of a survey, sent out to art teachers via the KwikSurveys software as a service platform. Based on this research, there are a variety of roadmaps that could be taken, however giving the timeframe of the study, one where a persons' aptitude to code should be then assessed on a qualitative basis. There should be a variety of user groups, and age profile to

base this off, and indeed, the application should assess if a person working in computer science scores highly in the application. Timing of the application's answering may also need to be a feature, so a database for collecting the data, a timing mechanism via JavaScript or time-stamping may also be important to include. It should also be assessed if a "page-per-question" approach, or a list of questions approach would be more desirable. Indeed, looking at if an AJAX powered questionnaire would be appropriate, however, this may not be necessary at initial alpha development stage. There is issue also with gaining qualitative data in relation to an aptitude test, as it gauges individuals as opposed to a broad overview of a target group's competence as a whole, therefore a quantitative approach to many users and groups may be more beneficial.

3.4.1 Data

In her research project (Kehoe, 2014), a major limitation for her data collection was the poor response rate of survey questionnaires.

> *"If a similar study were to be conducted in the future it would be beneficial to cultivate relationships with Art Teacher graduates, for example though the Art Teachers' Association of Ireland (ATAI), to help increase participation in the research and to take precautions to ensure higher response rates, which would allow the findings to be statistically analysable" (Kehoe, 2014).*

With this in consideration, it would be ideal to contact concerned teacher representation groups, namely though the Art Teachers' Association of Ireland [ATAI], who have a database of all art teacher members of the organisation. Those who are members facilitate best practise of Art. One of the main reasons for using Art Teachers as a base is that art teachers are qualified on graduation to teach just one subject, Art, Craft and Design. This can theoretically offer a shared skills base with P&C methodologies.

Another group to consider contacting is the CESI or Computers in Education Society of Ireland, who represent ICT teachers at all levels, in Ireland. This would give two focus groups to look at, and with which to compare responses.

3.4.1.1 The number of Teachers Teaching Art in Ireland

Kehoe, in her research deduced that there are about 368 Art Teachers in Leinster. The Teaching Council states there are 1,594 Art Teachers registered to teach in Ireland as of January 2015. Correspondence was sent to the DES statistics office, enquiring how many Art Teachers' are employed and how many Art posts there currently. The Department's statistics office replied that those statistics are currently not assessed, however this has been previously addressed in section 3.3.3.2.2.

3.4.1.2 Teaching Council

In order to be able to be hired as a primary, post-primary, or further education teacher in Ireland, and be paid by state funds, under section 30 of the Teaching Council Act, 2001, one must be registered to teach with the Teaching Council of Ireland.

> *"The Minister for Education and Skills, Ruairi Quinn T.D. commenced Section 30 of the Teaching Council Act, 2001 on 28 January 2014. Section 30 makes it a requirement for teachers to register with the Teaching Council in order to be paid salary by the State.*
>
> *This development paves the way for the commencement of the remaining sections of the Teaching Council Act, including those relating to the Council's investigative and disciplinary functions. The Council will therefore be empowered to conduct inquiries into the professional conduct of teachers."* (Section 30 and the Requirement for Registration, Teaching Council, n.d.)

It is therefore important to have an awareness of the Teaching Council's numbers, as these reflect those that are officially permitted to teach subject areas.

3.4.1.3 Art Teachers' Association of Ireland

The Art Teachers' Association of Ireland (ATAI), established in 1950 is the oldest subject association group in Ireland. It formally represents and includes qualified Art Teachers in its membership. There are currently over 300 members of the ATAI (January 2015), which requires a membership fee to be paid annually to be a member. The ATAI has members throughout Ireland, so are in an ideal position to distribute electronic communications via e-mail and their members website (www.artteachers.ie).

3.4.1.4 Computers in Education Society of Ireland

The Computers in Education Society of Ireland (CESI) was founded in 1973 and has continued to adapt and move forward in a speedily changing landscape. Technology has enabled the society overcome the twin barriers to participation (distance and time) and facilitated the development of a strong community online (CESI, n.d.). It caters for Computing in Education enthusiasts across the entire educational spectrum in Ireland. In an article about the history of the society, the surmising sentence reads "In summary CESI is about people with ideas about computers in education" (CESI, n.d.).

3.4.2 Findings

During the literature review process, it was deduced that there are a large number of Art Teachers; there are a number of registered ICT teachers, less than one for every school in Ireland. ICT is not a formal taught subject. There is no formal curriculum guideline for ICT in Ireland however there is a short course framework in the shape of the Draft Syllabus for P&C and the Draft Syllabus for Digital Media Literacy.

It was noted that the level of STEM literacy in Ireland is somewhat low (OECD/PIACC) and that theoretically, championing a STEAM based methodology, as observed in Donegal ETB, and in several American educational districts could prove beneficial not just to Irish learners and teachers, but also to society as a whole.

In the UK Computing at School was introduced at primary level in September 2014 as a compulsory element, replacing the optional ICT syllabus. At post-primary level in the UK, there is a Computer Science syllabus that is also now compulsory, replacing the "out dated" ICT syllabus, as described by Education Secretary of the UK, Michael Gove, in 2013.

From this basis it is necessary to carry out research in relation to the knowledge and ability of Art Teachers, and subsequently ICT teachers. It is necessary to devise a quantitative survey that can inform and measure ability and status of teachers of these areas in general in Ireland.

3.4.3 Action Research Meta Cycle

Action research is generally described as inquiry or research in the context of focused efforts to improve the quality of an organisation and its performance. Jean McNiff is one of the leading figures in this area, and has written extensively on this area since the 1980's.

In this instance, the research point of view will assess Art Teachers' roles, and attempt to ascertain if there is a desire or a need to up skill with ICT skills, primarily focusing on P&C as a modular subject in post primary educational establishments.

Action research typically is designed and conducted by researchers who analyse the data to improve their own practice. An action research style approach, applied to art education will give a clean and concise view of what Art Teachers' engagement and knowledge of ICT is, if there is a desire to develop this knowledge, and what needs to be done to further direct the research. The approach and style of questioning will be determined by a variety of factors. It may be necessary to employ a mix of quantitative analysis and possibly further exploring findings thought a qualitative analysis.

By developing and delivering quantitative research from an initial focus body of Art Teachers (teaching and non teaching) within Ireland, data can help influence the viability of this topic. Furthermore, it will be necessary to gain data from teachers who currently teach ICT in schools, to assess what their needs are, and indeed, what backgrounds they come from, and if their needs reflect Art Teachers needs. If teachers currently teaching ICT have aptitude and skills in P&C, there may not be a need for Art Teachers to up skill in this area. This follows the methodologies discussed in the book, "*Action Research: Principles and Practices",* (McNiff & Whitehead, 1992).

Initially, it was envisioned that an application would be built to enable teachers to learn some basic programming skills. The issue is that there are currently free online web applications that do this much better than an application that is generated in a thirteen-week research project. Such applications and websites include, but ate not exclusive to CodeSchool Codecademy, Team Treehouse, and Learnable, as well as Pluralsight, which is approved and endorsed by the NCI Moodle website, (moodle.ncirl.ie, 2014).

During the literature review process, it was deemed that developing an aptitude test, or looking at the viability of developing an aptitude test would be the best means of progressing the project.

Quantitative	
Advantages	**Disadvantages**
• Survey Findings can be statistically analysed • Survey data is deemed reliable • Self-administered questionnaires distributed online do no require researcher presence • Online tools allow data to be complied much faster	• Time and Research is necessary to develop an appropriate question methodology • Requires a large sample size • Can be subject to low response rates (20-30%)
Qualitative	
• Does not require a large sample size • Can be structured to suit researchers needs • Researcher can ask leading questions during the research task to get the information required.	• Obtaining reliable Data can be difficult • Verbal data is difficult to analyse • Interview transcription is time consuming

Table 3-4

3.4.3.1 Quantitative Analysis

Quantitative analysis is the questioning and analysis of a broad number of respondents. Typical modes of quantitative analysis include surveys or experiments. Based on the timeframe involved, a survey is the best mode of research for this project.

Survey/Questionnaire	
Advantages	• Reliable data source • Anonymity of process encourages honesty of response • Cheaper to conduct • Economic on Time consumption • Easy to access (online) • Easy for respondent to answer the survey (online)
Disadvantages	• Respondents may not complete survey • If poorly selected, target group may not give an accurate overview • Can deliver low response rate • Response rate is not controllable • Researcher is not present to clarify questions. Respondents "in the dark"

Table 3-5

3.4.3.1.1 Art Teacher Survey via the ATAI

With the co-operation of the ATAI, a survey to Art Teachers via the Art Teachers' ATAI mailing list took place, which was distributed to its then 250 members in October via Kwiksurveys. The response and feedback will inform the next steps involved in the research. It was important to survey Art Teachers to gauge what anecdotal information they can provide so that a plan could take shape.

3.4.3.1.2 ICT Teacher Survey via the CESI

Upon seeing Art Teachers' responses, discussed further in Chapter 4, it became apparent in November 2014 that there was a deal of information not present, and therefore it was required for further quantitative analysis will be derived from a similar survey, sent to ICT Teachers via the Computer Education Society of Ireland (CESI) mailing list, with ICT teachers able to provide a better outline of what is taught in schools' ICT Departments. It was necessary to survey ICT Teachers to gauge what anecdotal information they could provide to affirm there is a lack of skills in the area.

3.4.3.2 Qualitative Analysis

Qualitative analysis involves questioning and assessing a small number of respondents through a more rigorous detailed testing phases, to get specific data, that quantitative analysis is unable of achieving. While quantitative data gives a broad overview, qualitative data can give an insight into a particular section of a focus group. This will involve an aptitude test.

3.4.3.3 Hybrid of Quantitative and Qualitative Analysis

By using a hybrid of qualitative analysis and quantitative analysis, you can get a large groups opinion, and select a section of this, which can give you in-depth insights.

3.4.3.4 Interviews

Interviews are a novel way of gathering data from a variety of sources. They can offer niché perspectives. The can help back up data with real world experience and feedback.

Interview	
Advantages	• Allows a range of question styles • Allow researcher to probe further • Allows researcher to confirm responses • Researcher has opportunity to explain complex questions
Disadvantages	• Not reliable, does not give broad overview • Subject to bias, depending on interviewee • Incredibly time consuming to arrange, conduct, and analyse • Transcription can omit unwanted data • Subject to interviewee availability • Can be unworkable

Table 3-6

Interviews however, can take a lot of time to organise, and furthermore, transcribe. Sometimes interviews will not give you the data you need, and present you with a plethora of whole new issues to assess. With the short time frame of the research period, it may not be feasible to conduct formal interviews.

3.4.3.5 Focus Groups

Focus groups, like interviews, can give you a wealth of data, but can be incredibly time consuming. For such a short time frame, focus groups are not feasible.

Focus Groups	
Advantages	• Allows a range of questioning and investigations • Allows group and respondent interaction • Allow researcher to probe further • Allows researcher to conduct experiments • Researcher has opportunity to demonstrate and query an application, or theorem.
Disadvantages	• Subject to bias, depending on group size • Must be conducted on several groups to gain a consensus • Incredibly time consuming to arrange, conduct, and analyse • Transcription can omit unwanted data • Subject to interviewee availability • Recording tools can break or lose battery power • Must be very well planned to be effective • Subject to several persons being on a panel, collective availability.

Table 3-7

3.4.3.6 Experiments

Experiments can be used to test if an application or research topic can proceed. Experiments can also be used to create and analyse data. Experiments vary depending on the data collection method. Experiments are unlikely to be beneficial to this research topic in the initial stages, however, the aptitude test will be an experiment of kinds, and will assess the ability of several demographics. This will be discussed in detail in section 3.5.2.

Experiments	
Advantages	• Measures cause and effect • Can guarantee and control environment of what is being tested • Can be replicated in different settings/situations. The more times the experiment is repeated to the same result, the more verifiable it is. • Quantifiable
Disadvantages	• Artificial environment and scenario that does not reflect real life situations • Behaviour of participants may not reflect real life • May be biased so as to pass/fail

Table 3-8

3.4.4 Resources

Resource	Description	Link/Location
Art Teachers' Association of Ireland	The representative group of Art Teachers in Ireland. Important link for survey distribution.	www.artteachers.ie
Code School		www.codeschool.ie
Codecademy		www.codecademy.ie
Computers in Education Society of Ireland	The representative group of ICT Teachers and those with interest in Computing in Education in Ireland. Important link for survey distribution.	www.cesi.ie
Department of Education and skills		www.education.ie
GitHub	Repository for not only storing application code, but also a resource for learning and seeing how others develop applications.	www.github.com
Kwiksurveys	Survey and testing engine used to gather data.	www.kwiksurveys.com
NCAD Library	Library of the National College of Art and Design. As a graduate the author has access to theses and educational resources particular to Art education found here.	Www.ncad.ie/library
NCI Library	Library of the National College of Ireland. Many books, journals and other resources, as well as Information Project Officer Keith Brittle	www.ncirl.ie/Campus/Norma-Smurfit-Library
P-pod	Post primary education database of number of subjects, schools and other data particular to post primary education in Ireland. Key resource for figures relating to Education in Ireland.	www.education.ie/en/Schools-Colleges/Services/Returns/Post-Primary-Online-Database-P-POD-Project
Railscasts	Ruby on Rails resource and tutorial site. Key resource for developing the application.	www.railscasts.com
Teaching Council	Resource for finding numbers and figures of those recognised to teach subjects in Ireland. Upholds the professional standards of Education in Ireland.	www.teachingcouncil.ie

Table 3-9

SMART Objectives:		
Criterion	**Tasks**	
Specific	What:	Assess the ability for Art Teachers to be able to teach P&C
	Why:	Lack of Coding Teachers in Ireland Oversupply of Art Teachers in Ireland Two Problems, one solution
	Where:	Internet
	Who:	Art Teachers ICT Teachers Further Education Institutions
	Which:	Identify requirements and constraints.
Measurable	How Much?	How many Art Teachers are there, how many schools teach Art. How many ICT Teachers are there, how many schools offer ICT.
	How Many?	TC numbers on Registered Art Teachers
	How will I know when done?	Adequate response numbers
	Quantified?	Comparative Survey Results
Attainable	How can I accomplish this?	Survey data Research literature of area
	How realistic is this goal?	Aptitude test design is attainable
Relevant	Is this worthwhile	Does research show there is a desire for this?
	Is it the right time?	Why is now good? Why not in 2018?
	Am I the right person?	Art Background ICT training
	Does this match societal needs?	Tech Boom Lack of Tech People
	Is it relevant now?	Junior Cycle Review UK Computer Science Syllabus Three years to introduce a subject
Time-Bound	When?	13 week project
	Start	October
	End Point	January 2015
	Future growth	Potential of research area.

Table 3-10

3.4.5 Limitations

3.4.5.1 SWOT analysis

SWOT Analysis	
Strengths	Weaknesses
Writing Skills and supports Excellent Supervisor Industry experience from experts	Application Development and Development Language
Opportunities	Threats
A variety of connections • Links to CESI • Links to ATAI • Access to NCAD Library • Access to NCI Library and Online Resources Data RAD Development Cycle	Time People and responses App Development Issues Deployment Issues

Table 3-11

3.4.5.1.1 Strengths

1. **Writing skills and resources**
   The author has good writing skills, and this is reinforced by the NCI's support via student services.

2. **Links to Industry**
   The author had informal discussions with experts in industry, both education and I.T. This has lead to the development of information and resource gathering.

3. **Excellent Supervisor**
   A good supervisor can help direct the flow of the research, and recommend other experts who can lend technical or theoretical help.

3.4.5.1.2 Weaknesses

4. **Application Development**
   Application development will take time from research, and data collation.

5. **Development Language**
   Choosing a development language and framework type may also be an issue.

6. **Application Development**
   The application may take some time to develop. Conducting research and building the application may take time from each other. Effective planning and building of the application, as well as a rapid deployment must happen so that the application can be used.

7. **Static or Full Scale Application**
   A Ruby on Rails, full stack solution would offer a lot of functionality and interaction, as well as powerful dynamic content, it may be more prudent to develop a static AJAX powered beta application, which can incorporate the base functionality. This may not be ideal, as it will not be as robust, be able to store data, like a RoR application would. It is therefore necessary, particularly as the application will gather aptitudes, that it is a full-scale application using Rails and contemporary front-end best practice.

8. **R Programming Language**
   As the research will involve charts, graphs and data, it could be surmised that using the R programming language (www.r-project.org) to help show and visualise data could be useful. However, as this is a thirteen-week MSc research project, as opposed to a BSc final project, the focus should be on research, not application development, so for that reason, using R would not be an appropriate use of time.

3.4.5.1.3 Opportunities

9. **Links to Libraries**
   The author, as a graduate of NCAD has access to that library, thesis store and resources associated with that library, as well as access to NCI library, and online thesis search facilities. Keith Brittle, of the NCI library is also a fantastic resource for helping to gather sources for literature review data.

10. **Links to subject associations**
    As a member of both ATAI and CESI, the author has the ability to contact a large group of professional Art Teachers, and post-primary ICT educators. This can help with survey distribution and combat a potential disadvantage of the mode of research.

11. **Data**
    Data is subject to surveys coming back, and within a timeframe. The data may highlight new concerns. Data can prove a hypothesis, or equally disprove it, or direct research into a new direction.

12. **Rapid Application Development**
    Rapid application development or R.A.D is a software methodology that focuses on iterative development focusing on prototypes. Rapid application development is used to deliver applications rapidly. There are some situations however where this approach is not appropriate such as designing an air traffic control system for instance. There would not be much faith in such a complex program developed in such a short time.

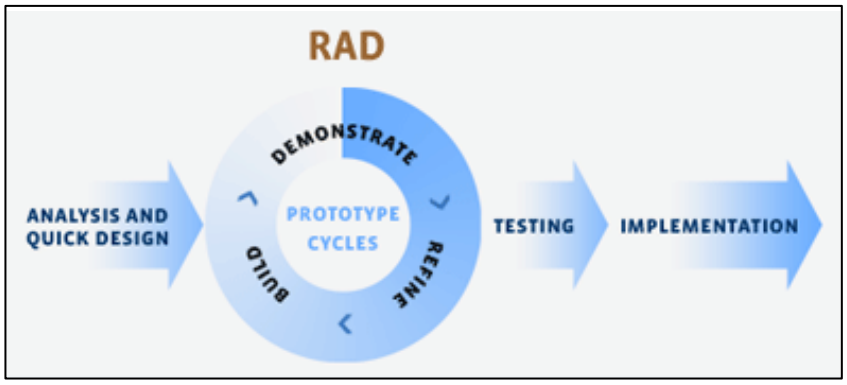

Figure 3-1 ***source: http://www.chrysalis-solutions.com/images/rad.gif***

Suitable projects for RAD are ones, which have a focused scope and where the business objectives are well defined and narrow. Therefore using this methodology in the development of a beta online resource is acceptable, as the base functionality of the system is standard.

3.4.5.1.4 Threats

13. **Time**
    Time is a major concern with this research topic. There is not a lot of time to compile data and conduct research. The Semester in which the dissertation is scheduled lasts roughly 13 weeks. Many post-graduate research projects span nine months to two years.

14. **People**
    Getting the right people is also an issue. There may be a need to combine qualitative analysis, quantitative analysis and interview-based research. With this in mind, online tools to optimise the speed of the research and results conducted, as well as to get a broader spectrum of feedback is necessary. Using online blogs, forums and articles is paramount.

15. **Application Development and Deployment**
    While it would be aspirational to use Rails 4, the risk is that issue with changes in the framework would make development more time consuming and create unanticipated errors, which were not present in previous versions of the framework.
    Deployment to a server may also be an issue, as what works locally, may not work as exactly envisioned on a server. Deploying to a specific server/SaaS platform may be problematic, as the author is more accustomed to front-end development, and may require help to deploy to a service like Heroku.

3.4.6 Development Technologies

There will be several online tools and frameworks that will be employed to design and develop the online testing and assessment of the research.

3.4.6.1 Ruby on Rails Framework

Currently on version 4 the Ruby on Rails application framework, often shortened to Rails or RoR, is an open source web application framework based on and created for development with the Ruby programming language. It should be implemented with an iterative and incremental development methodology. It is best incorporated in an Agile Development environment or during Rapid Application Development software processes. Web Applications, such as Twitter, Shopify and Indiegogo were initially rapidly developed using Rails (Siepen, 2014).

The application was written in Rails 3 and deployed to Heroku SaaS platform. Using an older version of Rails is mainly due to differences between Rails version 3.2.17 and Rails 4.2. Much of the way one develops an application has changed between framework versions, that during development of the application, it was necessary to restart development in Rails 3, which was a more familiar way of coding, and speeded the development of the accompanying application during this thirteen-week research period.

Much like many of its contemporaries, RoR utilises the Model-View-Controller software architecture pattern to organise application form. Rails will generate a basic application structure consisting of Model, with application logic, View, with presentation structure, and Controllers, which help the application display the correct data to the end user, as well as routing information to the database.

"Rails" takes advantage of the dynamic, object-orientated philosophy of the Ruby programming language. It is a fast and productive framework for building and developing database powered web applications, and works best upon a system of development paradigms, these include; Convention over Configuration and the rapid development principle of keeping code DRY, i.e. Don't Repeat Yourself; these lay the foundations of the basic philosophy and design of the Ruby on Rails framework.

When one writes a web application using Rails, almost all of the development is done through Ruby. Databases can be defined and accessed through Ruby. Embedded Ruby can be used in templates amongst HTML and business logic can be coded in Ruby. The Rails framework is known for its ability to build Web applications quickly and with ease. The rapid feedback loop is an excellent feature of the Ruby on Rails framework. This loop is basically the amount of time between making a change in code and seeing the results in the execution of your application on the screen. Feedback is nearly instant. There is no compile or packaging phase needed.

Rails' growth is not limited to the existing community of Ruby developers. It has pulled in converts from languages such as Java, PHP and Perl amongst others. The Ruby on Rails framework has served as a catalyst for incredible growth of awareness and use of the Ruby programming language.

3.4.6.1.1 Toolkits, Libraries, Plug-ins, Extensions

Being an open source community, Rails has many 3rd party features and functionality that can be added to your base code. Display logic can take use of Sass based CSS, which is built into Rails basic application. Similarly JavaScript can be called upon and compiled by use of sprockets.

Rails can be further extended by a variety of toolkits, plug-ins and gems that will make the application more robust.

3.4.6.1.2 Ruby Gems

A Ruby Gem is a package that contains Ruby code to provide some functionality. These Gems are used to enhance a web application and provide additional features. Many developers share their code via GitHub, and encourage community-based development, and allow others to enhance or customise their code. The rubygems.org website, allows developers to post their code online. This site will also track and show the popularity of a gem.

3.4.6.1.2.1 Simple Form

Simple form is used to simplify the form building process in an application, making forms easier to build – requiring less code and repetition, is a key example of a DRY gem, to help speed application development.

3.4.6.1.2.2 Devise

Devise provides user log in and admin levels to the application. It is a robust, rounded application that is an industry standard for user login.

3.4.6.1.2.3 Humanize Boolean

Humanize Boolean is a simple gem that allows a method for auto customisation of a Boolean response, so instead of True/False, it shows Yes/No. This makes the app friendlier

3.4.6.1.2.4 Lazy-High-Charts / Charts-js-rails

Choosing a chart JavaScript engine is not easy. There are many great and powerful libraries out there to enable dynamic presentation of data. The two most popular seem to be chart.js and highcharts.js. Both have pros and cons, however highcharts.js seems to have a greater range of potential, with the only major downside being that it cannot be used for commercial applications without a licence. Charts.js seems to have an error with rails, in that when a page is reloaded, the JavaScript does not render the chart again, and a blank page is then left. Highcharts works right out of the box and allows more customisation, so for this reason, it would be the better gem/library to use. As mentioned previously, Charts could have been developed in R language, but this would have been counter-productive.

3.4.6.1.2.5 Heart-Seed

Heart seed allows excel xls and xlsx files to be uploaded and converted to YAML format via the seeds file. This can allow survey content and responses to be uploaded to the database for both development and production. This can be incorporated to allow survey data created online to be rendered into the database and parsed to charts. Due to time constraints, this will end up being an aspirational goal for future development.

3.4.6.2 HTML5 Sassy CSS3 and JavaScript Libraries

HTML is the basic content structure of web pages. With HTML5, some additional functionality, and a much easier way of building pages has evolved.

CSS3 allows for creative, dynamic, and rich user interfaces and this is expanded on, by using Sass or LESS pre-compilers for CSS respectively. Sass is compiled via Ruby and Compass, whereas LESS is JavaScript based. For this application development, Rails comes with Sass pre-installed, so using a mix of Sass and pure CSS makes the most sense.

JavaScript brings dynamic behaviours and server side logic to the client side of an application. It can be used to talk asynchronously with the server and render pages with out full reloading the page (AJAX). It can alert users that certain form criteria have not been filled in correctly, in conjunction with HTML5.

3.4.6.2.1.1 HAML and JADE

HTML Pre-processors HAML and JADE work similarly to LESS CSS Sass CSS and CoffeeScript for JavaScript. Based on research, learning HAML would be too time consuming for app development, and would not add any benefit at this level, as it falls outside the remit for the project scope.

> "*But it's a mark-up language for programmers, and ultimately the people who use HTML the most aren't programmers(sic)"* (Symonds, 2012).

3.4.6.3 Application Design

The application will have a light, contemporary clean feel to it, similar to survey engines like Kwiksurveys and Survey Monkey (see Figure 3-2, Figure 3-3). Main information will be in the main area of the view, and additional information will be in the sidebar, as well as a login area in

the footer. The quiz section will use the sidebar as the answer area. Questions will be placed in the main area (Figure 3-3).

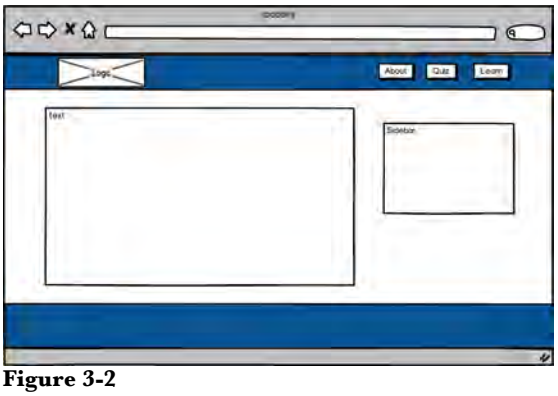

Figure 3-2

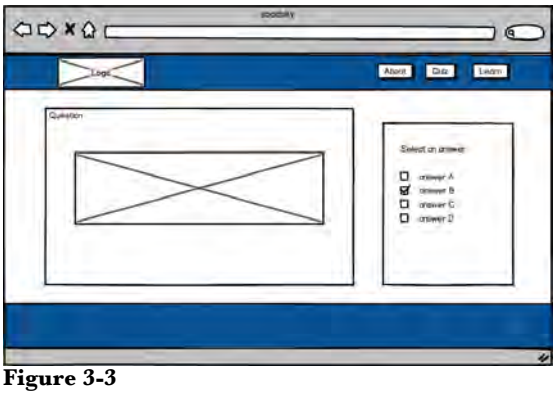

Figure 3-3

3.5 Test Design

The testing occurred over three prongs, two surveys to two different target groups, and an online aptitude test, developed and informed on best practice criteria informed in Chapter 2 – Literature Review.

3.5.1 Surveys as a testing Method

Initial quantitative testing was conducted on a target group of Art teachers, via the Art Teachers' Association of Ireland's mailing list. This allowed a greater reach, in that a larger number of responses could be gained over a short scale of time. The advantage of an online mailing system and survey SaaS tool, is that information can be collated rapidly, aid Rapid Application Development, as well as meeting the timeline of the research, given that it is delivered over thirteen weeks. It was important to use a range of question types, and data analysis tools, such as Likert scales, closed-questions, and rated questions, (Gillham, 2008). Open questions were overly time consuming to collate so were not included in the design of the survey. Kehoe mentioned in her research, that low response rates were an issue. Surveys were sent online, and sent via subject association mailing lists, after meeting with and talking to respondents of those groups via group meetings and group forum pages. This meant that respondents were aware research was taking place, and meant they were personally engaged, and more likely to respond.

Open Questions	
Advantages	Disadvantages
• Allows for unanticipated responses • Respondent can describe things as they see them personally • Can be explained in a respondents own words	• Answers can be difficult to compare and analyse • Can be tiring for the respondents to complete, many may not complete the survey
Closed Questions	
Advantages	Disadvantages
• Easy to interpret or analyse - More reliable • Allows for laziness, respondent can respond without writing detailed response. • Less time consuming for the respondent to answer	• Can prove difficult to compose • Susceptible to bias
Likert Scales	
• Measures beliefs, attitudes and opinions • Gives good general outline/overview of opinion • Uses a scale to gauge agreement • Universal method of data collection • Easy to interpret and analyse data • Helps draw reliable graphs, and data from responses • Quick to answer, requires less effort on part of respondent, helps make long surveys seem shorter	• One Dimensional • Limited to a certain amount of choice that may not reflect real life • Previous questions may influence answers • Tendency to either avoid extremes or select them • Respondents may choose to answer how you may 'expect' them to

Table 3-12

It was also necessary to phrase questions to combat the potential disadvantages each question posed. In Likert scale design, by incorporating negative statements, which respondents were to agree or disagree with, made a conscious effort to make respondents consider what they may be obliged to automatically agree or disagree with. Closed questions were designed so that they reflected a variety of opinions, and with this, should not be as susceptible to personal bias. A variety of closed questions which farmed specific data, such as career length needed to be included to filter further responses, and gauge attitudes and compare more experienced respondents to those newer to teaching. Extra information (section of the NCCA draft syllabus in P&C) and help bubbles were included in the survey to aid those respondents who may need additional help/information to complete it.
During research and analysis it became evident that only Art Teachers' feedback was not enough. It was then that another survey was compiled and distributed to the members of CESI, who kindly engaged in filling out the second survey, with 40 doing so within the first five hours of distribution. The CESI group is a mixed group. Many teach in different levels, primary, secondary or tertiary, or may be sponsors of education [better word]. They come from a variety of subject areas, so those teaching second level would truly enable a broad view of what contemporary computer education is like at second level. It would also be interesting to contrast the feedback from the Art Teacher group to that of the CESI teacher group.
It is important to consider what style of questioning when designing the survey questionnaire. Open questions allow for a personal response, but can be very difficult to get a cohesive trend from the results. Closed questions are much easier to analyse, though they may not totally reflect exactly how a respondent feels, they can still respond with an acute reflection to their position.

3.5.1.1 Rationale for Survey Design 1 Computing and Art Education

This section of the research set out to scope preliminary data gathering to get some sense of whether the idea is viable. Consequently, by surveying Art Teachers to find out such metrics as: how much they knew about digital literacy and coding, specifically; whether they believed digital literacy was being cultivated in their schools; whether it should be if it's not; and what mode of learning is involved. It was important to ask questions, which mined important and relevant data. Full layout of the survey, exported from Kwiksurveys.com, is available in Appendix D – Art Teacher Survey.
The survey was titled under several headings: career length, Educational Terms, Your Professional Status, Your Skills and knowledge of the field, NCCA Draft Syllabus, Computers in your School, Teaching P&C, and How do you like to learn a new skill.

3.5.1.1.1 What would best describe the length of your professional teaching career to date?

This question was important to ask, as it gauged the level at which each respondent was at, in relation to their career, and an ideal way of further filtering down the analysis into categories, based on five-year increments over the typical career length. 0-5 years or Newly Qualified Teacher (NQT), 5-10 years, 10-15 years, 15-20 years, and 20+ years.

3.5.1.1.2 What do you associate the following words and phrases with:

- Just Computing and Science
- Relevant to Computing/Science and Art/Craft/Design
- Just Art/Craft/Design
- None

This question was used to gauge teachers' opinions on a range of phrases derived from syllabi and general topics related to certain subject areas. It was important to look from a creative artistic left-brained perspective, as well as a logical analytical right-brained perspective also, seeing what was thought to be relevant to both areas, relevant to one, or neither. Several Likert items make up this question.
It will ask respondents to assess the following terms (Table 3-13):

RATIONALE OF STEAM OPTION STATEMENTS	
Problem Solving	A key skill in both IT and Art education as cited in both syllabus documents.
Literacy Development	A Key issue at the minute in terms of education
Numeracy Development	A Key issue at the minute in terms of education
Logical Analysis	A key skill in art as regards Observational Drawing, but also a key Science/Mathematics technique (Appendix J – Statements of Learning)
Mathematical Skills	Can refer to logic and analytical reasoning.
Scientific Analysis	Can refer to the measuring and reasoning skills involved in project work.
Brief Design	Can this area help participants design and develop a working scheme, can it help them lay out tasks in a specific timeline
Providing Solutions	Does this area help participants realise outcomes?
Creativity	Does this area allow creative development?
Confidence Building	Can this area help participants build skills and strengths in a positive way?
Team Work	Does this area encourage working in a group environment?
Project Management	Can this area help manage and delegate tasks in a specific timeline?
Tools for Communication	Does this area allow participants to express themselves and communicate ideas?
Self Expression	Does this area allow participants to realise their creative self?
Valued by Society	Is this area valued by society?
Worthwhile	Is this area worthwhile partaking in?
Hard to Learn	Is this area hard to learn?
Must be born with skills	Is this a skill that can be learnt, or must you be naturally talented?
Useful to Society	Is this area useful to society?
Important to Learn	Is this area important to engage in?
Necessary for wholistic development	Is this area necessary for developing a rounded individual?
Increases Vocabulary	Can this area increase one's vocabulary?
Improves writing skills	Can this area improve written skills?
Caters to a variety of learners	Is this an area for everyone, or can only a specific skillset partake in it?

Table 3-13

3.5.1.1.3 Do you currently teach a second subject?

This was gauged to ascertain if Art Teachers are currently teaching more than just Art, or if they teach multiple subjects.

3.5.1.1.4 What subject do you teach?

This question listed a number of subjects, to gauge what areas Art Teachers taught. The hypothesis is that if more than art was taught, that the majority of responses would be for small non-exam subjects or short courses, such as CSPE, SPHE, Religion, and areas of ICT in Transition Year.

3.5.1.1.5 Does the Teaching council certify you to teach this second subject?

This question set out to see if the teacher was qualified to teach this second subject by the teaching council. This will be weighed up against feedback from the Teaching Council, to give a measurable comparison. The hypothesis here is that many *may* feel they are qualified to teach SPHE or CSPE with their initial teacher qualification, but may well not be.

As mentioned previously, the Teaching Council regulates teaching practice in Ireland.

3.5.1.1.6 What ICT Skills do you have/tools can you use?

This question sets out to gauge teachers' ability to use certain programs and tools, within ICT, without specifically referring to P&C, although it may be relevant to those areas.

3.5.1.1.7 Do you have significant knowledge on any of the following computer languages, tools or terminology?

This question outlines several Coding languages and technologies used in industry standard coding. The hypothesis is that some will know HTML mark-up, be aware of Flash, Wordpress/PHP, and possibly CSS, but be unaware of more specific technologies such as Ruby, C# or Objective-C for example. This question will help gauge the general level of Art Teachers' knowledge of certain areas.

3.5.1.1.8 Are you aware of the NCCA Junior Cycle Draft Syllabus for P&C?

This question analysed the important question if Art Teachers were aware of the draft syllabus proposed by the NCCA. It also outlined the basic information and layout of the syllabus.

3.5.1.1.9 What areas of ICT are currently taught in your school?

This question was important to ascertain the variety of computing taught in the sample set schools. The hypothesis here is that the majority would engage in typing or ECDL style skills development.

3.5.1.1.10 What primary subject(s), do your colleagues teaching computers teach in your school?

This was important to discover, as the hypothesis would be that it is a majority of Maths, Science and Technical Graphics/DCG teachers engaging in computer education, with few Art Teachers engaging in computer education.

3.5.1.1.11 Do you feel you could teach P&C at second Level, based on the draft NCCA Syllabus?

This question aimed at assessing respondents' self-evaluation of ability to teach P&C, based on reading the syllabus. Teachers were asked if they felt they "could teach" as opposed to "would they like to teach" as this would measure ability to teach as measured of the syllabus descriptor, as opposed to their desire to teach.

3.5.1.1.12 Evaluate the following phrases in relation to P&C:

This Question was asked to determine Art Teachers opinion on certain words or phrases based on opinions of coding and programming, as well as facts of coding and programming.
The following statements will be asked:

OPINIONS ON PROGRAMMING AND CODING IN RELATION TO ART	
P&C is Hard	Does the participant think P&C is difficult?
P&C has nothing to do with Art	Is there a relationship between Art and Computing?
ACD methodologies could help teach coding better	Does the participant think Art methodologies could be applied to the teaching of Computing?
P&C has much cross Curricular potential	Is there cross-curricular potential in P&C?
P&C can improve literacy and numeracy	Can P&C help develop literacy?
The NCCA Draft Syllabus is easy to understand	Does the participant think the Draft syllabus is easy to understand, accessible?
There are elements I could teach without knowing code	Does the participant think they currently have skills to engage in the syllabus?
I would be willing to teach P&C	Is the participant willing to teach P&C?
Texts and Online resources	Do digital tools aid teaching methods?

are useful for helping to teach P&C	
An online resource specifically tailored to teaching P&C would help me teach and understand it	Would an online resource help the respondent to better learn the skills related to P&C?
Coding is a skill I would like to learn	Would the participant like to learn P&C?
P&C could be taught alongside Graphics	Does the participant think P&C could be an element in Graphic Design education?
Knowing Flash makes P&C easier	Does knowing how to code flash make P&C easier to digest.
Animation has transferable skills to P&C	Does animation have skills that could be applied to P&C, and vice-versa?
My Students would love to learn P&C	Would the participants' students like to learn P&C?
P&C is important in Irish Society	Is P&C important to Irish Society?
You need impressive labs to teach P&C	Is an impressive computer lab necessary for the effective teaching of P&C?
I have all the skills needed to start learning P&C	Does the participant think they have the skills to effectively engage in and learn P&C?
Learning P&C to teach would make me more employable	Does the participant think that learning P&C would make them more employable?
Principals will want teachers to teach P&C in schools in next five years	Does the participant think Principal teachers would like P&C ICT teachers on their staff within the next five years?
P&C will become an important subject in schools	Does the participant think P&C will become an important subject in schools?

Table 3-14

3.5.1.1.13 How do you feel you engage with the following types of learning methods?

This question assessed Teacher's engagement level with certain modes and methods of learning a new skill. This was initially important when the research began, as the aim was initially to develop an application that helped teachers learn P&C. As the research went on, time did not seem to allow for such an endeavour, so this was curtailed to an aptitude test design. However, this question as well as the subsequent two would inform further research and future development.

3.5.1.1.14 If there was a resource to help you learn to teach P&C, which would be the most important features of the site/application?

Similarly to the previous question, this assessed what would be the most important features of the application, should it be developed to teach P&C skills.

3.5.1.1.15 How effective do you feel the following tools would be to learning P&C (ICT) - mark out of 5?

Similarly again, this measures teachers' preferred mode of learning, rating each tool out of 5 for effectiveness.

3.5.1.1.16 Do you feel being able to teach P&C (ICT) would make an art teacher more employable?

This question was asked, as it was desirable to determine what Art Teachers' attitudes to P&C was in general. It would also determine respondents' opinion in relation to P&C, and whether having it as an additional teachable skill, would make Art Teachers more employable.

3.5.1.2 Rationale for Survey Design 2 – Computing in Post Primary Education

This survey was somewhat similar to the Art Teacher focussed survey, however it is shorter, and poised the questions in a different way, based on the group it was engaging with.
The survey was titled under several headings: career length, Educational Terms, Your Professional Status, Your Skills and knowledge of the field, NCCA Draft Syllabus, Computers in your School, Teaching P&C, and Final Question.

3.5.1.2.1 What would best describe the length of your professional teaching career to date?

As with the Art Teacher survey, this question was important to ask, as it gauged the level at which each respondent was at, in relation to their career, and an ideal way of further filtering down the analysis into categories, based on five-year increments over the typical career length. 0-5 years or Newly Qualified Teacher (NQT), 5-10 years, 10-15 years, 15-20 years, and 20+ years.

3.5.1.2.2 What do you associate the following words and phrases with:

- Just Computing and Science
- Relevant to Computing/Science and Art/Craft/Design
- Just Art/Craft/Design
- None

As with the Art Teacher Survey, this question was used to gauge teachers' opinions on a range of phrases derived from syllabi and general topics related to certain subject areas. It was important to look from a creative artistic left-brained perspective, as well as a logical analytical right-brained perspective also, seeing what was thought to be relevant to both areas, relevant to one, or neither. The same criteria in section 3.4.2 were applied.

3.5.1.2.3 What is your Primary Subject?

The rationale behind this question sets out to assess what areas of education at post-primary that ICT teachers are primarily involved in. Hypothetically it would involve Science, Mathematics, and Business, based on Art Teacher survey results.

3.5.1.2.4 Do you teach another subject, if so what do you teach? (choose all that apply)

This was important to ask, as theoretically all would teach a second, or third subject area. Again, it would be expected that this should reflect the Art Teacher survey somewhat.

3.5.1.2.5 If yes, are you certified to teach this second subject by the Teaching council?

As with the Art Teacher survey, it was important to know were the teachers responding qualified under teaching council regulations to teach these subjects.

3.5.1.2.6 What ICT Skills do you have/tools can you use?

This question sets out to gauge teachers' ability to use certain programs and tools, within ICT, without specifically referring to P&C, although it may be relevant to those areas.

3.5.1.2.7 Do you have significant knowledge on any of the following computer languages, tools or terminology?

As with the Art Teacher survey, this question outlines several Coding languages and technologies used in industry standard coding. The hypothesis is that some will know HTML mark-up, be aware of Flash, Wordpress/PHP, and possibly CSS, but unlike the Art Teacher survey it is more likely that respondents will be aware of more specific technologies such as Ruby, C# or Objective-C for example. This question will help gauge the general level of ICT Teachers' knowledge of certain areas.

3.5.1.2.8 Are you aware of the NCCA Junior Cycle Draft Syllabus for P&C? (see below for brief outline)

As with the Art Teachers' survey, this question analysed the important question if ICT Teachers were aware of the draft syllabus proposed by the NCCA. It also outlined the basic information and layout of the syllabus. Hypothetically this should starkly contrast the results from the Art Teachers survey, indicating that there is a greater awareness among ICT teachers of the draft syllabus.

3.5.1.2.9 What areas of ICT are currently taught in your school?

As with the Art Teacher survey, this question was important to ascertain the variety of computing taught in the sample set schools. The hypothesis here is that the majority would engage in typing or ECDL style skills development, however the feedback from this survey may be more valid, as there is the guarantee that the teachers here are aware of what is being taught in the ICT departments they are members of.

3.5.1.2.10 What primary subject(s), do your colleagues also teaching computers teach in your school?

As with the Art Teacher survey, this was important to discover, as the hypothesis would be that it is a majority of Maths, Science and Technical Graphics/DCG teachers engaging in computer education.

3.5.1.2.11 Do you feel you could teach P&C at second Level, based on the draft NCCA Syllabus?

This question aimed at assessing respondents' self-evaluation of ability to teach P&C, based on reading the syllabus. Teachers were asked if they felt they "could teach" as opposed to "would they like to teach" as this would measure ability to teach as measured of the syllabus descriptor, as opposed to their desire to teach. It would be assumed that the majority of ICT teachers would agree with this statement.

3.5.1.2.12 Evaluate the following phrases in relation to P&C:

This Question was asked to determine ICT Teachers' opinion on certain words or phrases based on opinions of coding and programming, as well as facts relating to coding and programming.
The following statements will be asked:

OPINIONS ON PROGRAMMING AND CODING	
P&C is Hard	Does the participant think P&C is difficult?
P&C has nothing to do with Art	Is there a relationship between Art and Computing?
P&C has much cross Curricular potential	Is there cross-curricular potential in P&C?
P&C can improve literacy and numeracy	Can P&C help develop literacy?
The NCCA Draft Syllabus is easy to understand	Does the participant think the Draft syllabus is easy to understand, accessible?
There are elements I could teach without knowing code	Does the participant think they currently have skills to engage in the syllabus?
I would be willing to teach P&C	Is the participant willing to teach P&C?
P&C could be cross curricular	Is there cross-curricular potential in P&C?
An online resource specifically tailored to teaching P&C would help me teach and understand it	Would an online resource help the respondent to better learn the skills related to P&C?
Coding is a skill I would like to learn	Would the participant like to learn P&C?
P&C could be taught	Does the participant think P&C could be an element in Graphic

alongside Graphics	Design education?
Knowing Flash makes P&C easier	Does knowing how to code flash make P&C easier to digest.
Animation has transferable skills to P&C	Does animation have skills that could be applied to P&C, and vice-versa?
My Students would love to learn P&C	Would the participants' students like to learn P&C?
P&C is important in Irish Society	Is P&C important to Irish Society?
You need impressive labs to teach P&C	Is an impressive computer lab necessary for the effective teaching of P&C?
I have all the skills needed to start learning P&C	Does the participant think they have the skills to effectively engage in and learn P&C?
Learning P&C to teach would make me more employable	Does the participant think that learning P&C would make them more employable?
Principals will want teachers to teach P&C in schools in next five years	Does the participant think Principal teachers would like P&C ICT teachers on their staff within the next five years?
P&C will become an important subject in schools	Does the participant think P&C will become an important subject in schools?

Table 3-15

3.5.1.2.13 Do you think a coding aptitude test would give confidence to those who may be starting to learn how to code?

This question was added in place of the learning method question from the Art Teacher survey. This was used to gauge if teachers thought this would teachers felt this approach would enable those learning coding to see if an aptitude test would help them to gain the confidence to take on coding. N.B. The decision to build an aptitude test to analyse ability was already decided at this time.

3.5.1.2.14 Do you feel being able to teach P&C (ICT) would make a teacher more employable?

This question was asked, as it was desirable to determine what CESI teachers' attitudes to P&C was in general, as well as if they feel that it would make a difference to the employability of a teacher.

3.5.2 Aptitude Test

The aptitude test is necessary to determine an individuals' ability to code or program based on several logic questions and scenarios.

3.5.2.1 Assessing potential coding competence

A key factor in deciphering whether Art Educators would be good at taking on coding, would be to develop an application that uses logical tests to assess whether someone can recognise elements that would prove an ability to understand the logic of coding, and if they have the transferable skills in order to learn and develop P&C skills.
An application that measures this would be the best avenue to approach. To do this, analyses of best e-learning practices are required. On top of this, the application would need to test users with a variety or questions, which test a variety of skillsets, synonymous with coding.

3.5.2.2 Programming Aptitude Tests

Companies often use programming aptitude tests (PAT), when determining the ability of a potential hire, as to how they may. While talking to Liam Hurrell of BigWave Media Training and DevSteams.io as part of industry research, he noted that a lot of the PAT's used commercially have a very high threshold, and there is a niche in the market for an application or test, which analyses potential for getting people onto a training course, which may also be applicable to post-

primary level pupils, as well as their teachers who wish to up-skill (Appendix H – Industry Programming Aptitude Tests).

3.5.2.3 Testing rationale

The rationale behind the structure of this test was informed by research carried out in the literature review, and advice and guidance offered by
The test will assess the following areas

- Recognition of pattern, sequences and series
- Spatial awareness and planning
- Instruction development with pseudo code
- Logic tests
- Data querying

The test will not use code per se, but will employ an understanding and awareness of the logic behind code, using a pseudo code metric to determine an individuals' competency.
As discussed in Chapter 2, an effective aptitude test employs the following…

The Key steps are

- Determine the basis
- Establish a format
- Create the questions
- Review and Finalise

Key areas P&C ability tests should assess are:

1. Pseudo code
2. Logic tests
3. Syntax Analysis
4. Data Mapping

3.5.3 Structure of Test

The test will have several areas. The first will be a data collection page to determine which areas and backgrounds those doing the test come from.
Several questions will repeat the form and function of previous questions so as to ascertain the true level of ability. There will be several types of questions in a bank of 30. On a qualitative basis, all 30 will be issued to a select number of candidates. On a Quantitative basis, a set of 13 or 14 questions will be sent to many candidates.
Candidates supply the following information, which can be used to filter responses

- Name
- Email
- Age
- Professional Background
- Teaching Length (if applicable)
- Location
- ICT Level

3.5.3.1 Pseudo Code/Pattern /Syntax Analysis

Several questions range at looking at a pseudo code, and trying to decipher the pattern of the query. This is asked in a variety of ways, thought translation, cipher shuffling and rearrangement of letters/numbers.

3.5.3.2 Calculations and Mathematical reasoning

Several questions deal with computational skills. These range from simple mathematical calculations, to more complex algebraic expressions. While in computing, the code will often calculate these in a program, it is important to know how to build functions that will do this, and these questions fill that requirement. Some questions look at the measurement of angles, and vary

in complexity. Some questions will start require the candidate to work backwards to determine the starting point, not dissimilar to a navigation/orientation theme question.

3.5.3.3 Navigation and Orientation

An important part of any program, is deciding what it will do. Several questions are gauged towards this skill. Sometimes one needs to move in and out of directories; other times it is necessary to plan how an animation will traverse a screen, or in the example of a game, it is necessary to move around the canvas plane, while avoiding obstacles. The questions vary for each of these skills, some are using direction, and some look at directory mapping, and others ask to use an illustration as the basis of how to determine the correct outcome.

3.5.3.4 Loops

Loops are a major part of any computer program. Loops deal with such issues as interest or timetabling (crontabs). The simplest loop anyone would understand is his or her birthday (which occurs once, annually on the same date) and this is the hook for the loop question.
A question looks at the concept of a for-while-until loop by looking at the concept of saving and interest. It is somewhat complicated but it offers the chance to demonstrate the ability to think of how a loop system works.
There is also a less complicated question, not taking the interest into account, which may simplify it, but it still demonstrates ability to understand how loops work.

3.5.3.5 Logical Reasoning

Some questions look at if/else conditioning, such as the "bod" question, and another question, which is much less descriptive, but asks in a very succinct way a similar question.

3.5.4 Aptitude Test Questions

The aptitude test questions are listed in full below. They will refer to the above methodologies. Full breakdown of each question can be found in Appendix K – Aptitude Test Questions.

Question	Text	Rationale
1	If the hour hand of a clock is turned anticlockwise from 2pm to 9am, through how many degrees will it have turned?	Tests ability to measure and analyse and think in an abstract way.
2	If in the "DaintyGull" coding language the following are examples of the code pattern…	Measures ability to analyse patterns.
3	Five children are sitting on a bus to a Miley Cyrus concert. Shea is sitting next to Pam, who is not next to Tracy. Kel is sitting next to Rachel, who is sitting on the extreme left, and Tracy is not sitting next to Kel. Which children are sitting adjacent to Shea?	Measures ability to analyse patterns, and contextualise information based on a series of informative clues.
4	In the old dynastic pre Valyrian language these are several phrases…	Measures ability to analyse patterns.
5	Bod, Aunt Flo, PC Copper, Farmer Barleymow, Frank the Postman, and Alberto Frog are holding a competition to see who could jump the highest. Though it was the 70's, no one observed everyone at the same time, they had to figure it out from each other's observations. As it is the 70's, none of them will lie...	Measures ability to analyse patterns, and contextualise information based on a series of informative clues.
6	Your robot maid is required to activate "dinner", wait 60 minutes, and then run the "*servedinner*" function, when you arrive home. She needs to perform three specific instructions at the right time, and in the right order for this to be successful…	Measures ability to analyse patterns, and contextualise information based on a series of informative clues. Visually assesses navigation skills
7	What is C2 multiplied by A3, plus D2, then divided by A4?	Tests calculation skills, and mathematical reasoning.

8	You did it! You climbed to the top of Mt Everest! You are facing North. You turn 90 degrees to the left to take a selfie with Paula. Then you turn 180 degrees to the right to take a selfie with John. You then reverse direction…	Measures ability to analyse patterns, and contextualise information based on a series of informative clues. Visually assesses navigation skills
9	Consider the following: FRIEND = FPIBNZ MASTER = _____	Measures ability to analyse patterns, and decipher patterns similar to algebra
10	Lloyd has just turned 30. He wants to save for retirement. Until he is 40 he will save €50 euro a month…	Measures ability to analyse loops and patterns
11	Elaine Paige (blue) and Barbara Dickinson (red) are performing in their music video for "I know him so well"…	Measures ability to analyse patterns, and contextualise information based on a series of informative clues. Visually assesses navigation skills
12	Three girls are waiting for the number 42 bus. They are lined up in a row. Each has a different name, and is wearing a different dress…	Measures ability to analyse patterns, and contextualise information based on a series of informative clues.
13	Mark thinks of a number. He squares it, then takes away 5, next multiplies it by 4, takes away 7, divides it by 3 and finally adds 6. His answer is 9. What number did he start with?	Tests mathematical and calculation skills
14	Your robot receptionist is required to run the shutdown system, 30 minutes after everyone leaves work. She needs to perform three specific instructions, at the right time and in the right order for this to be successful. A list of commands is highlighted below…	Measures ability to analyse patterns, and contextualise information based on a series of informative clues. Assesses navigation skills
15	Sandra thought of a number, added 7, multiplied by 3, took away 5 and divided by 4 to give an answer of 7. What was the starting number?	Tests mathematical and calculation skills
16	Elaine's dancers (blue) have just been really rude to Barbara, so she is leaving. She needs to dance out, however, so as not to have to come back.	Measures ability to analyse patterns, and contextualise information based on a series of informative clues. Visually assesses navigation skills
17	In the "kittywake" language...	Measures ability to analyse patterns.
18	Consider the following…	Measures ability to analyse patterns, and decipher patterns similar to algebra
19	If in the "VileTrout" code language, where all words are seven letters long:	Measures ability to analyse patterns.
20	In a game of chess…	Measures ability to analyse patterns, and contextualise information based on a series of informative clues. Visually assesses navigation skills
21	The following represents computational functions. Determine the value of p…	Measures ability to analyse patterns, and decipher patterns similar to algebra.
22	What is the measurement of the angle between the hour hand and the minute hand, when the clock reads 10:30pm?	Tests ability to measure and analyse and think in an abstract way.
23	Lyndsey is 10 years old. She begins to saves five euro every week. Once a year, while she is a child but up until she is 16 years old from her 10th birthday, her Grandmother puts 100 euro into her account on her birthday…	Measures ability to analyse loops and patterns; Mathematical deductions.
24	Dave was given a large bag of sweets and ate one third of the sweets before stopping, as he	Measures ability to analyse loops and patterns

	was feeling sick. The next day he ate one third of the remaining sweets…	
25	In the old dynastic pre Valyrian language these are several phrases…	Measures ability to analyse patterns.
26	Three computers were lined up in a row, each is a different make, and runs its own operating system...	Measures ability to analyse patterns, and contextualise information based on a series of informative clues.
27	Penny is lost in Paris and cannot find the syndicat d'initiative. She finds a map, as she only knows basic French and realises she needs to get to the place marked Q…	Measures ability to analyse patterns, and contextualise information based on a series of informative clues.
28	What is the measurement of the angle between the hour hand and the minute hand, when the clock reads 2:30am?	Tests ability to measure and analyse and think in an abstract way.
29	Killian is learning how to code, so he can pay his staff. The rule of the Sapphire language is that every bit of functionality must be given a name…	Measures ability to analyse patterns, and assess syntactical errors
30	Sarah did it! She made her way to King Jareth's Castle to rescue Toby, only to find she is lost in a circular room, with 8 doors…	Measures ability to analyse patterns, and contextualise information based on a series of informative clues.

Table 3-16

3.5.5 Aptitude Test Variation Rationale

Initially, the aptitude test was sent to IT professionals, Lecturers and Industry connections. Informally, the feedback given was that the test seemed like a good general gauge of aptitude. Some felt that the test was too long, and that 10-15 questions would be sufficient. Research indicated that question repetition, or questions style repetition is necessary in multiple choice question so as to ensure that those who attempt the tests do not solely guess the correct answer, and measuring similar question is a good gauge of aptitude in any mode of assessment (Stanley, 2004). If the test is too long, or deemed to difficult, those attempting it will quit the test before it is completed. If it is too difficult it will dissuade participants from pursuing the area further. If too easy, it will give an unrealistic perspective of the area.

3.5.5.1 Version 1 – Easier test

The rationale behind this iteration was to make the test more accessible, therefore it was essential that the questions, where possible were more visual, worded more simply and were more thorough in instruction to candidates of the test. This will be verified in section 4.5.4. This test would be purely a STEAM based approach to aptitude testing.

3.5.5.2 Version 2

Questioning in this iteration of the test aimed to form the middle ground. The assessment was suitably difficult, but not too abstract. The assessment retained some of the visual stimuli from the easier test, but also incorporated some more difficult variations of questions. This approach is a STEAM based approach, with a variety of difficulty and reasoning employed.

3.5.5.3 Version 3

The rationale behind this iteration of the test was to use the more difficult variations of questions to gauge if a person had an aptitude. Questions were much more abstract in their methodology in this iteration. This test would be more of a STEM methodology than a STEAM methodology.

3.6 Conclusion

By developing quantitative surveys targeted at two demographics, as well as devising and distributing the "codability" aptitude test, it is possible to gauge a sense of the status of not only ICT education, but to have an insight as to whether it is a solely STEM based education world out there, or if STEAM methodologies and attitudes are somewhat present, hypothetically, if there is a

numerate number of teachers engaging in scratch programming, this may be the case. The experiments will enable a greater sense of one's potential code ability.
By testing many demographics, not just teachers but also IT professionals, students and candidates of a variety of ages, it is possible to assess and measure the effectiveness of the test, before a beta application can be deployed and used.
By following standard practice of developing and iterating a meta-cycle, and by testing aptitude via an online mechanism, a wealth of information can be mined and used to benefit this research.

4 Results and Data Analysis

4.1 Introduction

The research conducted spanned over two research modes, a survey and an application. The data gleamed from this showed different results.

The survey was carried out over two weeks and there were 104 respondents, out of a potential 250 at the time of which the survey was carried out in October 2014, 41% which is a very good for Art Educators. Kehoe notes that is was difficult for her to get above 16 survey responses, and had to resort to four telephone interviews to back up results – within a nine-month research period – though one must consider Kehoe had a much more narrow target group, which was limited to 129 recent art education graduates. In her recommendations, she recognises tying in with associations like the ATAI in further research, which is what had occurred prior to the investigation of her research.

4.2 Analysis of Art Teacher Survey Responses

4.2.1 Career Length

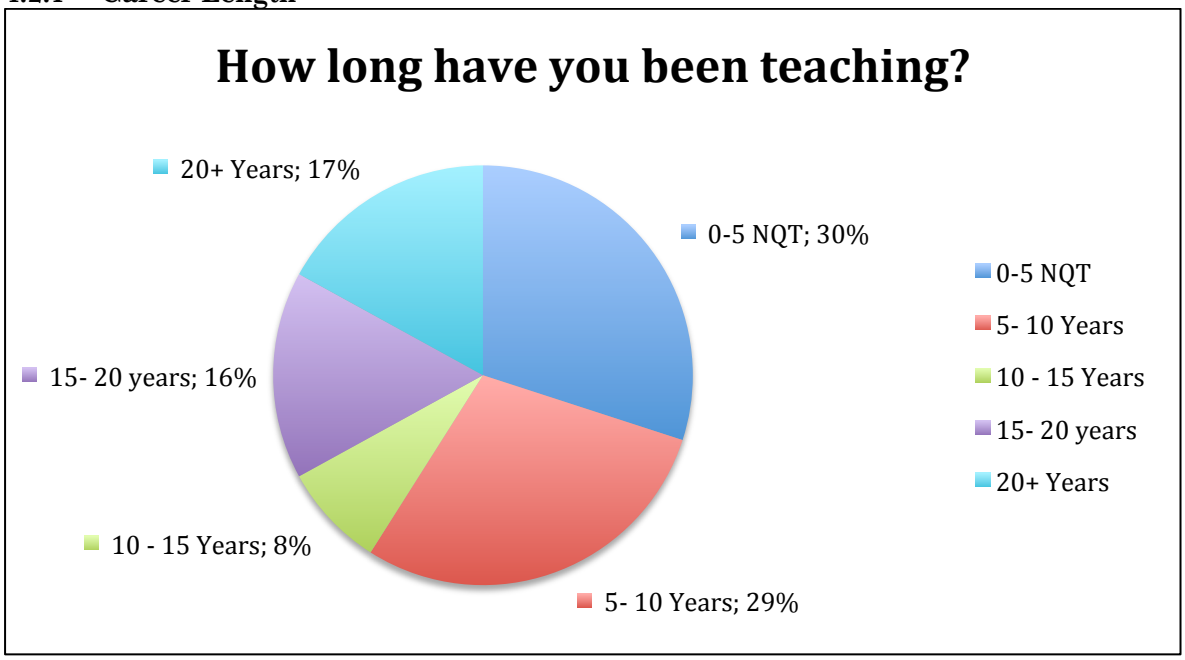

Figure 4-1

The respondents of the survey were asked to show how long they had been teaching. The greatest number of respondents seem to be from 0-10 years teaching, which is almost 60% of the respondents. This would also tie in with the growth in teacher numbers, and retirements from 2004-2014.

4.2.2 Skills and their perception from Art Teachers

This question was included to gauge Art Teachers perception of their own subject, as well as the perception of Computing and sciences, based on words used in the Syllabi of both. Some skills such as graphic design, layout and measuring to a trained art teacher would stand out as mathematical skills, yet a teacher of another subject may not be as sympathetic to this.

Most respondents seemed to feel the statements were applicable to both a Computing/Science skillset, as well as an Art/Craft/Design skillset.

SKILLS, AND WHAT THEY RELATE TO – ART TEACHERS

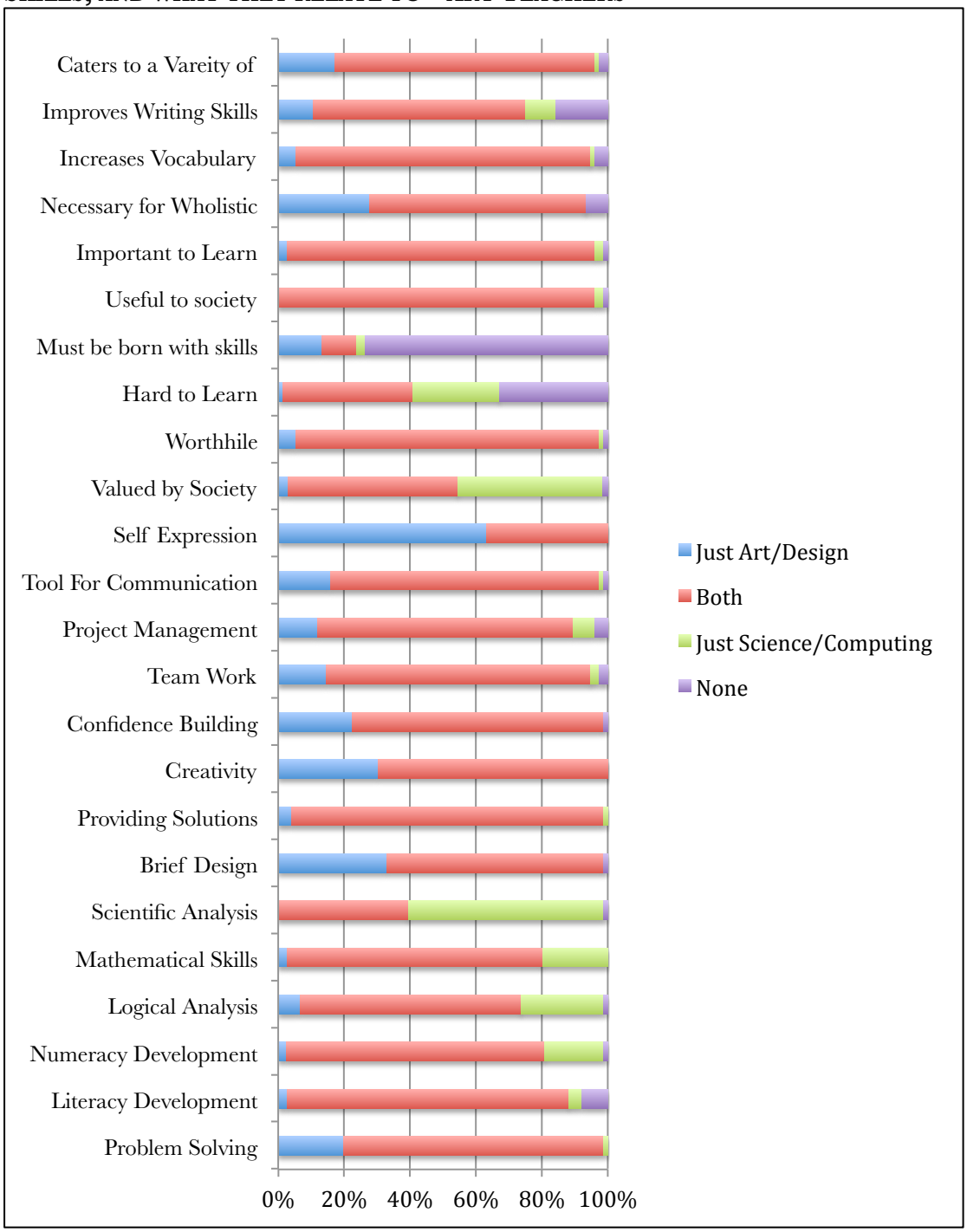

Figure 4-2

Analysis of Statements	
Problem Solving	Most felt that this statement is applicable to both areas, with a number feeling that it was only applicable to Art/Design.
Literacy Development	A large number agree that this is applicable to both areas. A small number feel it is applicable to neither.
Numeracy Development	A number feel Computing and Science is better associated for this statement. The majority recognise that that it is applicable to both areas.
Logical Analysis	Almost twenty respondents felt that this was only applicable to Science and Computing, despite observational drawing being a major art skill/practice at post-primary (ATAI website, 2013).
Mathematical Skills	A number feel Computing and Science is better associated for this statement. The majority recognise that that it is applicable to both areas.
Scientific Analysis	The majority of respondents feel that this caters for mostly Science and Computing, though a number feel the statement is applicable to both areas.
Brief Design	The majority feel this is relevant to both areas. However a number feel this is just relevant to Art/Design. None feel it is relevant to Computing/Science alone.
Providing Solutions	The majority feel this statement is relevant to both areas. Small numbers feel it is solely relevant to each of the areas alone.
Creativity	The majority feel this is relevant to both areas. However a number feel this is just relevant to Art/Design. None feel creativity is relevant to Computing/Science alone, which is sad but not a surprise.
Confidence Building => Team Work => Project Management => Communication ->	The majority feel this is relevant to both areas. However a number feel this is just relevant to Art/Design. None feel it is relevant to Computing/Science alone. The respondents feel that by and large this is applicable to both areas, with just under 20 respondents feeling it is only applicable to Art/Design. The majority feel this statement is relevant to both areas. Small numbers feel it is solely relevant to each of the areas alone. The majority feel this is relevant to both areas. However a number feel this is just relevant to Art/Design. One feels this is relevant to Computing/Science alone.
Self Expression	This is the only area where Art/Design is the majority response to a statement. Many feel it is relevant to both, however.
Valued by Society	Slightly more respondents felt that Science and Computing is valued more by Irish society. One respondent felt just Art/Design is valued by society.
Worthwhile	While this was an important question to ask, there is the bias present of Art Teachers, who will in general be biased towards their practice. However, the respondents recognise by and large that both Science/Computing and Art/Design are worthwhile engaging in.
Hard to Lear	This question was asked, due to gauge perception of difficulty in an area. There was no real consensus, with respondents either agreeing both areas were hard to learn, or the statement applied to neither area.
Must be born with skill	From conversation with people of a non-artistic background, the phrase "I can't draw" is often bandied about. It is the perception of many that you must be born with the skills to draw where as other skills can be learned. This is the only statement where the majority of respondents feeling that this statement is not applicable to either areas, with a small number agreeing you must be born with the skills for Art/Design, and a slightly smaller number feeling that you must be born with the skills for both areas.
Useful to Society/ Important to Learn	As expected, the majority of respondents felt that both are useful to society, and both areas are important to learn.
Necessary for wholistic development	Respondents agreed that both subject areas cater for this statement, with a small handful feeling that just Art qualifies for this statement
Increases Vocabulary/ Improves writing skills	The majority feel this is applicable to both areas The majority agree this applies to both areas, with some feeling it is not relevant.
Caters to a variety of learners	Again, most respondents felt that both areas cater for all learners, with a small handful feeling that just Art qualifies for this statement.

Table 4-1

4.2.3 Teaching a Second Subject

Art Teachers were asked if they taught a second subject, and what subjects they taught alongside Art – multiple answers could be chosen. Surprisingly, the results show that a narrow majority of art teachers are teaching a second subject, however, this mostly alludes to CSPE (20%), SPHE (22%) and Resource (16%), which do not have specific qualifications attached to them in order to be taught, in fact, it is often thought that these are "filler" subjects to fill a person's timetable. In particular, CSPE is criticised a lot, as the majority of people teaching it seem to have no political desire, motivation, or substantial political knowledge (Redmond et al., 2002).

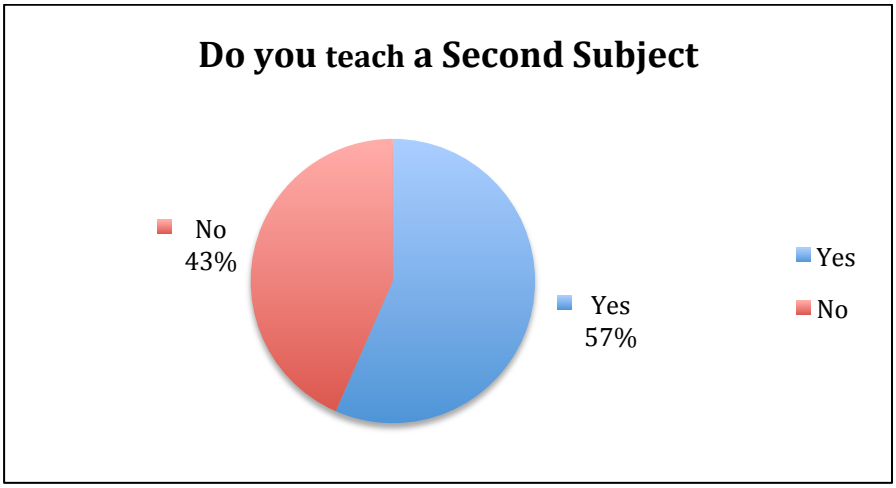

Figure 4-3

Group	Yes	No	% of respondents
0-5 years	57	43	30
5-10 years	60	40	29
10-15 years	29	71	8
15-20 years	64	36	16
20+ years	50	50	17

Table 4-2

4.2.4 If yes, what subject do you teach?

The hypothesis is that if more than art was taught, that the majority of responses would be for small non-exam subjects and short courses, such as CSPE, SPHE, Religion, and areas of ICT.
Furthermore, of the art teachers engaged in the ICT departments (about 23% of second subjects) just under 14% are teaching Digital Art/Photography, 6% teach ECDL, which according to research from both surveys is main element of ICT engagement in schools, 1% is teaching Digital Cre8or, and surprisingly 2% teach coding in their school, despite this, no Art Teachers are engaged in Coder Dojo, according to the survey.
Some Art teachers teach unusual subjects, such as one teaching Technical Graphics and Design & Communication Graphics, just fewer than 3% teach History or Religion (Figure 4-4).

4.2.5 If yes, are you certified to teach this second subject by the Teaching council?

This question set out to see if the teacher was qualified to teach this second subject by the teaching council. This will be weighed up against feedback from the Teaching Council, to give a measurable comparison. The hypothesis here is that many *may* feel they are qualified to teach SPHE or CSPE with their initial teacher qualification, but may well not be (Figure 4-5).
The number of Art teachers who were not qualified to teach the subject or who did not know if they were was interesting to see. Those that claimed they were qualified, about 40% (see Table 4-3 * Teaching council states zero Art Teachers are (Appendix A) for a complete breakdown) must have done additional training, as no college that offers Art Teacher education currently, also trains teachers to teach another subject at the same time (Appendix A – Correspondence).

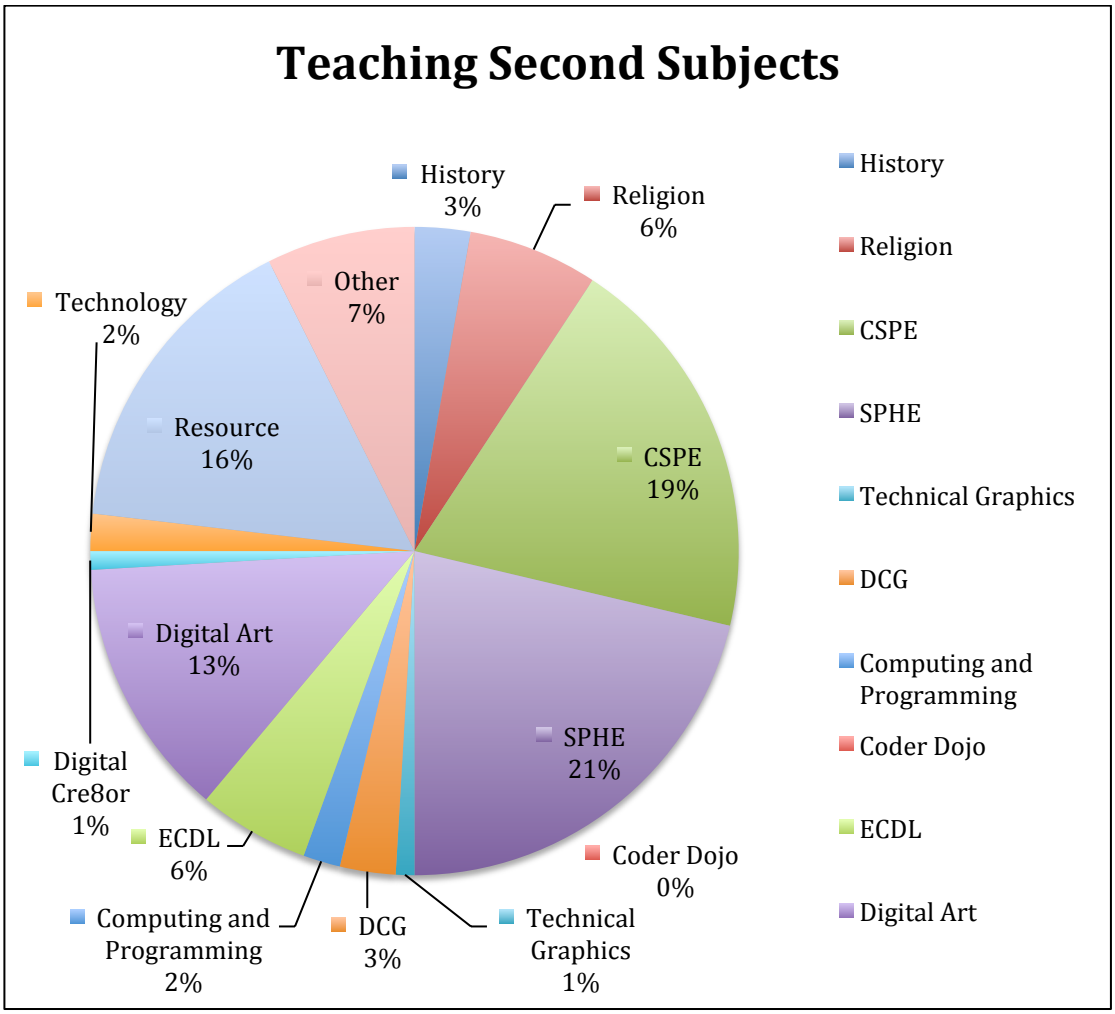

Figure 4-4

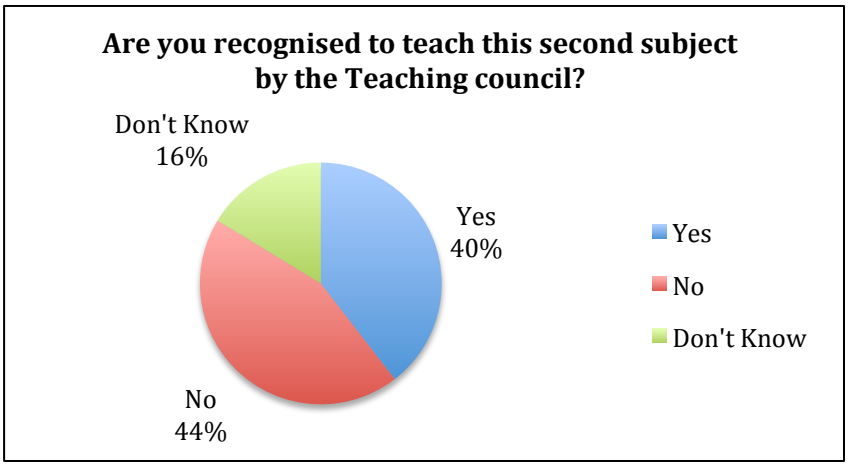

Figure 4-5

100% of those teaching 10-15 years claim they are qualified to teach SPHE and Digital Art/ICT. Feedback from the teaching council of Ireland (see appendix) claims zero Art Teachers in Ireland are registered, recognised, and certified with the teaching council to teach a second subject (Teaching Council, 2015). Several teachers who are no longer registered with the Teaching Council (due to retirement or a change of field) were previously recognised to teach Religion and Science, but these are two cases the author is aware of personally, and cannot be substantiated. Correspondence was sent to Teaching Council but they are yet to confirm this.

Group	Yes	No	Don't Know	% of respondents
0-5 years	27*	60	13	29.9
5-10 years	33*	33	33	28.9
10-15 years	100*	0	33.3	7.7
15-20 years	44*	44	11	16.4
20+ years	67*	33	0	17.3

Table 4-3 * Teaching council states zero Art Teachers are (Appendix A)

4.2.6 What ICT Skills do you have/tools can you use?

As anticipated, the majority of respondents were clearly very well able to use Office tools, such as word processing, slide shows, and spreadsheets. Several had good knowledge of online tools such as Moodle, Edmodo and Google Docs. Not surprisingly, many were also adept at using photo manipulation tools such as Photoshop or Gimp. More advanced programs such as Flash, animation tools, Vector tools and WYSIWYG editors had awareness, but low competency levels. Few knew what an IDE was, or had experience of coding tools.

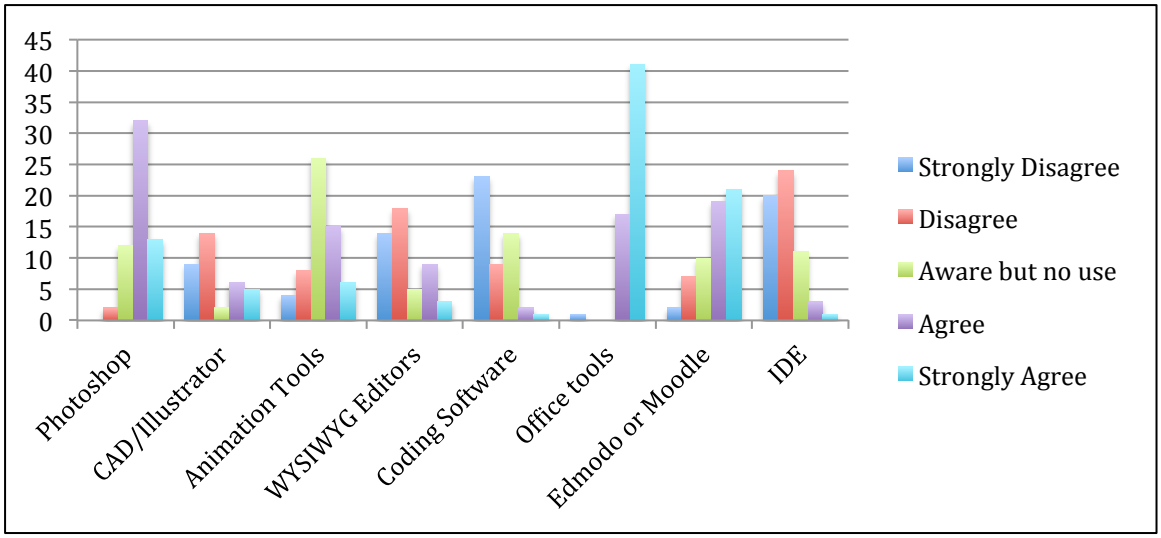

Figure 4-6

4.2.7 Do you have significant knowledge on any of the following computer languages, tools or terminology?

It was important to gauge what skills Art Teachers had, as well as what tools and technologies they were aware of and capable of using. Theoretically, there should be a good number with basic Office skills, awareness of Prezi, Flash and Animoto, and understanding of Photoshop and Creative Suite. This seems to be the case. However, when comparing knowledge of design and development languages ranging from HTML to JavaScript, there was a surprise in that some teachers were indeed aware, and skilled in these areas. Particularly a surprise was the awareness/knowledge of use in PHP and Wordpress (Figure 4-7).

ART TEACHERS' KNOWLEDGE OF AREAS OF COMPUTING TOOLS AND TERMINOLOGY

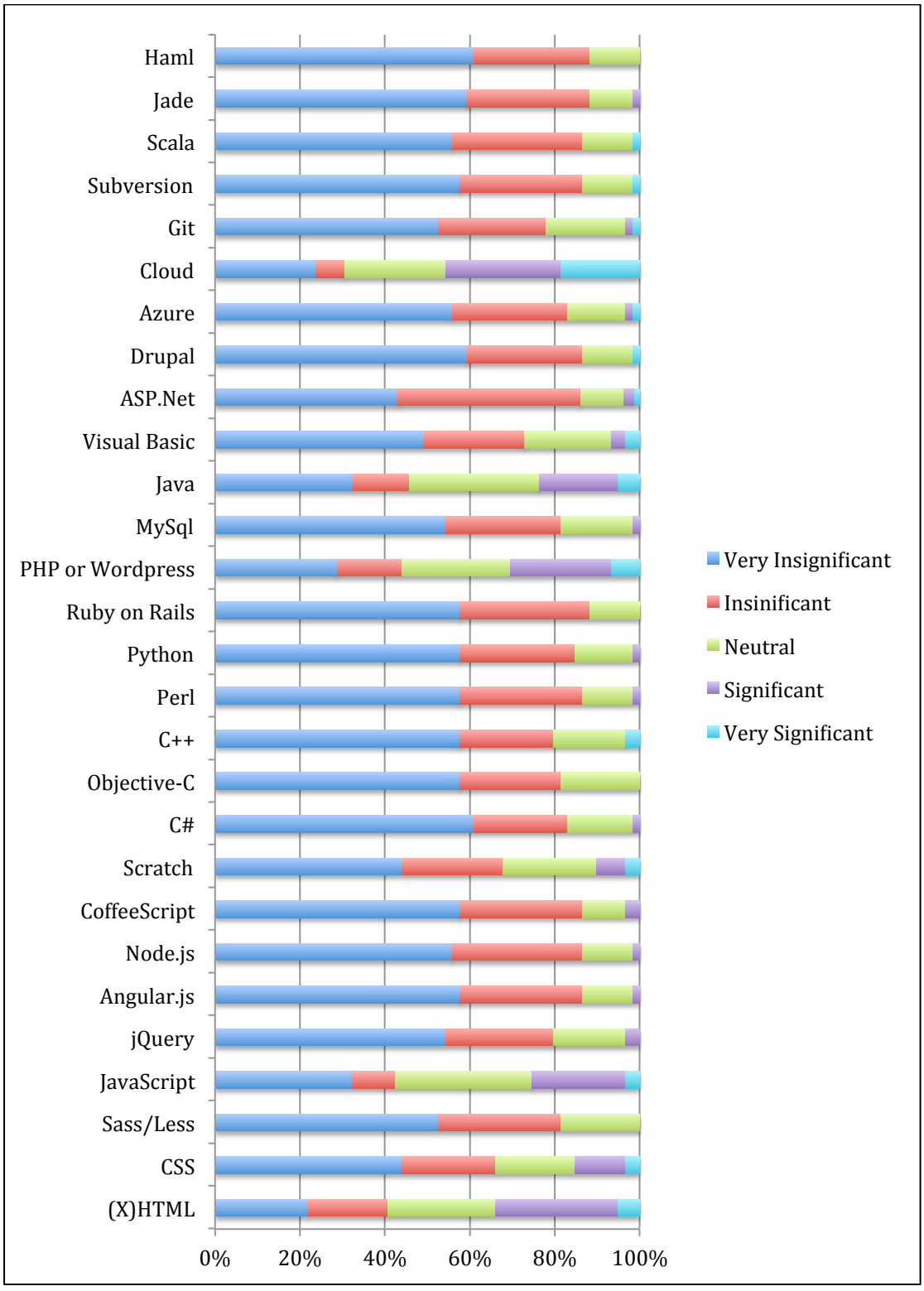

Figure 4-7

4.2.8 Are you aware of the NCCA Junior Cycle Draft Syllabus for P&C?

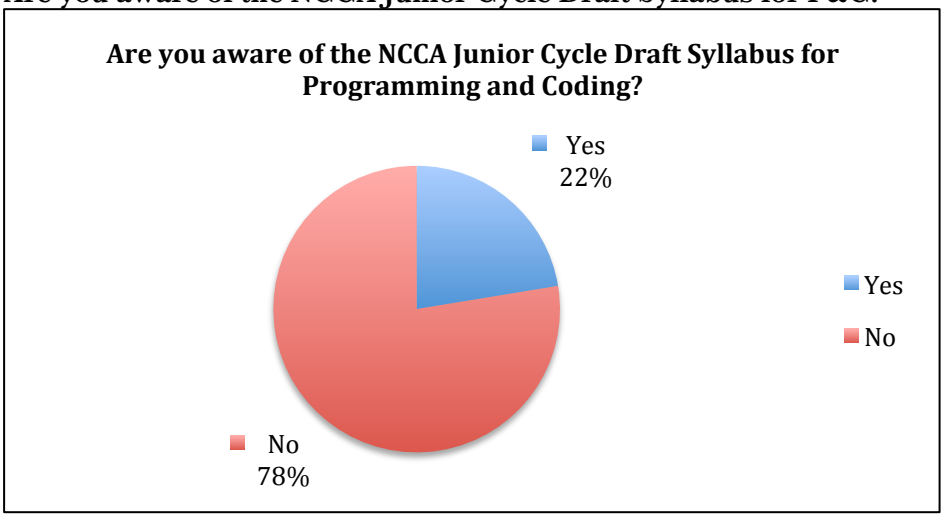

Figure 4-8

Unsurprisingly, the majority of people had not heard of the Junior Cycle draft short course syllabus. According to data breakdown, it was those who were 10-20 years teaching who were most likely to be aware of the ICT curricular developments than any other group (Table 4-4).

Group	Yes	No	% of respondents
0-5 years	6	94	29.9
5-10 years	13	87	28.9
10-15 years	43	57	7.7
15-20 years	42	58	16.4
20+ years	25	75	17.3

Table 4-4

4.2.9 What areas of ICT are currently taught in your school?

This question was important to ascertain the variety of computing taught in the sample set schools. The hypothesis here is that the majority would engage in typing or ECDL style skills development. Several options could be selected. Almost 88% of respondents selected ECDL style ICT being taught in their schools (Figure 4-9).

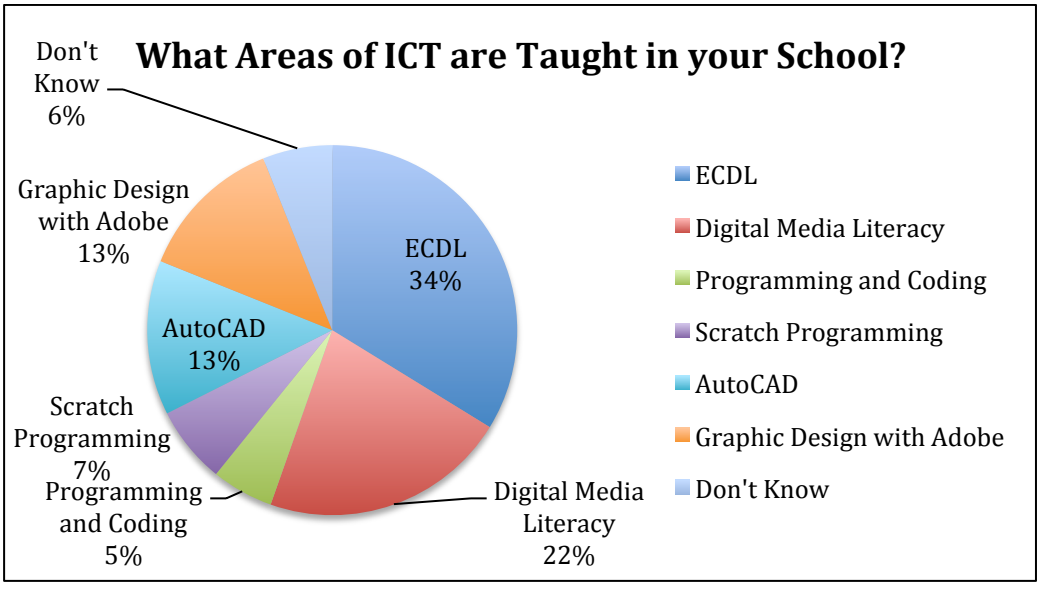

Figure 4-9

Group	ECDL	Digital Media Literacy	Programming Coding	Scratch/ CoderDojo	CAD	Graphics Adobe	Don't Know
0-5 years	88	56	6	18	18	25	13
5-10 years	93	64	7	7	36	50	21
10-15 years	86	57	14	14	29	43	29
15-20 years	92	50	25	25	50	17	0
20+ years	75	50	25	25	50	38	25

Table 4-5

4.2.10 What primary subject(s) do your colleagues teaching computers teach in your school?

This was important to discover, as the hypothesis would be that it is a majority of Maths, Science and Technical Graphics/DCG teachers engaging in computer education, with few Art Teachers engaging in computer education. Respondents could select several subjects. Maths, DCG and Business are the highest represented subjects, with half of respondents picking these subjects. A high number of Art Teachers are engaged in ICT education, which is surprising, and goes against the initial hypothesis.

SUBJECT AREAS OF ICT TEACHERS, ACCORDING TO ART TEACHERS

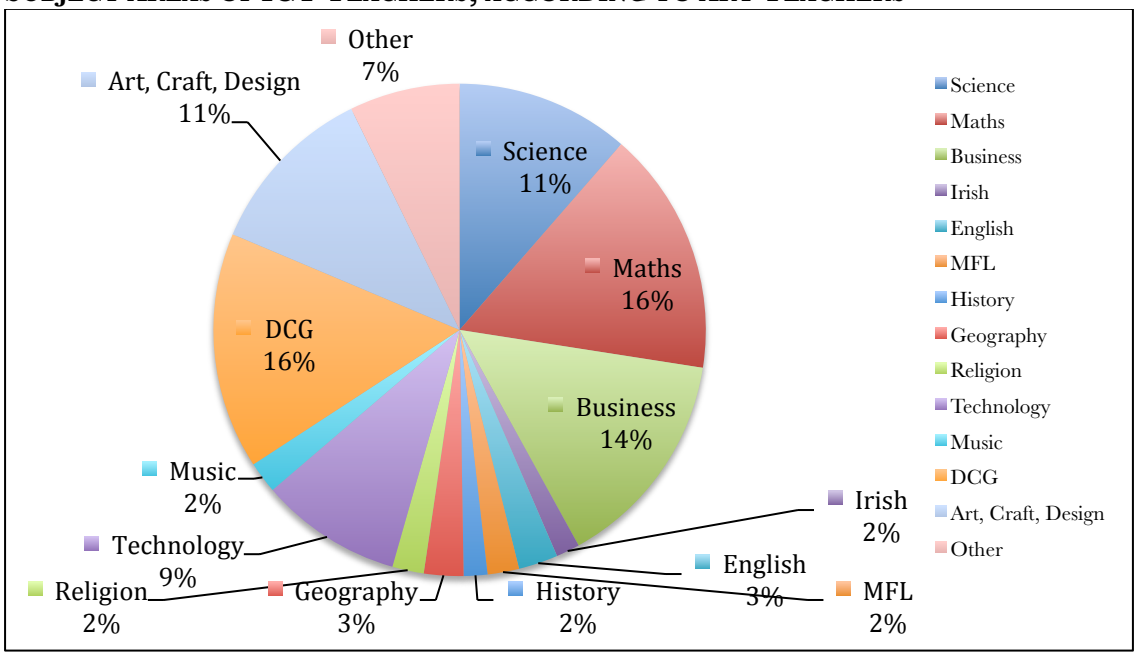

Figure 4-10

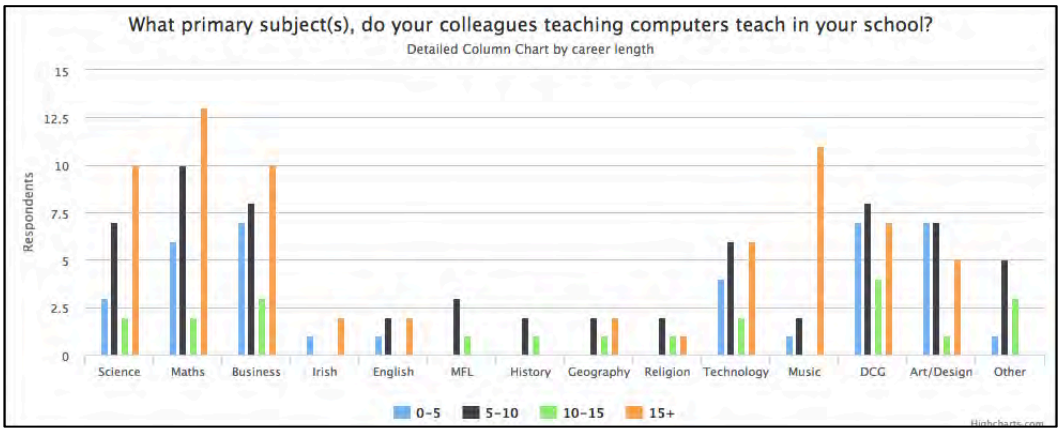

Figure 4-11

4.2.11 Do you feel you could teach P&C at second Level, based on the draft NCCA Syllabus?

This question aimed at assessing respondents' self-evaluation of ability to teach P&C, based on reading the syllabus. Teachers were asked if they felt they "could teach" as opposed to "would they like to teach" as this would measure ability to teach as measured of the syllabus descriptor, as opposed to their desire to teach.

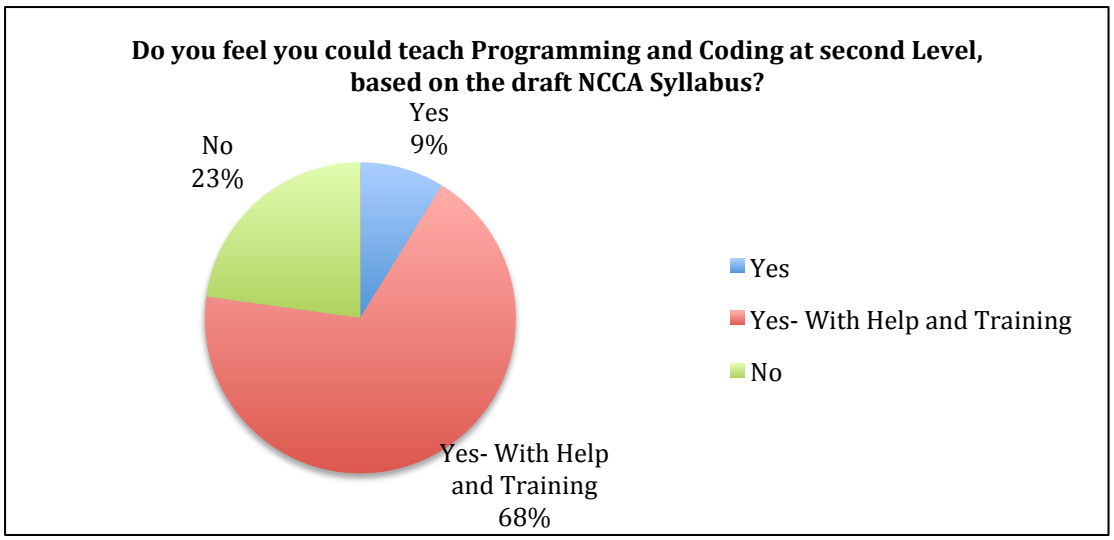

Figure 4-12

Group	Yes	No	Don't Know	% of respondents
0-5 years	13%	75%	12%	29.9
5-10 years	7%	72%	21%	28.9
10-15 years	14%	43%	43%	7.7
15-20 years	8%	84%	8%	16.4
20+ years	0%	50%	50%	17.3

Table 4-6

Based on career length group, those who are earlier in their career are more like to be willing to teach Programming and Coding. However the 15-20 years' career length would also be open to teaching the course, however those who do, overwhelmingly believe they would need help and further training.

4.2.12 Evaluate the following phrases in relation to P&C:

This Question was asked to determine Art Teachers' opinion on certain statements. These statements reflect opinions or stereotypical views people may have on coding and programming. It also sets out to assess respondent's opinion of several topics (Figure 4-13).

STATEMENTS RELATING TO P&C, ART TEACHERS' RESPONSE

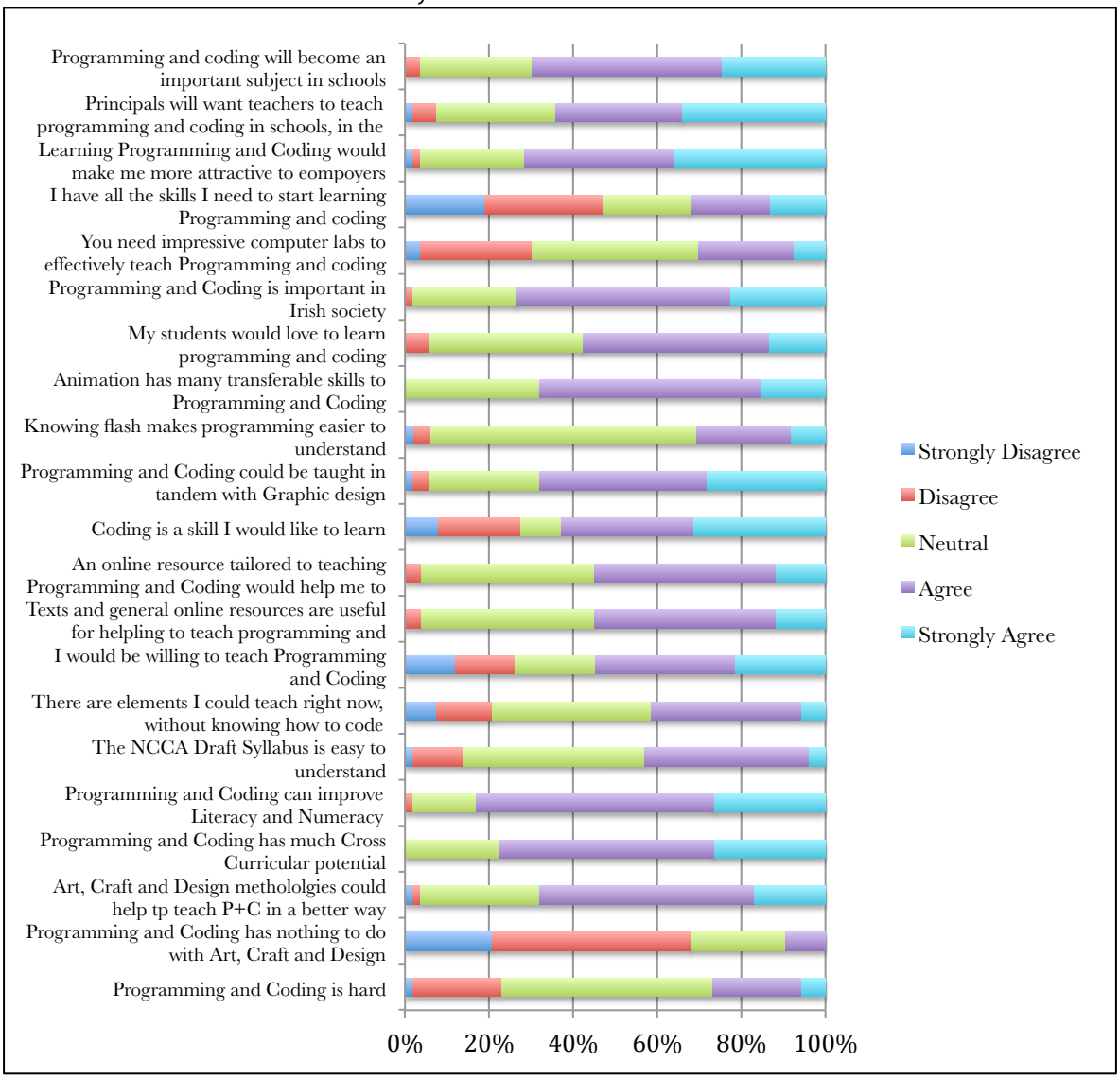

Figure 4-13

ICT ANALYSIS OF RESPONSES	
P&C is Hard	In relation to perceived difficulty levels, most art teachers remain neutral in opinion to the difficulty level of P&C.
P&C has nothing to do with Art	Most respondents would disagree also, that coding and Art/Craft/Design have no relationship to one another, with only five respondents feeling P&C has nothing to do with Art. This particular statement is important when considering the potential for a STEAM based approach, as well as how it would be received.
ACD methodologies could help teach coding better	The majority of respondents agree with this statement, proving the artistic methodologies employed in the art classroom can better help learners program and code.
P&C could be taught …	Unsurprisingly, the majority of respondents agreed with this statement, with a small number feeling that Graphic design could not be taught alongside coding.
P&C has much cross-curricular…	No respondent disagreed with this statement, remaining neutral, or recognising the cross-curricular potential P&C offer.
P&C can improve literacy and numeracy	Unsurprisingly, the majority of respondents recognise the ability for P&C to improve reading, writing and analytical skills.

The NCCA Draft Syllabus is easy to understand	The majority of respondents seem to agree with this statement, or have a neutral opinion of it. Seven respondents think it is not easy to understand.
There are elements I could teach without knowing code	The majority of respondents seem to agree with this statement, or have a neutral opinion of it. Only eleven respondents do not feel they could teach elements of the draft syllabus without knowing to code. There are elements of the syllabus that do not require code knowledge.
I would be willing to teach P&C	A strong majority agree that they would be willing to teach P&C. Similar to the last question, eleven would not be willing to teach P&C, which makes sense.
Coding is a skill I would like to learn	Eleven respondents would not like to learn how to code. The majority who responded would like to learn how to program and code.
Knowing Flash makes P&C easier	The majority of respondents replied with a neutral opinion. Flash is written in ActionScript, a variant of JavaScript, so knowing Flash is the same as knowing how to code.
Animation has transferable skills to P&C	No respondent disagreed with this statement, remaining neutral, or recognising the ties animation has with P&C. Again a STEAM methodology could be built in here.
My Students would love to learn P&C	The majority of respondents agreed or strongly agreed with this statement. A large number remained neutral and one respondent disagreed. This is somewhat in line with the UPC/Amarach results suggest, however this ought to be expected from ICT teachers. A small number disagree with this statement.
P&C is important in Irish Society	The majority of respondents agreed or strongly agreed on this statement. Several remained neutral. Three disagreed. This reflects UPC/Amarach research
You need impressive labs to teach …	The response to this statement seemed to be mostly neutral. There was mostly a balance between those who agreed and those who disagreed.
I have all the skills needed to start …	Many respondents disagreed with this statement. However the majority felt neutral or agreed with this statement.
Texts and Online resources are useful for helping …	The majority of respondents feel this is true, or have neutral opinions on this statement. It will be interesting to compare ICT teacher's opinion of this response.
An online resource specifically tailored to teaching …	The majority of respondents agree with this statement.
Learning P&C to teach would make me more employable	The majority of respondents agree with this statement. Only two respondents disagree. Thirteen remain neutral to this opinion, yet nearly 2/5's of respondents think that learning P&C with a view to teaching it, would make them more employable.
Principals will want teachers to teach P&C in schools in next five years	The majority of the respondent agrees or strongly agrees with this statement. This may reflect I.C.T.'s role within Irish society and the growing technology sector now operating here it is also in parallel with UPC/Amarach research.
P&C will become an important subject in schools	The majority of respondents feel P&C will become important in schools. This may be influenced by the UK's decision to teach computer science as a compulsory subject from the age of five.

Table 4-7

4.2.13 How do you feel you engage with the following types of learning methods?

This question assessed Teacher's engagement level with certain modes and methods of learning a new skill. This was initially important when the research began, as the aim was initially to develop an application that helped teachers learn P&C. As the research went on, time did not seem to allow for such an endeavour, so this was curtailed to an aptitude test design. However, this question as well as the subsequent two would inform further research and future development.

LEARNING METHODS

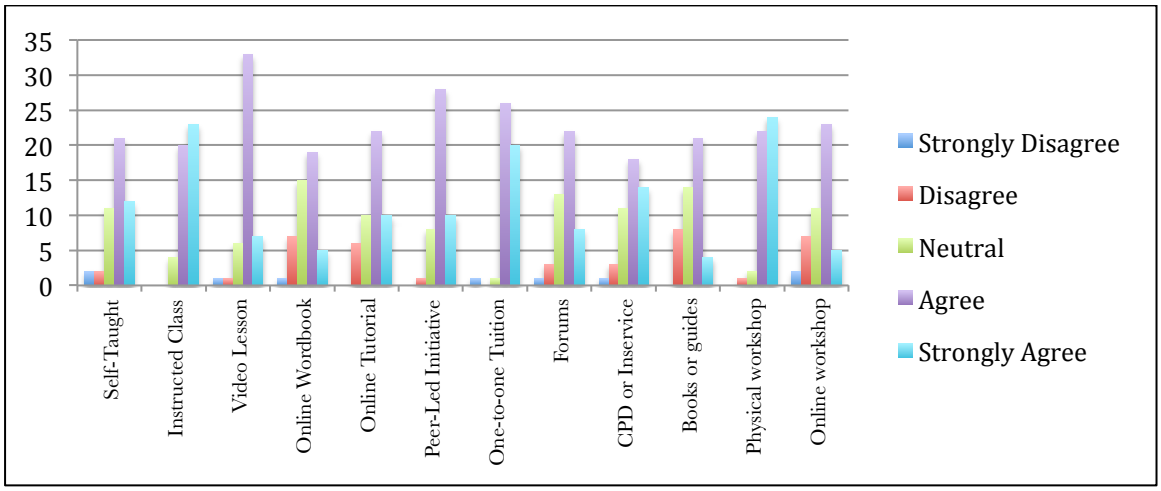

Figure 4-14

4.2.14 How effective do you feel the following tools would be to learning P&C (ICT) - mark out of 5?

Similarly again, this measures teachers' preferred mode of learning, rating each tool out of 5 for effectiveness. This will inform future development of a training application.

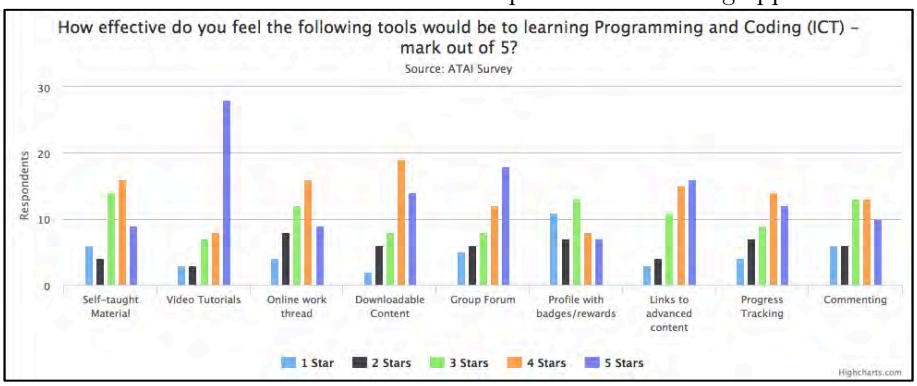

Figure 4-15

4.2.15 Do you feel being able to teach P&C (ICT) would make an art teacher more employable?

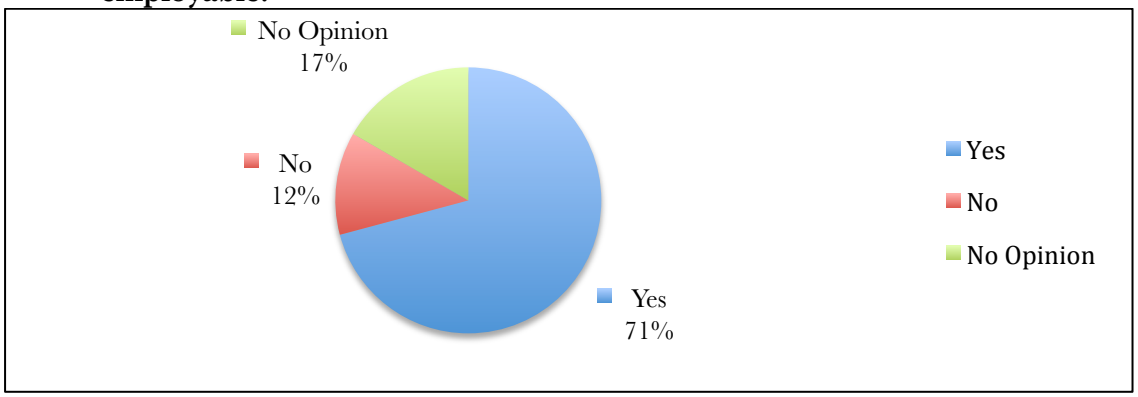

Figure 4-16

As anticipated, the majority of Art teachers do think that being able to teach P&C would make an Art Teacher more employable, with 71.4% agreeing this to be the case. 16% felt it would not make an Art Teacher more employable, and 12% held no opinion. When broken down to age groups, those teaching 0-5 years felt the most that being able to teach P&C would make someone more employable. A quarter of 20+ years' respondents thought it would not make an art teacher more employable. 100% of 15-20 years' experience felt that it would be beneficial, which is

somewhat surprising. 10-15 years experience was split three-ways equally between the three options (see Table 4-17 and Table 4-8).

Group	Yes	No	No opinion	% of respondents
0-5 years	80	13.3	6.6	29.9
5-10 years	66.6	16.6	16.6	28.9
10-15 years	33.3	33.3	33.3	7.7
15-20 years	100	0	0	16.4
20+ years	62.5	25	12.5	17.3

Table 4-8

4.2.16 Analysis and findings of results

The survey affirms many hypotheses speculated before it was conducted. It also affirmed there is a desire among art teachers to engage with Programming, Coding and ICT education. In fact many already do in more traditional modes of computing education, so an addition engagement of professional development and up skilling with P&C would be a natural progression, based on the feedback.

On completion and compilation of the results, it was clear it was necessary to attempt to get feedback from ICT teachers, where no doubt some will overlap with the Art Teacher survey as distributed via the ATAI.

4.3 Analysis of ICT Teacher Survey Results

The Survey was carried out in December 2014. In the CESI mailing list there are about 1,100 members, and according to Teaching Council numbers there are 579 teachers recognised to teach in second level and further education (Appendix A). According to DES numbers, there are 362 schools currently offering computer studies as a subject, so the number of ICT teachers is not quantifiable, it can be assumed that just over a third of which are teaching at post-primary level, just over half teach primary level, and the remainder are those in interest groups and third level or FETAC education. Only those in Post-primary education were requested to respond, and therefore 70/400 or about 20% of the mailing list. 70 ICT teachers responded, while smaller response than the ATAI survey, it is still a substantial number. The survey was carried out over one week, in which, to have 70 respondents is a high volume, when over a space of two months, Kehoe received just sixteen respondents, out of 139, which is only about 11%.

4.3.1 What would best describe the length of your professional teaching career to date?

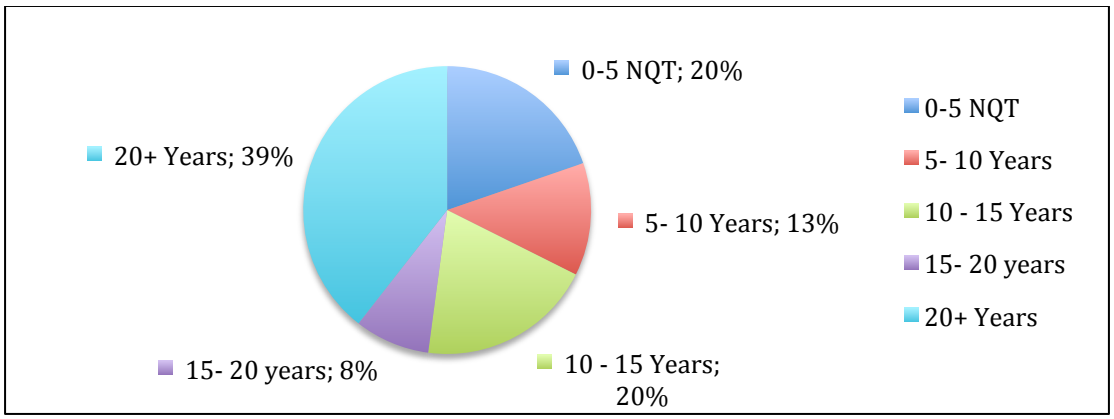

Figure 4-17

A figure 4-20 shows, 40% of respondents have been teaching in excess of 20 years, which is somewhat surprising. NQT's and teachers teaching 10-15 years are the next biggest groups both at 20%. A small number of respondents (8.6%) are teaching in the 15-20 years' group, and those

teaching 5-10 years' are make about 11.4% of responses. This is quite contrasted to the Art Teacher survey, where the majority of the respondents were NQT's followed closely by those 5-10 years teaching.

4.3.2 What do you associate the following words and phrases with:

- Just Computing and Science
- Relevant to Computing/Science and Art/Craft/Design
- Just Art/Craft/Design
- None

ICT TEACHERS' RESPONSE ON STEAM STATEMENTS

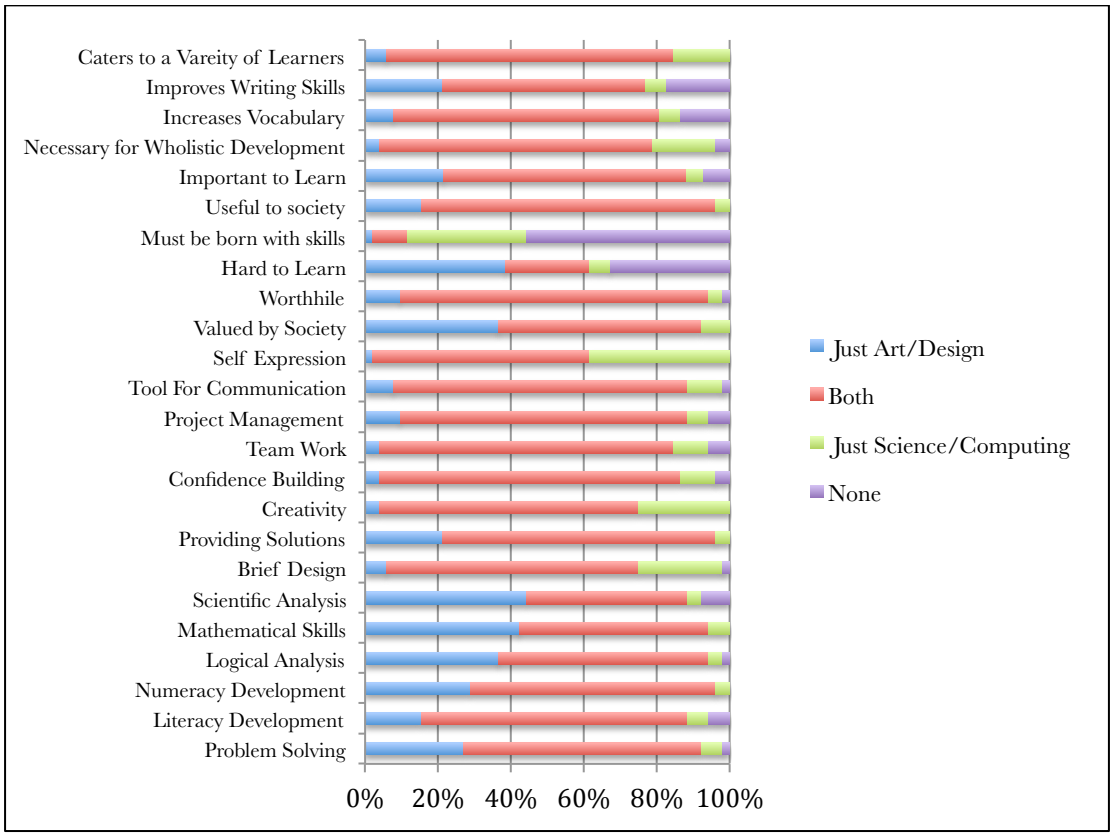

Figure 4-18

Overall, this series of questions is similar to the Art Teacher survey, yet it does show a slight differentiation. A lot more tend to affix a link to Science/Computing to the statements than the Art Teachers did. However like the Art Teacher survey, the majority feel the statements apply to both, with the exception of two statements. This is discussed in the table below.

ANALYSIS OF STATEMENTS	
Problem Solving	Unsurprisingly, compared to the Art Teacher survey, a number of CESI respondents felt that Problem solving was purely a scientific skill, rather than something that can happen in Art and Design. The majority of course recognised its relevance to both areas, which would prove that many teachers feel problem solving is a STEAM element, not just a STEM phenomenon.
Literacy Development	A large number agree that this is applicable to both areas. Small numbers feel it is applicable to just Science/Computing, just Art/Design, or neither.
Numeracy Development	Significantly more respondents feel that numeracy is more a scientific skillset, rather than something that can be applied to both subjects, compared to other answers, despite the general description of numeracy, as discussed previously, reflecting many artistic skills.

Logical Analysis	Similar to Problem Solving, a number of CESI respondents felt that logical analysis was purely a scientific skill, rather than something that can happen in Art and Design. Slightly more recognised its relevance to both areas, with a small number equating it being related solely to Art/Design, or neither area.
Mathematical Skills	As above, this seems to be deemed relevant to both areas, or just to Science/Computing, with a small number linking it just to Art/Design. It is important to note that it was anticipated that it would be expected that the majority of ICT teachers would have opted for the above five statements to have been more so linked to just Science/Computing, it is surprising, yet refreshing to see that this is not the opinion.
Scientific Analysis	This statement is almost split between those who feel it is a skill honed purely in a Science/Computer environment, and those who feel it is applicable to all areas.
Brief Design	A number feel this is more related to Art/Design than Science/Computing, however the majority deem it to be relevant to both areas.
Providing Solutions	Reflecting STEM approaches, and a STEM outlook, a number think Science/Computing provide solutions. The majority think it is relevant to both areas.
Creativity	Unsurprisingly, a number associate creativity with Art/Design more so than Science/Computing, but as previously mentioned most responses are of the opinion that the statements are relevant to both areas.
Confidence Building/ Team Work/ Project Management/ Communication	The responses in these four statements are almost identical, with Project Management deemed to have more relevance to Science/Computing than Art/Design, however the overwhelming majority would deem both Science/Computing and Art/Design is relevant to both areas
Self Expression	Not surprisingly, almost twenty respondents feel that Art/Design is more related to self-expression, however a number more that responded feel that this statement is relevant to both areas.
Valued by Society	In contrast to the previous statement, almost twenty feel that Science/Computing is valued by society compared to Art/Design, though like above more feel it is related to both areas. It was expected; especially from CESI respondents that this would be overwhelmingly on the side of Science/Computing.
Worthwhile	The Majority of respondents recognise both areas as being worthwhile. A small number fell that just Science/Computing as being worthwhile.
Hard to Learn	As expected, a majority feel that Science/Computing is harder to learn, however it was expected it would be felt this would be more so the case. What is more surprising is that almost as many feel neither area is hard to learn.
Must be born with skills	Conversely to the previous statement, almost twenty felt you must be born with artistic skill, yet the majority more so felt that this statement was not relevant to either area.
Useful to Society/ Important to Learn	The majority feel these statements are relevant to both areas, again, which is somewhat surprising. Small numbers feel they are just tied to Science/Computing, which was expected to be the majority response from non-Art Teachers, yet this was not the case.
Necessary for wholistic development	A small number feel this is just relevant to Art/Design, however the majority would advocate for both areas in relation to this statement.
Increases Vocabulary/ Improves writing skills	The responses for these two statements are similar. While the latter has more in favour of it being tied to Science/Computing, the majority would associate it with both areas.
Caters to a variety of learners	It was expected non-Art Teachers would associate Art/Design being related to "catering for all". However, this was deemed to be relevant to both areas, though eight felt it was actually just relevant to Art/Design.

Table 4-9

4.3.3 What is your Primary Subject?

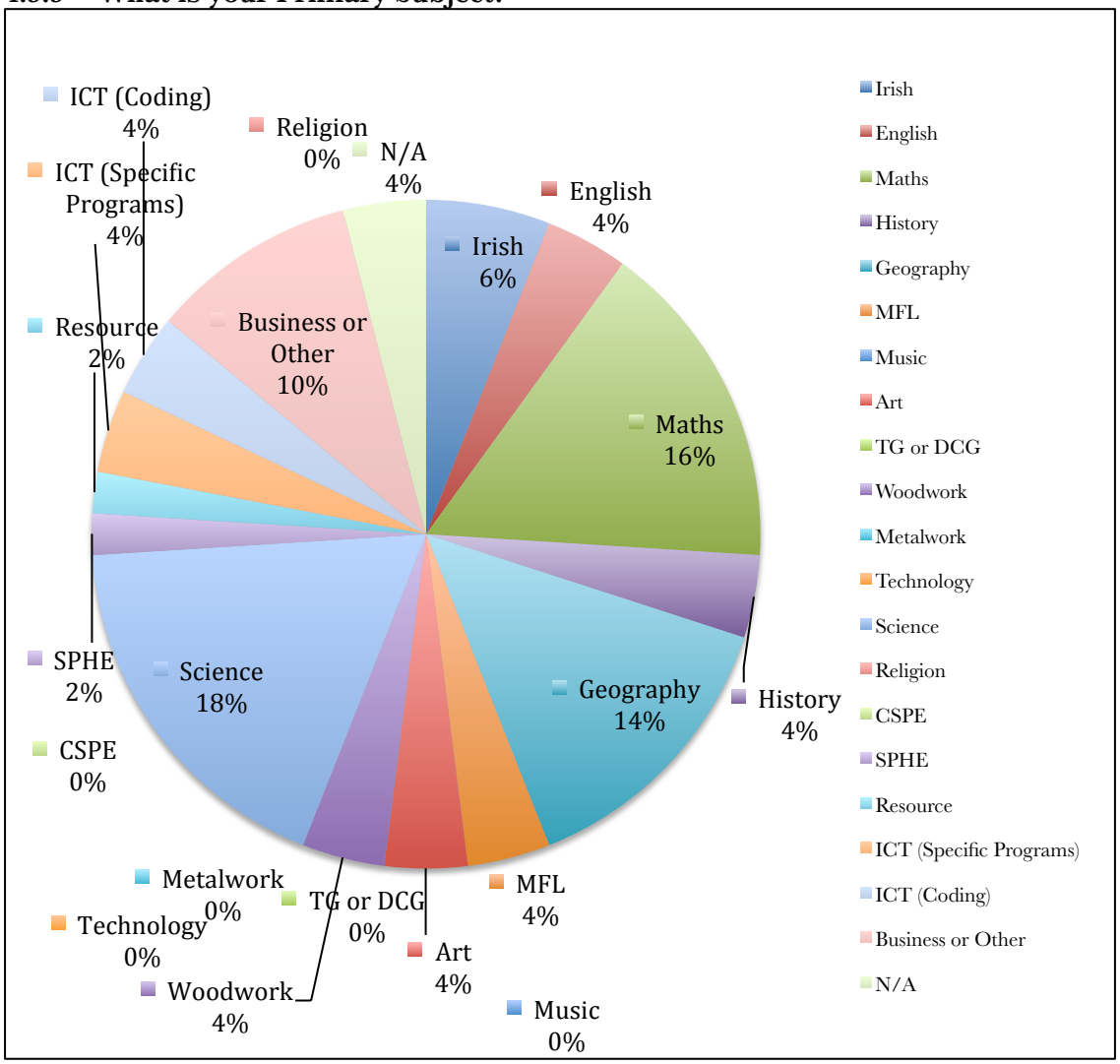

Figure 4-19

Based on the Art Teacher survey response, the top subjects here should be Maths and Science. The top three however, are Science, Maths and Geography. The majority teach core subjects, with optional subjects and short courses being smaller in number of being represented.

4.3.4 Do you teach another subject, if so what do you teach?

Unsurprisingly, the majority of respondents teach ICT as their second subject. This is split between specific programs and coding. Point 4.3.9 will add further to this answer. Respondents could choose multiple answers. Still, Maths seems to be a high response among CESI Teachers, as figure 4-26 highlights, Maths is the highest number of responses (with 22.92%) of respondents selecting this.

SECOND SUBJECTS TAUGHT BY ICT TEACHERS

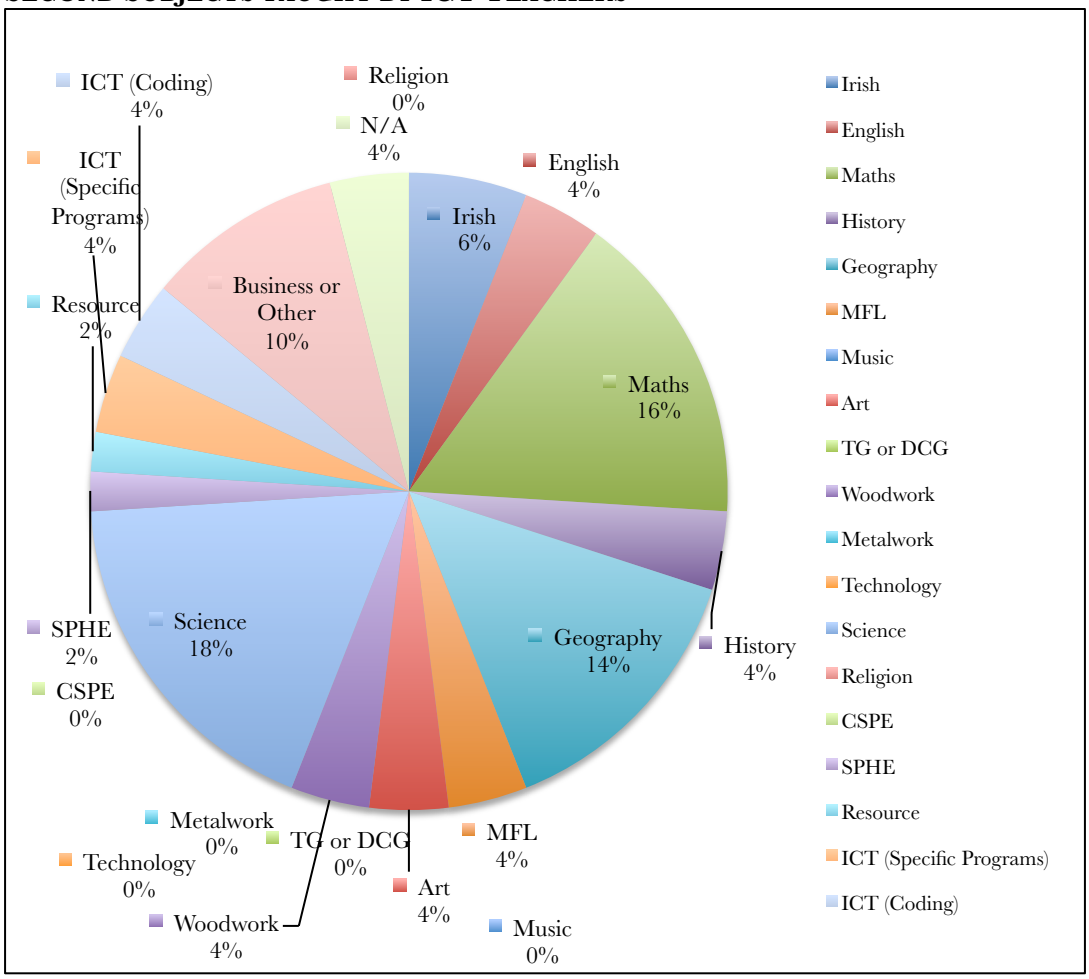

Figure 4-20

4.3.5 Are you recognised as certified to teach this second subject by the Teaching council?

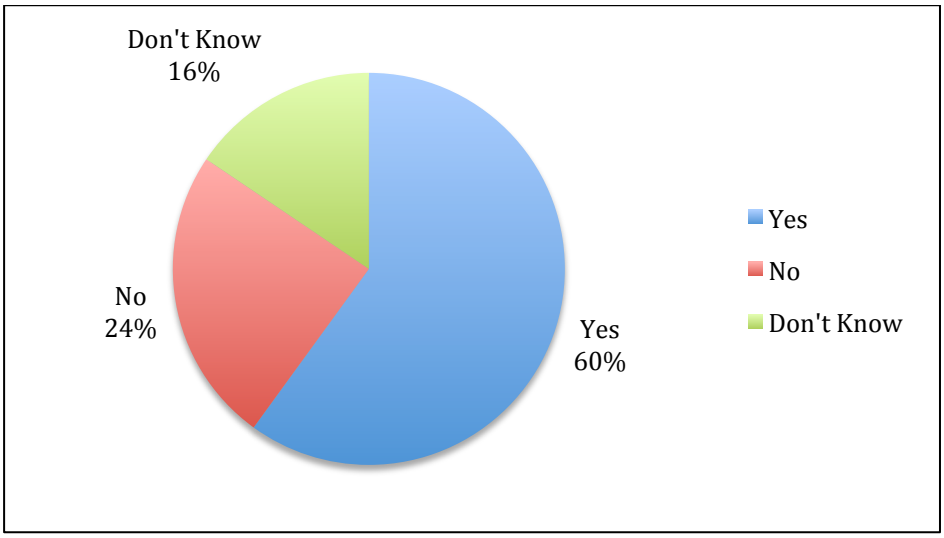

Figure 4-21

Interestingly, almost two-thirds of respondents are definitely qualified and recognised as such to teach their second subject (Figure 4-21). Just over one-fifth is not, and the remaining 16% do not know if they are. This is somewhat interesting, as it would be expected that the yes number would be higher. However as ICT has no formal taught curriculum in place, this could explain the no figure somewhat, as those numbers somewhat align. It could also be appropriated to CSPE/SPHE.

Group	Yes	No	Don't Know	% of respondents
0-5 years	63	25	12	20
5-10 years	83	17	-	13
10-15 years	44	44	11	20
15-20 years	33	-	67	7
20+ years	63	21	16	40

Table 4-10

4.3.6 What ICT Skills do you have/tools can you use?

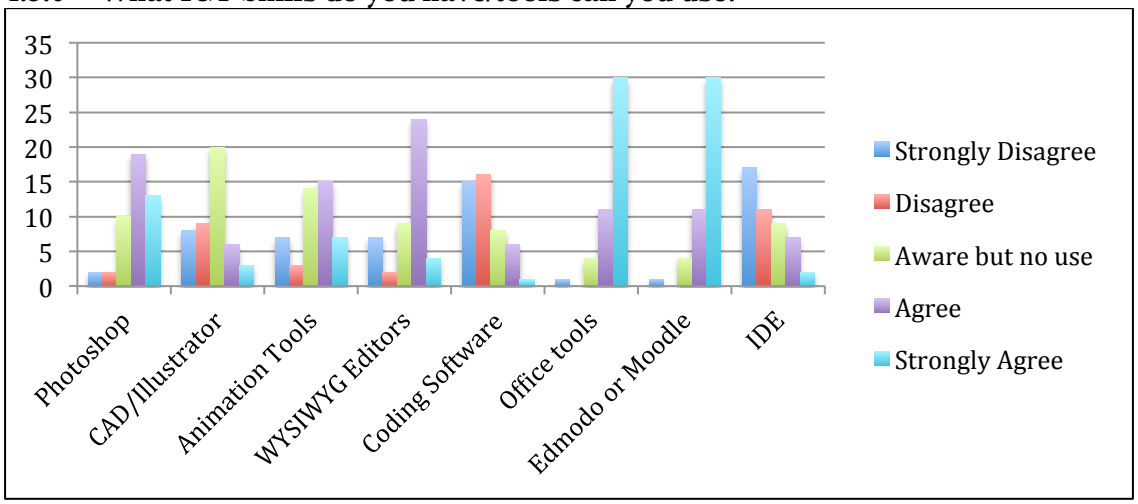

Figure 4-22

As expected, the majority are familiar with office like tools, for example, Microsoft office. Unsurprisingly, the numbers for those unaware of tools and skills are significantly lower than the Art Teacher responses; of particular surprise is the proficiency in WYSIWYG editors, IDE's and Animation tools, which would not be as ubiquitous and mainstream as photo-manipulation.

4.3.7 Do you have significant knowledge on any of the following computer languages, tools or terminology?

When considering the draft NCCA syllabus, this particular question raises food for thought. The majority of respondents are unaware of more advanced code languages such as Sass/Less/Jade/Haml, which are pre-compiled versions of HTML and CSS, which there is a sizeable number either having significant knowledge or neural aware ness of. More difficult areas, such as JavaScript, while it has the highest increase of use among programming languages in 2014 (Tiobe index for December 2014), it is still much less known in comparison to HTML and CSS. Scratch is also unsurprisingly well known, due to Coder Dojo and the lesson schemes provided by LERO via www.scratch.ie. The knowledge of Wordpress and PHP is somewhat similar to be expected. Wordpress is the most popular blogging platform/tool ("Wordpress about page", Anon, n.d.) and has evolved from a blog engine to a quasi-CMS. Drupal, also based on PHP, like wordpress has some who are significantly aware or neutrally so compared to other statements. Cloud technology also has high awareness (Figure 4-23).

There is, unsurprisingly, a greater unawareness of server side languages and tools, though some actually are aware and have use/knowledge of tools like Git, which is rather surprising. What is surprising is that there are a number of respondents, though small who have either knowledge, or

significant knowledge of a server-side language. The number are neutrally aware of these, vastly contrasts Art Teachers' knowledge of these tools.

ICT TOOLS/SKILLS AWARENESS

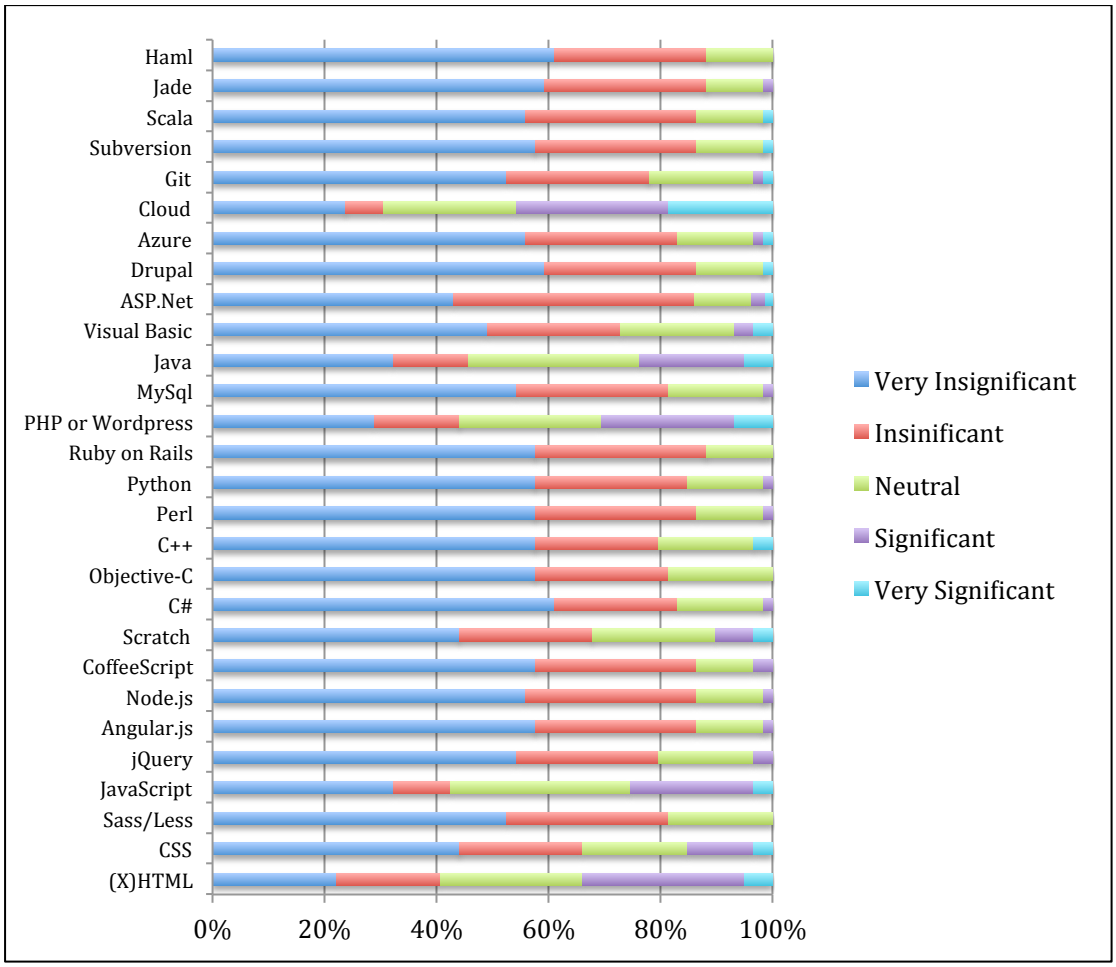

Figure 4-23

4.3.8 Are you aware of the NCCA Junior Cycle Draft Syllabus for P&C?

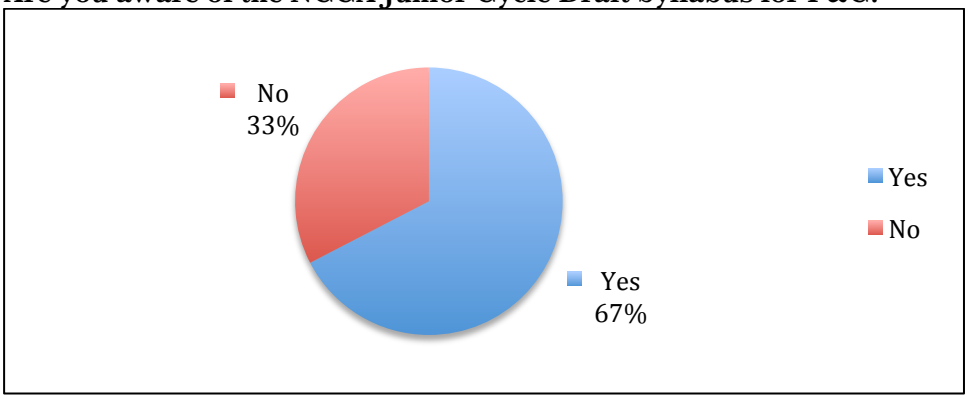

Figure 4-24

Rather surprisingly, just over 30% of ICT teachers are not aware of the NCCA draft syllabus in P&C, Figure 4-24. CESI teachers would, it must be noted, would have a particular interest and involvement with computing in Irish education, so though it is significantly lower than the Art Teacher survey, and indeed, it is almost the opposite response, it is high. As Table 4-11 shows,

there is a variety in those aware of curricular developments, with a longer career being more likely to know of curricular developments, though NQT's are better than their next peer group.

Group	Yes	No	% of respondents
0-5 years	58	43	20
5-10 years	40	60	13
10-15 years	60	40	20
15-20 years	75	25	7
20+ years	80	20	40

Table 4-11

4.3.9 What areas of ICT are currently taught in your school?

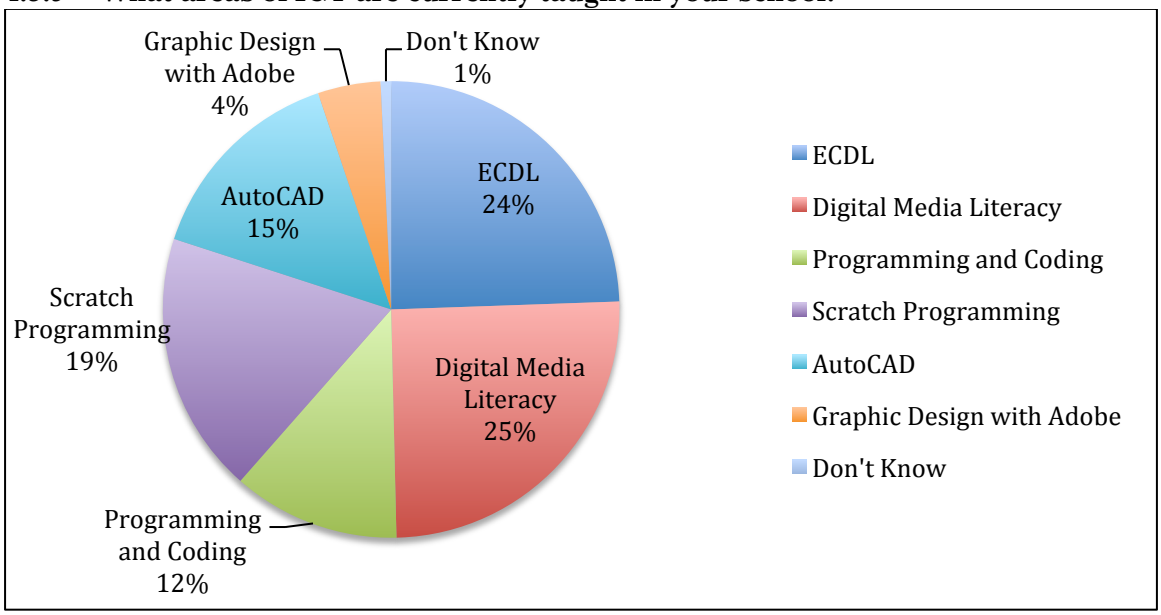

Figure 4-25

The majority of what is taught is deemed to be ECDL or Digital Media literacy and web safety, with three quarters of respondents selecting these. Scratch and Coder Dojo style education is taught in the schools of over 56% of respondents, and equates for almost 20% of what is taught in Irish computer classrooms, according to responses, which is much higher than what the Art Teacher survey (17% respondents/6.76% of what is taught) suggested.

AREAS OF ICT TAUGHT IN IRISH SCHOOLS – ICT TEACHERS

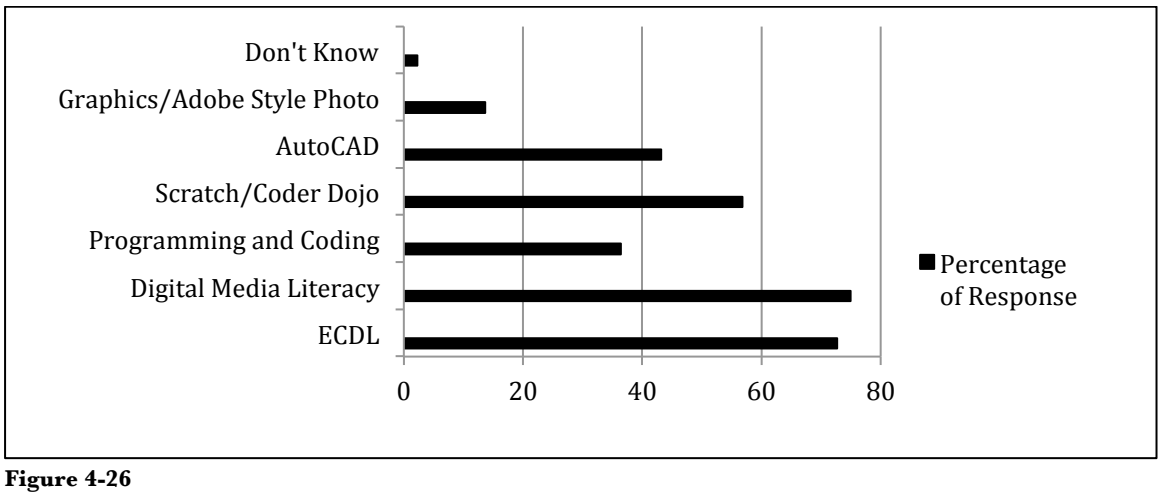

Figure 4-26

This implies that awareness of Coder Dojo and Scratch is not all that high, which reflects national opinion as states in the UPC/Amarach survey results, discussed in Chapter 2. Furthermore, coding and programming is deemed to be 36% of what is taught in computer classrooms, and 12% of what is taught overall. Again, this starkly contrasts Art Teachers' opinions (14% respondents and 5% overall, respectively). Similarly, Graphic Design and photo-manipulation play a much smaller role in schools, compared to what Art Teachers suggest. AutoCAD plays a much bigger role than expected, though this may be subject-specific.

Group	ECDL	Digital Media Literacy	Programming Coding	Scratch/ Coder Dojo	CAD	Graphics Adobe	Don't Know	%
0-5 years	86	57	29	43	43	14	14	20
5-10 years	80	100	40	80	60	20	-	13
10-15 years	80	70	20	20	30	20	-	20
15-20 years	75	25	25	25	50	-	-	7
20+ years	63	90	47	78	47	11	-	40

Table 4-12

4.3.10 What primary subject(s), do your colleagues also teaching computers teach in your school?

This was important to discover, as the hypothesis would be that it is a majority of Maths, Science and Technical Graphics/DCG teachers engaging in computer education, with few Art Teachers engaging in computer education.

Respondents broadly reflect this, with TG/DCG, Maths, Business and Science teachers making up the majority of computing teachers, overall, and would more broadly reflect the background profile of Irish computer education teachers in general. Art Teachers make up 4% of this number.

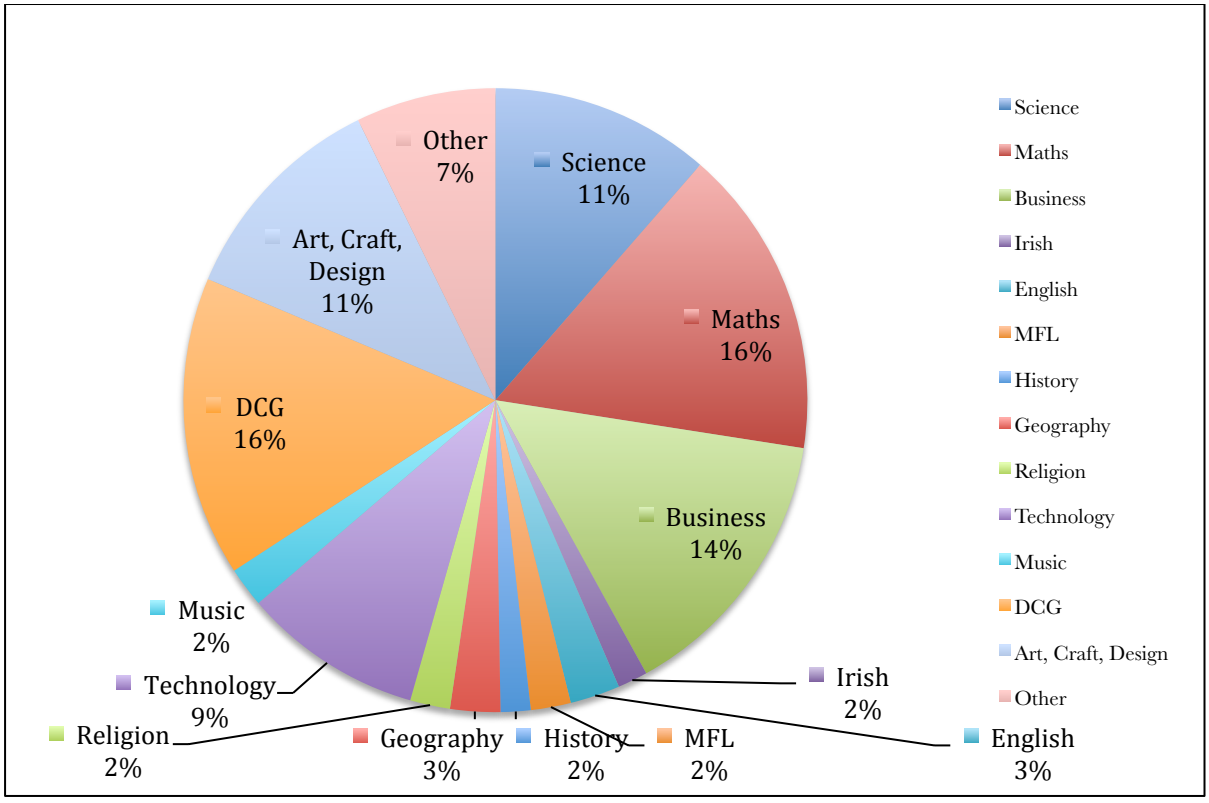

Figure 4-27

4.3.11 Do you feel you could teach P&C at second Level, based on the draft NCCA Syllabus?

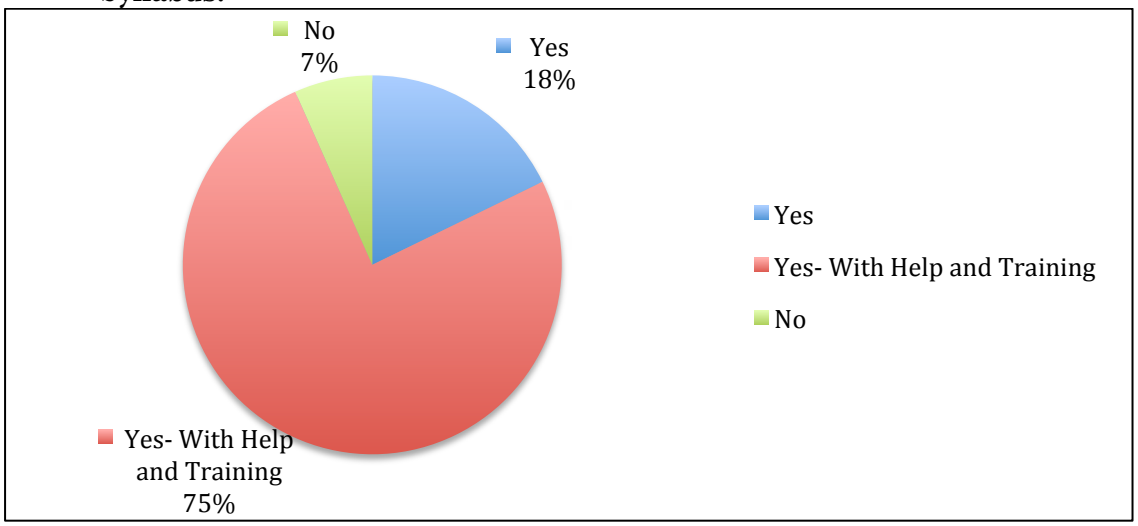

Figure 4-28

Less than 7% feel they could not teach P&C at second level. 75% admit they would need training and help to be able to deliver the subject. 18% feel that they could teach it without help.
This is a similar number to the Art Teacher response. As the research in 4.3.7 suggests, more ICT teachers are unaware of specific programming languages. Theoretically, Art Teachers could be up skilled, and helped put into this role.
Based on the breakdown of career length, only two groups said no, 10-15 years' and those 20+ years' teaching, and arguably close to retiring. Surprisingly, all groups would need substantial help and training, particularly those willing to teach P&C, it is only those at the start or end of their careers who would not need help. This gives logic to the fact that there may be a need, not just for Art and other teachers to up skills to teach ICT, Programming and Coding, or Digital Media Literacy, but also for incumbent ICT teachers themselves, as over 70% from all career length groups, feel they would need help and training to deliver this syllabus.

Group	Yes	Yes- with help	No	Without No% Yes/Yes –with help	% of respondents
0-5 years	29	71	-	29/71	20
5-10 years	-	100	-	0/100	13
10-15 years	10	80	10	9/81	20
15-20 years	-	100	-	0/100	7
20+ years	26	63	11	29/71	40

Table 4-13

4.3.12 Evaluate the following phrases in relation to P&C – Determining Attitudes to Art and ICT STEAM or STEM mentality

Figure 4-29

ICT Analysis of Responses	
P&C is Hard	The majority, understandably are neutral on this statement, as perhaps they do not have a significant knowledge of P&C, as the skills responses suggest, this is the case. A sizeable number disagree with this statement, however.
P&C has nothing to do with Art	The majority disagree or strongly disagree, with a small number agreeing. As many remain neutral as strongly disagree. This particular statement is important when considering the potential for a STEAM based approach, as well as how it would be received.

<table>
<tr><td>P&C has much cross Curricular potential</td><td>The majority recognise the cross-curricular potential P&C offer. This question was repeated with slightly different phrasing later on to ensure that respondents were answering honestly, and the results for the two questions are the same, although in the latter, slightly more agree than strongly agree.</td></tr>
<tr><td>P+C can improve literacy and numeracy</td><td>The majority of respondents agree with this statement. Programming and analysing code for correct syntax is arguably a skill that enhances reading and reasoning skills.</td></tr>
<tr><td>The NCCA Draft Syllabus is easy to understand</td><td>Few disagree with this, but the majority remain neutral about it, or agree it is easy to understand.</td></tr>
<tr><td>There are elements I could teach without knowing code</td><td>Some disagree with this statement, but the majority either feel neutral or confident they could deliver part of the course without knowledge of code.</td></tr>
<tr><td>I would be willing to teach P&C</td><td>The majority overwhelmingly agree with this statement. Based on age demographic, it is mostly those longer in their career that feel less positive about the prospect of teaching P&C.
<table>
<tr><th>%response</th><th>S.Disagree</th><th>Disagree</th><th>Neutral</th><th>Agree</th><th>S. Agree</th></tr>
<tr><td>0-5</td><td>-</td><td>-</td><td>-</td><td>17</td><td>84</td></tr>
<tr><td>5-10</td><td>-</td><td>-</td><td>20</td><td>20</td><td>60</td></tr>
<tr><td>10-15</td><td>-</td><td>10</td><td>-</td><td>50</td><td>40</td></tr>
<tr><td>15-20</td><td>-</td><td>-</td><td>25</td><td>25</td><td>50</td></tr>
<tr><td>20+</td><td>11</td><td>6</td><td>-</td><td>50</td><td>33</td></tr>
</table></td></tr>
<tr><td>Coding is a skill I would like to learn</td><td>The majority agree with this statement. When profiled based on age demographic, the results show that the longer one is teaching, the less likely they are to agree with the exception of the 15-20 years teaching cohort. Overall, the majority do not feel negatively about this statement
<table>
<tr><th>%response</th><th>S.Disagree</th><th>Disagree</th><th>Neutral</th><th>Agree</th><th>S. Agree</th></tr>
<tr><td>0-5</td><td>-</td><td>-</td><td>17</td><td>33</td><td>50</td></tr>
<tr><td>5-10</td><td>-</td><td>-</td><td>20</td><td>20</td><td>60</td></tr>
<tr><td>10-15</td><td>-</td><td>-</td><td>20</td><td>30</td><td>50</td></tr>
<tr><td>15-20</td><td>-</td><td>-</td><td>25</td><td>-</td><td>75</td></tr>
<tr><td>20+</td><td>6</td><td>11</td><td>11</td><td>33</td><td>39</td></tr>
</table></td></tr>
<tr><td>Knowing Flash makes P+C easier</td><td>Most remain neutral.</td></tr>
<tr><td>Animation has transferable skills to P+C</td><td>Most agree or strongly agree, realising the correlation between code and animation.</td></tr>
<tr><td>My Students would love to learn P+C</td><td>Most agree, strongly agree or remain neutral, which is higher than what the UPC/Amarach results suggest, however this ought to be expected from ICT teachers. A small number disagree with this statement.</td></tr>
<tr><td>P+C is important in Irish Society</td><td>Most agree or strongly agree or remain neutral, as with UPC/Amarach research</td></tr>
<tr><td>You need impressive labs to teach P+C</td><td>Most recognise this statement to be somewhat false (all one needs to code is a browser and a text editor, though better tools and technologies make it understandably easier to learn – such is the success of Scratch and Coder Dojo).</td></tr>
<tr><td>I have all the skills needed to start learning P+C</td><td>There is no clear overall consensus, in general most agree, strongly agree, or remain disagree. Few strongly disagree, which is surprising for ICT teachers and advocated of ICT education.</td></tr>
<tr><td>Learning P+C to teach would make me more employable</td><td>Most agree or strongly agree or remain neutral.</td></tr>
<tr><td>Principals will want teachers to teach P+C …</td><td>Most agree, or strongly agree, in parallel with UPC/Amarach research.</td></tr>
<tr><td>P+C will become an important subject in schools</td><td>Most agree or strongly agree or remain neutral</td></tr>
</table>

Table 4-14

4.3.13 Do you think a coding aptitude test would give confidence to those who may be starting to learn how to code?

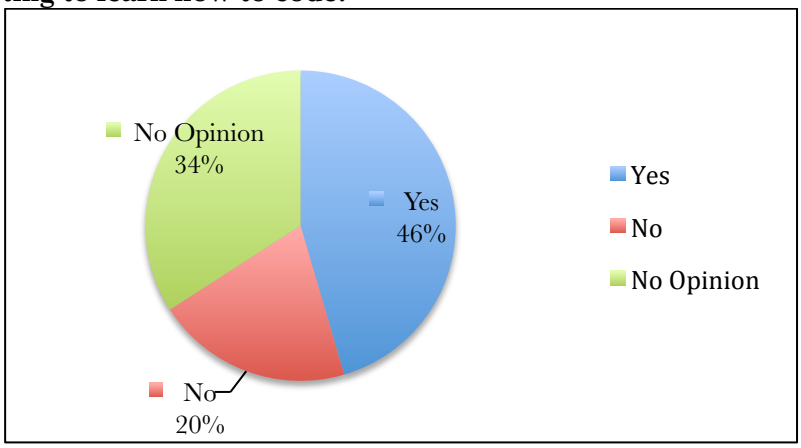

Figure 4-30

Most of those earlier in their career can see the benefit of this approach, with those teaching for longer periods less sure that it would be beneficial. Those at the start of their career, perhaps with "Industry Experience" recognise this as an effective tool.

Group	Yes	No	No opinion	% of respondents
0-5 years	100	0	0	20.0
5-10 years	100	20	20	11.4
10-15 years	30	10	60	20.0
15-20 years	50	50	-	8.6
20+ years	27.8	27.8	44.4	40.0

Table 4-15

4.3.14 Do you feel being able to teach P&C (ICT) would make a teacher more employable?

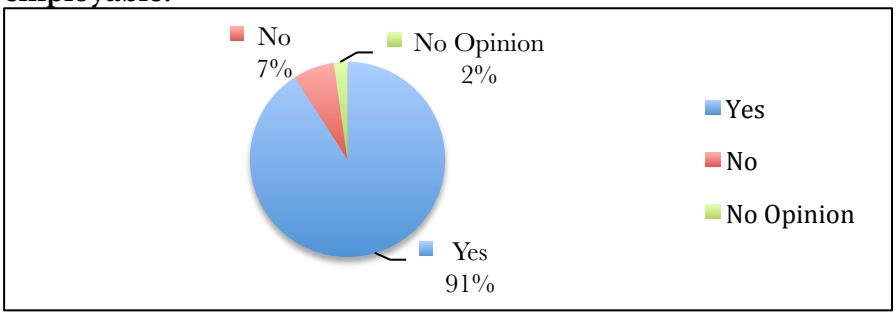

Figure 4-31

Group	Yes	No	No opinion	% of respondents
0-5 years	100	0	0	20.0
5-10 years	100	0	0	11.4
10-15 years	90	10	0	20.0
15-20 years	50	25	25	8.6
20+ years	94.5	5.5	0	40.0

Table 4-16

Analysis of this response was much more positive than the Art Teacher survey. 90% agree that the ability to teach would make a teacher more employable. Based on age demographic, those at the beginning of their careers, or those at the end seem to be more inclined to agree with this statement.

4.3.15 Analysis and findings of results

Interestingly, 75% of respondents feel they would need help and training to teach P&C, as outlined by the draft syllabus, highlighting somewhat surprisingly, that there is remit for an up skilling or conversion programme to enable teachers, not just Art Teachers to be able to teach ICT, P&C.

4.4 Comparison of Art Teachers to ICT Teachers Results

Both surveys were similar, but targeted different groups. There had to be a slight differentiation and wording from one survey to the next. In general they assessed the same criterion, with the exception of one CESI question, and three ATAI questions, due to a change in direction of the research project, after the initial survey was conducted.

4.4.1 Career Length Profile

By and large, there were similarities, but also many differences between the results. For example, the most populous group of Art Teachers is in the 0-5 and 5-10 years' groupings, where the most populous career length in CESI teachers is undoubtedly the 20+ years' respondent with 0-5 and 10-15 years' of that category having half the numbers.

Group	ATAI	CESI	Difference
0-5 years	29.9	20.0	9.9
5-10 years	28.9	11.4	17.5
10-15 years	7.7	20.0	12.3
15-20 years	16.4	8.6	7.8
20+ years	17.3	40.0	22.7

Table 4-17

The least populous areas are 10-15 years' experience in ATAI, and 15-20 years' in CESI. Surprisingly, there are more teachers at the end of their careers teaching computing, although research suggests that many Art Teachers, almost 60% have between 0-10 years' experience, which is also a surprise.

4.4.2 Statements

	Computing/ Science		Both		Art/Craft/ Design		None	
Area/Group =>	**A**	**C**	**A**	**C**	**A**	**C**	**A**	**C**
Problem Solving	1	14	60	34	15	3	0	1
Literacy Development	3	8	65	38	2	3	6	3
Numeracy Development	12	15	61	35	2	2	1	-
Logical Analysis	19	19	52	30	5	2	0	1
Mathematical Skills	15	22	59	27	2	3	0	-
Scientific Analysis	45	23	30	23	0	2	1	4
Brief Design	0	3	50	36	25	12	1	1
Providing Solutions	1	11	72	39	3	2	0	-
Creativity	0	2	53	37	23	13	0	-
Confidence Building	0	2	58	43	17	5	1	2
Team Work	2	2	61	42	11	5	1	3
Project Management	5	5	59	41	9	3	1	3
Tools for Communication	1	4	62	42	12	5	0	1
Self Expression	0	1	28	31	48	20	14	-
Valued by Society	39	19	34	29	2	4	1	-

Worthwhile	1	5	70	44	4	2	11	1
Hard to Learn	20	20	30	12	1	3	2	17
Must be born with skills	2	1	8	5	10	17	56	29
Useful to Society	2	8	73	42	1	2	1	-
Important to Learn	2	9	71	38	2	2	1	3
Necessary for wholistic development	0	2	50	39	21	9	5	2
Increases Vocabulary	1	4	68	38	4	3	3	7
Improves writing skills	7	11	49	29	8	3	12	9
Caters to a variety of learners	1	3	60	41	13	8	2	-

Table 4-18

4.4.3 Second Subjects

Group	ATAI	CESI	CESI 2
Irish		2	3
English		3	2
Maths		11	8
History	3	6	2
Geography		1	7
Business		8	6
MFL		2	2
Music		1	-
Art		1	2
TG/ DCG	4	1	-
Woodwork		1	2
Metalwork/ Engineering		0	-
Technology	4	4	-
Science		4	9
Religion	7	4	-
CSPE	19	7	-
SPHE	23	4	1
Resource	15	2	1
Other	8	8	4
n/a		3	2
ICT Specific Programs*	15	18	2
ICT Coding*	2	8	2

Table 4-19

4.4.4 Registered to teach Second Subject

Yes	ATAI	CESI	Difference
0-5 years	26.67*	62.5	20
5-10 years	33.3*	100	33.3
10-15 years	100*	44.44	56.7
15-20 years	44.44*	33.3	50
20+ years	66.7*	63.16	32
No			
0-5 years	60	25	13.3
5-10 years	33.3	0	16.6
10-15 years	0	44.44	23.3
15-20 years	44.44	0	25
20+ years	33.3	21.05	19.5
Don't Know			
0-5 years	13.33	12.5	6.6

5-10 years	33.3	0	16.6
10-15 years	0	11.11	33.3
15-20 years	11.11	66.67	25
20+ years	0	15.79	12.5

Table 4-20 *Appendix A – Correspondence

4.4.5 ICT tools and languages

	Very Insignificant		Insignificant		Neutral		Significant		Very Significant	
Area/Group =>	A	C	A	C	A	C	A	C	A	C
(X)HTML	13	6	11	5	15	11	17	20	3	4
CSS	26	13	13	6	11	11	7	13	2	3
Sass/Less	31	27	17	11	11	6	0	2	0	-
JavaScript/jQuery/ CoffeeScript	28	19	13	11	12	8	13	6	0	2
Angular	34	35	17	7	7	4	1	-	0	-
Node.js	33	34	18	6	7	6	1	-	0	-
Scratch/Logo	26	5	14	5	13	6	4	17	2	13
C# (C - Sharp)	36	27	17	9	9	7	1	2	0	1
Objective-C	34	30	14	8	11	5	0	3	0	-
C++	34	23	13	12	10	7	0	3	2	1
Perl	34	30	17	8	7	6	1	-	0	2
Python	34	20	16	13	8	8	1	3	0	2
Ruby/Ruby on Rails	34	31	18	9	7	3	0	3	0	-
PHP/Wordpress	17	8	9	3	15	12	14	14	4	9
MySQL/Postgres	32	22	16	8	10	10	1	3	0	3
Java/Scala	25	21	13	10	18	6	11	6	4	3
Visual Basic/ASP.Net	31	18	14	11	12	9	2	7	3	1
Drupal	35	23	16	11	7	3	0	6	1	3
Azure	33	34	16	7	8	4	1	-	1	1
Cloud	14	15	4	3	14	13	16	9	11	6
Git	31	32	15	5	11	5	1	3	2	1
Jade/Haml	35	34	16	7	6	3	1	3	0	1

Table 4-21

4.4.6 Awareness of Draft Syllabus

The numbers of teachers aware of the NCCA Draft Syllabus in P&C varies by subject area, as well as by career length. In the case of CESI Teachers, those who are teaching longer seem to have more of an awareness of the syllabus though, with the exception of NQT's whom almost 60% have an awareness of the syllabus, compared to NQT art teachers where almost a tenth of this number are aware of the syllabus in P&C (see Table 4-4).

Aware	ATAI	CESI	Difference
0-5 years	6.35	57.14	50.79
5-10 years	13.33	50	36.66
10-15 years	42.86	60	22.86
15-20 years	41.67	75	33.33
20+ years	25	80	55
Overall Aware %	22.41	68.89	46.48
Not aware	ATAI	CESI	Difference
0-5 years	93.75	42.86	50.89
5-10 years	86.67	50	36.67

10-15 years	57.14	40	17.14
15-20 years	58.33	25	23.33
20+ years	75	20	55
Overall Not Aware %	77.59	31.11	46.48

Table 4-22

In both focus groups, the majority of respondents are aware of the syllabus (CESI) or unaware, with the exception of the 5-10 years teaching group of CESI, who are 50/50. These numbers may suggest that outside a computing or ICT department, Computing and ICT does not have a strong status as a subject area or role in post-primary schools.

4.4.7 Areas of ICT

As expected, the numbers covering digital media literacy and web safety, as well as ECDL style ICT education covers the majority of what is taught. There is discrepancy of about 25% overall between results, the most prolific being levels of "Scratch" which seems much higher than Art Teachers are aware of.

Group	ATAI	CESI	Difference %
Digital Media Literacy	56	75	19
P&C	14	36	22
Scratch/Coder Dojo	18	57	39
AutoCAD	35	43	8
Digital Graphics	33	14	19
ECDL	88	73	15
Don't Know	16	2	14

Table 4-23

COMPARISON OF ICT AREAS TAUGHT IN SCHOOLS - DIFFERENCE

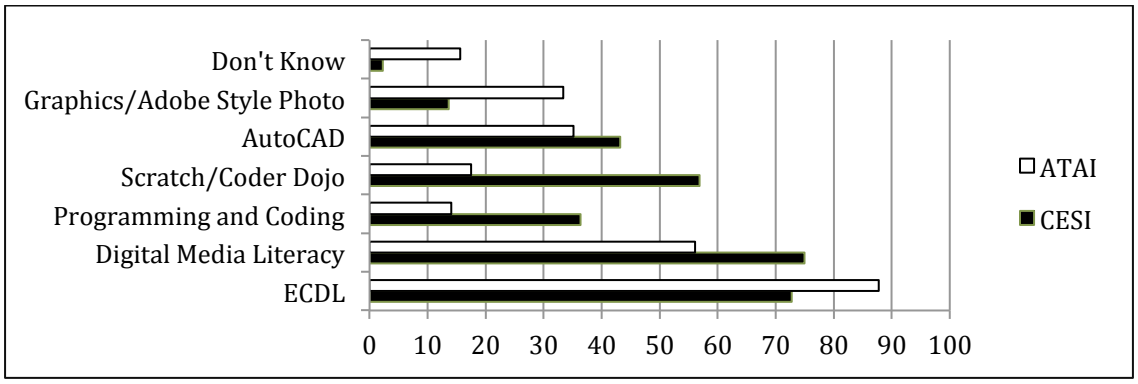

Figure 4-32

Interestingly, the largest discrepancy seems to be between the tuition of Scratch, and Coder Dojo style education in schools. 56.82% of CESI respondents selected this as something that was taught in their schools, compared to a mere 17.54% of Art Teachers. Seeing that the CESI number would be more credible, it is safe to assume that the presence of Scratch in post primary education, and indeed its potential is not promoted in post-primary schools.

Another discrepancy in the results is with those who suggest that they teach digital graphics. One third of ATAI respondents said this was the case, with 13.64% of CESI respondents recognising it as something that occurs. As with the scratch scenario, it may be the case that Art Teachers are teaching Transition Year modules in digital art/photography, and the general school/ICT department are not aware of this in general, and from general teaching experience it could be assumed this is the case.

4.4.8 ICT Teachers Primary and Secondary Subjects

Group	ATAI	ATAI 2nd Subject	CESI Respondent	CR 2nd Subject	CESI Colleague
Irish	3		3	2	2
English	5		2	3	9
Maths	31		8	11	14
History	3		2	6	8
Geography	5		7	1	5
Business	28		6	9	15
MFL	4		2	2	3
Music	4		-	1	4
Art	22		2	1	5
TG/ DCG	30		-	1	15
Woodwork			2	1	9
Metalwork/ Engineering			-	-	7
Technology	18		-	4	9
Science	22		9	4	11
Religion	4		-	4	4
CSPE			-	7	3
SPHE			1	4	2
Resource			1	2	7
Other	14		4	7	15
n/a			2	3	3
ICT Specific Programs*		21	2	18	
ICT Coding*		2	2	8	

Table 4-24 *ICT Teacher Primary Subject only. Art Teacher second subject.

4.4.9 Do teachers think they could teach P&C

As outlined in the table, the majority in both groups think they could teach P&C, though almost identical in those who feel they need help and training to be able to teach this subject, 16.7% of ICT teachers feel they could without help, and 8.77% of Art Teachers feel similarly. Just over a fifth of Art teachers would not be able to, with only 7% of ICT teachers feeling unable to.

Group	Yes %	Yes – with help %	No %
ATAI	8.77	68.42	22.81
CESI	16.7	67.2	7.1

Table 4-25

4.4.10 Statements

This table measures responses. Means between strong agreement/agreement as well as strong disagreement/disagreement were used to make a clearer table. This was an optional question, so in some instances not all respondents answered.

Group	Agree		Disagree		Neutral	
	ATAI	CESI	ATAI	CESI	ATAI	CESI
P+C is Hard	14	8	12	17	26	17
P+C has nothing to do with Art	5	3	36	29	12	10
P+C has much cross Curricular potential	41	35	-	1	12	6

P+C can improve literacy and numeracy	44	36	1	1	8	5
The NCCA Draft Syllabus is easy to understand	22	20	22	6	7	15
There are elements I could teach without knowing code	21	29	11	3	20	10
I would be willing to teach P+C	31	36	8	4	11	2
Coding is a skill I would like to learn	32	32	11	3	5	7
Knowing Flash makes P+C easier	15	6	3	8	31	28
Animation has transferable skills to P+C	36	30	-	3	17	9
My Students would love to learn P+C	30	31	3	4	19	7
P+C is important in Irish Society	39	39	1	2	13	11
You need impressive labs to teach P+C	16	5	16	28	21	9
I have all the skills needed to start learning P+C	17	23	25	13	11	6
Learning P+C to teach would make me more employable	38	31	2	3	13	8
Principals will want teachers to teach P+C in schools in next 5 years	34	35	4	2	15	5
P+C will become an important subject in schools	37	28	2	2	14	12

Table 4-26

4.4.11 Ability to teach programming making teachers more employable

Largely ICT teachers thought that having P&C skills would make a teacher more employable. Art teachers in large agreed, with the exception of the 10-15 years teaching group, who were split three ways on opinion and 50/50 when not taking those with no opinion out of the equation.

Agree	ATAI%	CESI%	Difference%
0-5 years	80	100	20
5-10 years	66.6	100	33.3
10-15 years	33.3	90	56.7
15-20 years	100	50	50
20+ years	62.5	94.5	32
Disagree			
0-5 years	13.3	0	13.3
5-10 years	16.6	0	16.6
10-15 years	33.3	10	23.3
15-20 years	0	25	25
20+ years	25	5.5	19.5
No Opinion			
0-5 years	6.6	0	6.6
5-10 years	16.6	0	16.6
10-15 years	33.3	0	33.3
15-20 years	0	25	25
20+ years	12.5	0	12.5

Table 4-27

4.5 Application Programming Aptitude Testing

The programming and Aptitude test was developed to assess the ability of respondents to code and think logically, as discussed in section 3.5.2.

4.5.1 Issues with Testing

Several unforeseen issues with the test arose. For example, one person doing the test failed as she has dyslexia. An online aptitude test is arguably not suitable for someone with dyslexia. Another issue was length and difficulty of the tests. Some respondents attempted the 30-question quiz but quickly stopped and left, as it was "too long". Many returned to do a simpler, or shorter test.
Getting candidates to sit the test was not an issue per se, but getting Art Teachers specifically seemed more difficult. A number of ICT teachers, ICT professionals, as well as those in learning (including an eleven year old) all sat a variety of the tests.
Time was also an issue (as highlighted 3.4.5). Aiming for the application to perform the testing to gather data was ambitious at best. This meant a substantial delay in deploying a cohesive aptitude test to respondents, with a very short time frame to retrieve data. The engine used to test the aptitude test was built on ASP.net, however it lacked the responsiveness of an engine like Survey Monkey (which does not allow quiz functionality – so that would not have been a viable option). However, it would have been ideal to launch on the Rails application, for data gathering,

4.5.2 Respondents

Respondents came from a variety of backgrounds. Both people in Ireland, and people in other countries carried out the test, globally. The age range was from 11 to 66. Professional backgrounds also varied, with many being from IT, Education or artistic backgrounds. As viewable in Figure 4-33, there is a good age range, with the 30's being the highest demographic of response. Had time allowed, it would have been interesting to test the application in a class situation, however this was not possible, due to the short time frame constraints of the project.

		Age Range
Youngest	Score – 76%	11
Oldest	Score – 77%	66
Average		36

Table 4-28

ANALYSIS OF AGE RANGE IN RESPONDENTS'

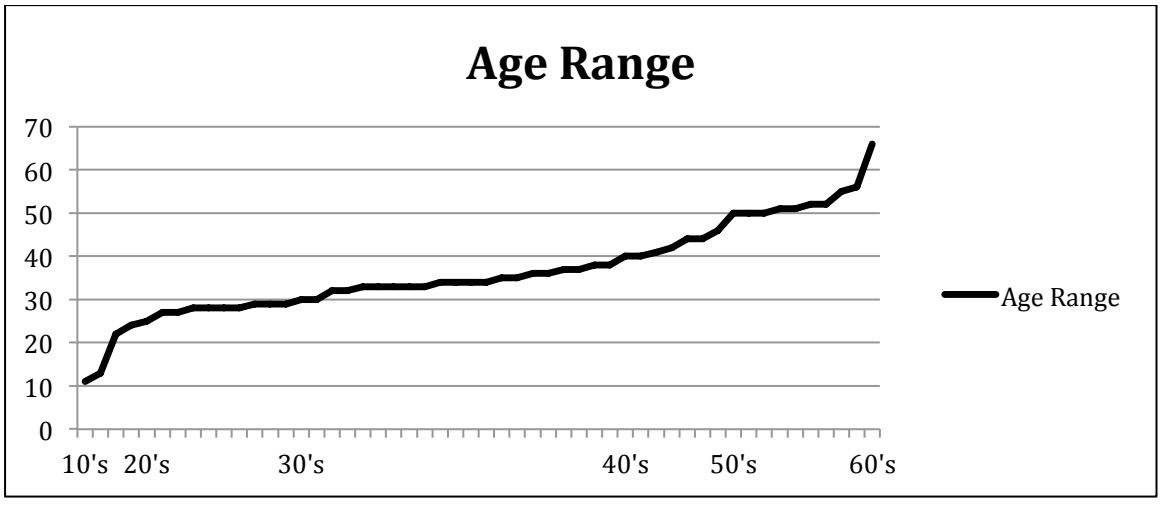

Figure 4-33

4.5.3 Analysis of Long Aptitude Test

82 respondents attempted the full aptitude test, however only 45 completed the test. Of those who quit, 90% of them went on to attempt the shorter variations of the test. As this was an experiment to measure the ability of participants, allowing them to choose the variation of test to attempt was an important element. In the real application, it may be better to allow respondents to choose their

own test length based on time available, such that if it were to be used in a post-primary classroom, the shorter tests would be more suitable, unless it was a double period. It would be useful to help plan lesson content, so that suitable content is delivered based on learners' levels. This will be talked about in Chapter 5 – Conclusions and Future Work. It will also be important to highlight the length of the test and potential time spent on completing the test. This may need a more rigorous qualitative analysis, and could be the basis of future work.

4.5.3.1 ICT Level

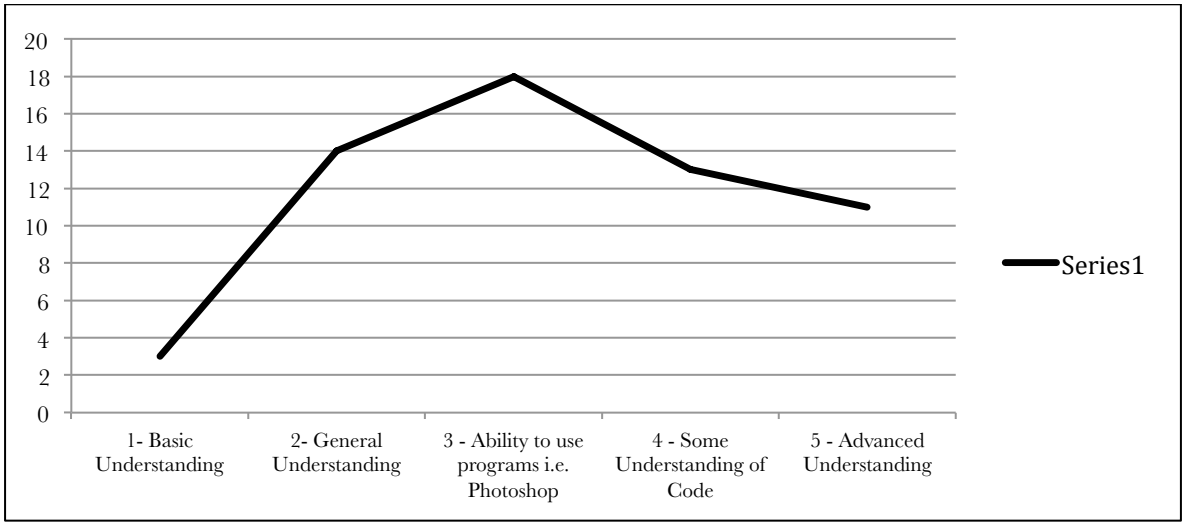

Figure 4-34

A variety of skill level is evident from the details section of the aptitude test. The highest demographic would be those who can use more complex programs such as Photoshop. Some have a basic understanding, such as an eleven-year-old-girl, who attempted the test, getting 76%, others claim an Advanced understanding, and attained 46%.

4.5.3.2 Location of Respondents

Respondents attempted the test from a variety of regions. Within Ireland, Dublin and the rest of Leinster accounted for 42% of the participants. A large cohort from the UK also attempted the test. 52% of respondents were in Ireland. Several may be Irish teachers, teaching in possible emigration destination hotspots, such as Dubai, in Saudi Arabia, or Australia, and Canada. On top of this, many NQT Irish teachers go to the UK to get their 300 hours in education, to be a fully recognised member of the teaching council.

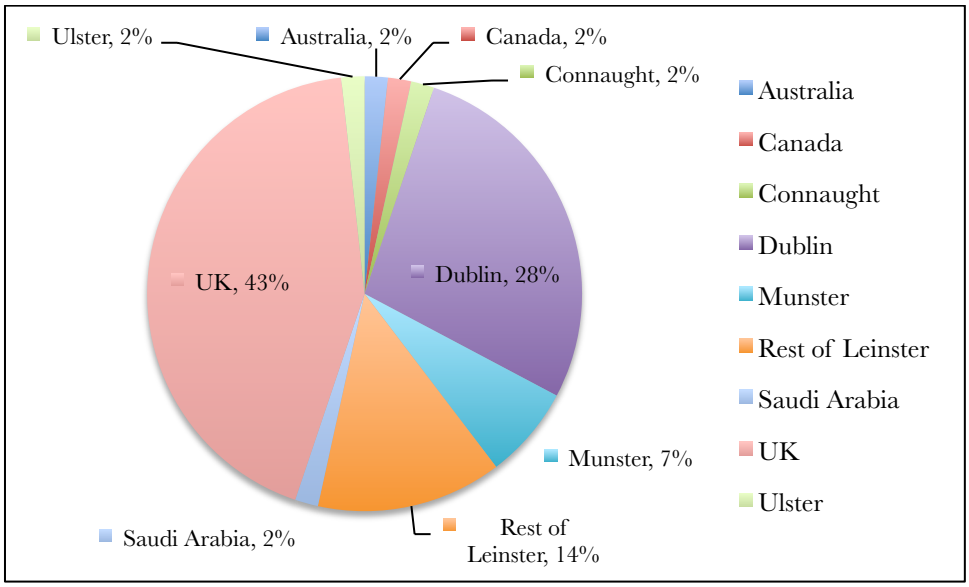

Figure 4-35

4.5.3.3 Professional Background

Teachers were the main focus of the test. The test examined not only Art Teachers, but also people from a variety of backgrounds, to ensure the viability of the test. Art Teachers represent just over 1/5 of respondents. Other teachers represent almost 30% of respondents, with the same amount in other smaller industry areas in relation to the range of responses. Student respondents make up 15%, one of which is an eleven-year-old child, who scores in primary school Drumcondra tests in the 94th percentile (Anon "Drumcondra Tests, n.d.).

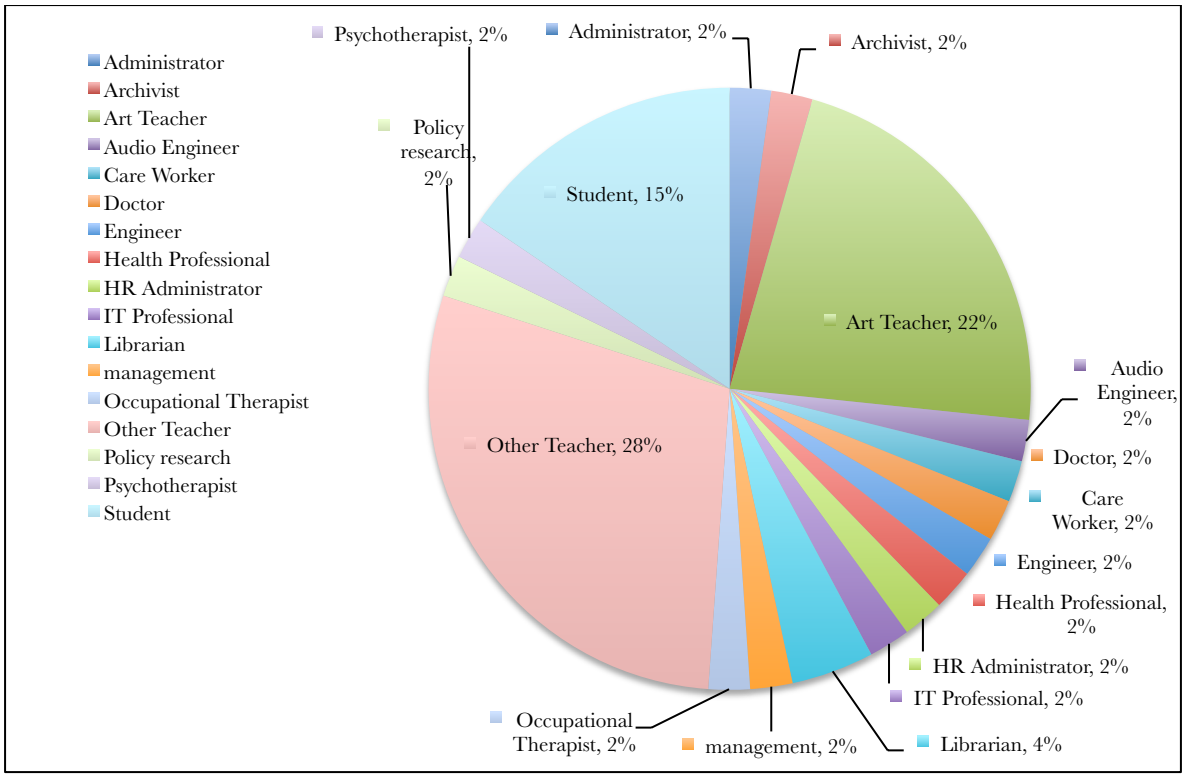

Figure 4-36

4.5.3.4 Results of Art Teachers compared to other groups

Art Teachers fared as well as, if not better than other respondents, with the exception of IT professionals. The results of this experiment are somewhat qualitative, as the percentage of

respondents in comparison to each other were much smaller than the overall number taking the test, however the aptitude levels of most taking the test, averaged in the B/C (55-85%) range (see Table 4-30). IT professionals scored highly in the test, with only 10% of IT respondents failing. This could be due to many reasons, such as time of test, or their level of IT. It was interesting to see a differentiation between UK and Irish IT professionals, with UK Professionals scoring higher, however the respondents from the UK also had a fail rate of 11%. The Irish IT respondents did very well, with 50% getting a B or C grade. This may indicate the level of challenge in the test, however an eleven year old girl managed to get 76% in the test, so it could be argued that the test is robust (see Figure 4-47).

BREAKDOWN OF RESULTS

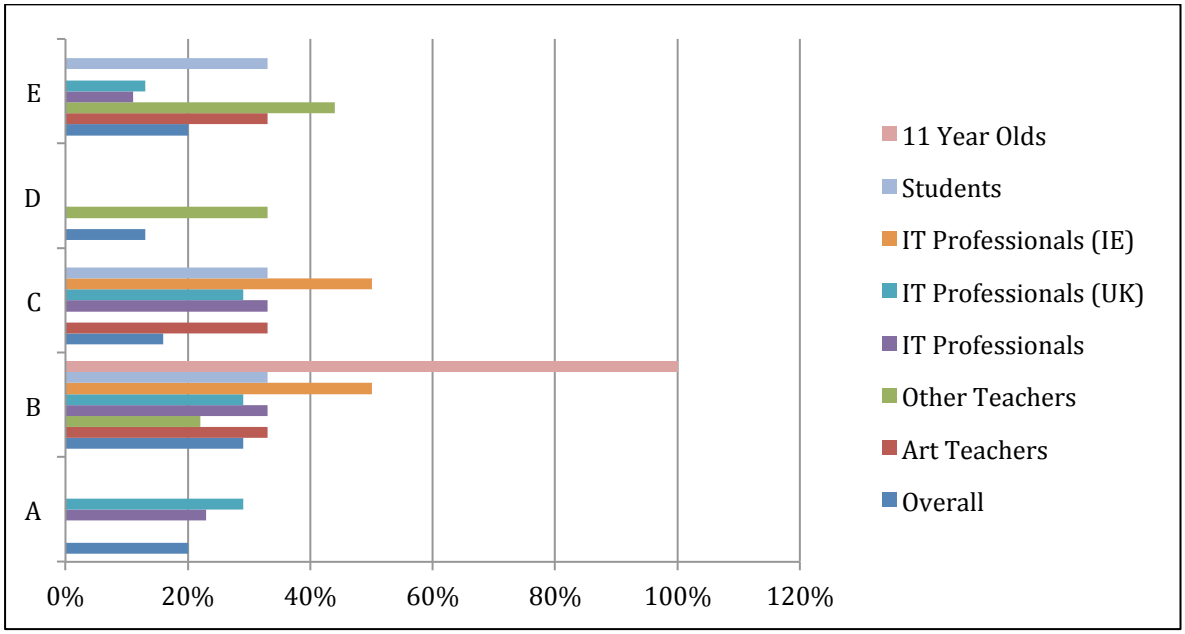

Figure 4-37

	Art Teachers	Other Teachers	IT Professionals	IT Professionals (UK)	IT Professionals (IE)	Students
A	0%	0%	23%	29%	0%	0%
B	33%	22%	33%	29%	50%	33%
C	33%	0%	33%	29%	50%	33%
D	0%	33%	0%	0%	0%	0%
E	33%	44%	11%	13%	0%	33%

Table 4-29

GRADING RUBRIC

	A	B	C	D	E
HIGH	100%	84%	69%	54%	39%
LOW	85%	70%	55%	40%	0%

Table 4-30

4.5.4 Analysis of Results Variation Tests

4.5.4.1 Variation 1 – Easier

The variation test took a sample of 13 from the main 30-question body. The idea behind these questions, was to develop a STEAM based question that mirrors the more difficult STEM examples found online in coding and aptitude tests.

4.5.4.1.1 Overall Results

Based on the numbers in Figure 4-38, overall results indicate that the simple test measures across the board. There is negligible difference in grade level, however the graph peaks at C – level, which would have an understanding, but not much experience in the area. Some exceeded this.

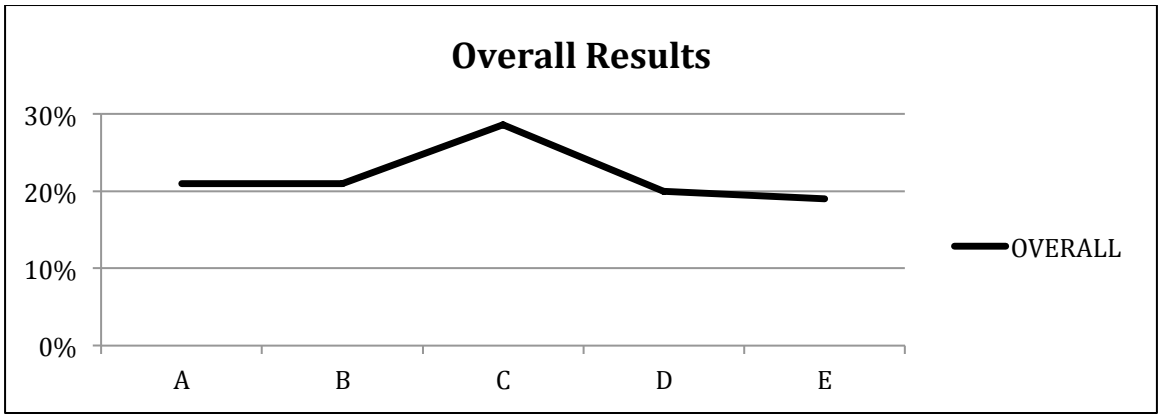

Figure 4-38

4.5.4.2 Teacher Results

The test results displayed in Figure 4-40 show how Art Teachers fared against IT Professionals, and Other teachers. No IT teachers took part in this iteration. Art Teachers out-performed IT professionals, and have the same fail rate. Though less Art Teachers got A's, more got B's than IT professionals. 22% of other teachers did very well, but the rate getting D's and E's was higher than those who got C's overall. This may suggest that Art Teachers would be better positioned to deliver P&C as a subject area they choose to up skill in.

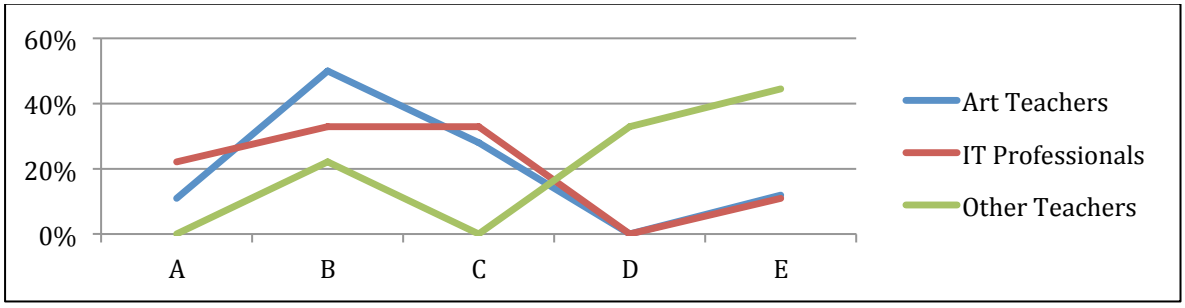

Figure 4-39

4.5.4.3 ICT Level

Before attempting the test, respondents gave data based on themselves, the rationale for this was based on aptitude test research methodologies.. This included a self-assessed determination of the skill they currently have in ICT, ranging from basic to advanced. In the full application, help boxes may make this process much easier for respondents.

Based on Figure 4-40, one can see the peak area of knowledge lies in their ability to use certain programmes, which for a basic test is higher than expected. There is a good number with advance awareness, and the same number with basic awareness.

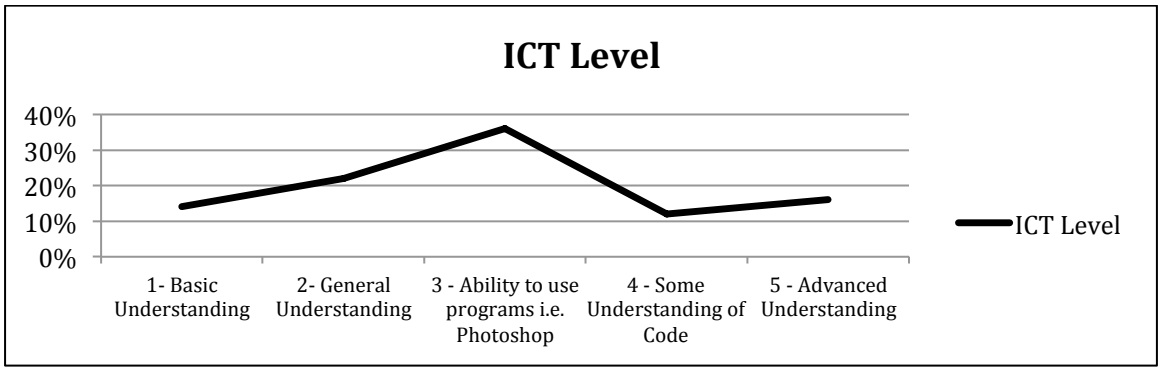

Figure 4-40

4.5.4.4 Location

This iteration of the test was very "Dublin" centric. 82% of the responses of this test were Irish, with 10% coming for the UK (see Figure 4-41).

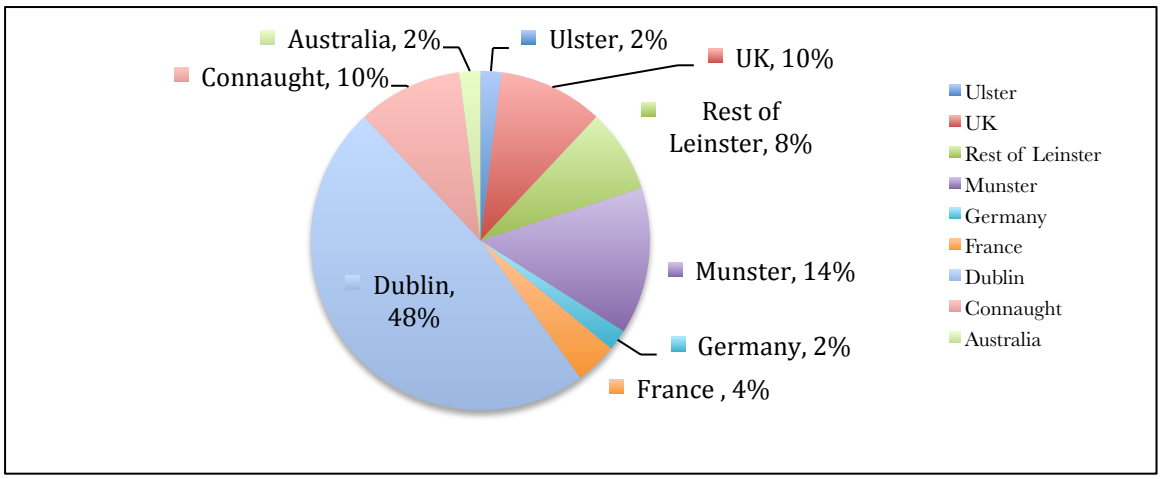

Figure 4-41

4.5.4.5 Professional Background

The majority of respondents here were "Art Teachers" (28%) or "Other Teachers" (28%), while IT Teachers (8%).

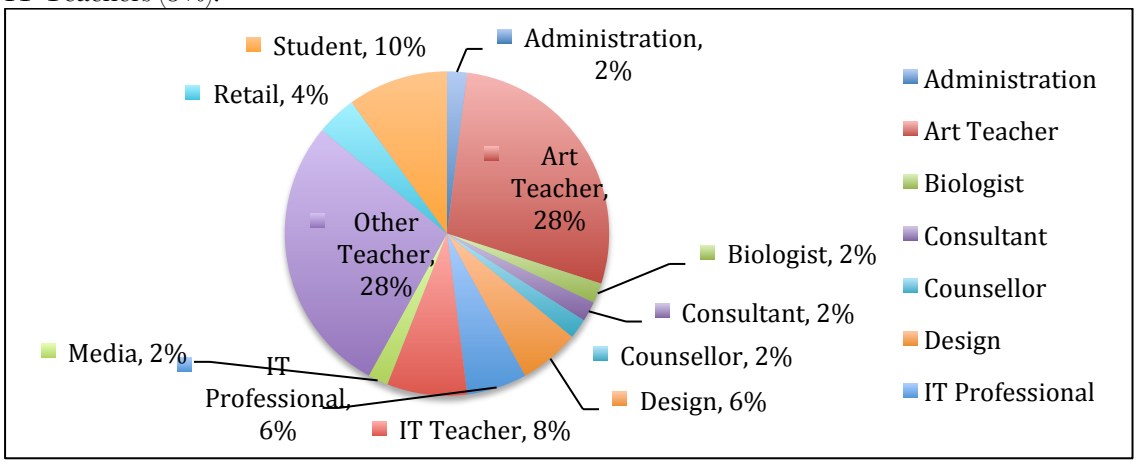

Figure 4-42

TEACHER RESPONDENTS

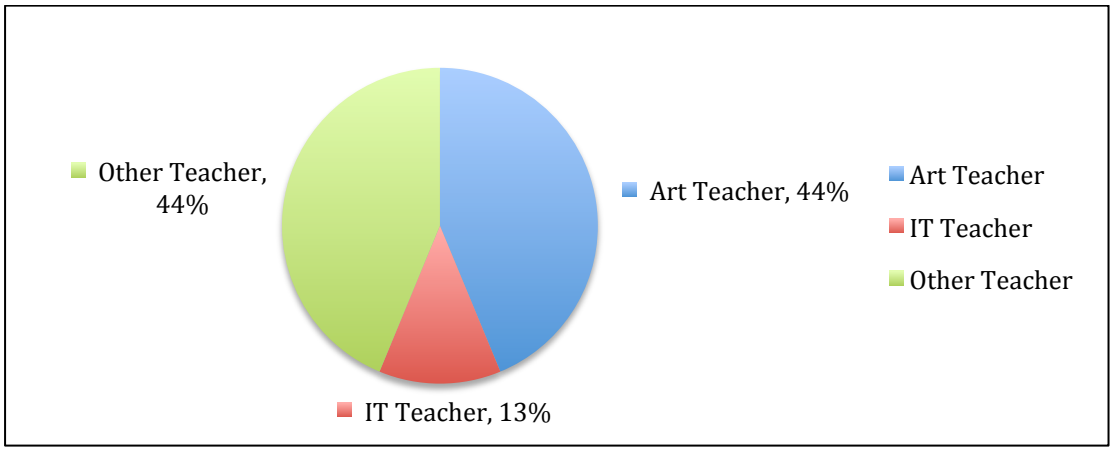

Figure 4-43

When breaking down teacher response (Figure 4-43), 44% are Art or other teachers, while only 13% of this breakdown are IT Teachers, possibly reflecting the low number of registered IT teachers (Correspondence to Teaching Council –Appendix A).

CAREER LENGTH TEACHER RESPONDENTS

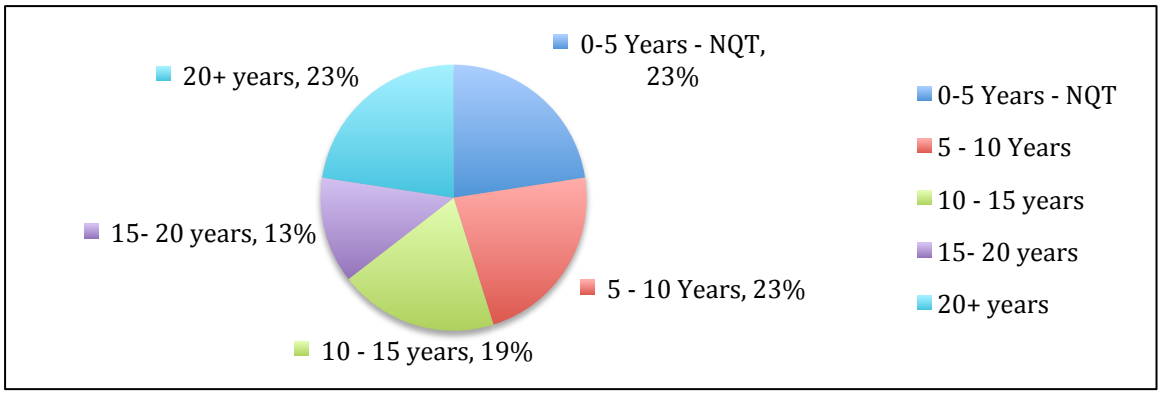

Figure 4-44

Of those that responded, there was a somewhat even distribution of career length. With those in the 10-20 years bracket, being somewhat lower. Ability varied considerably, however, it was those with 20+ years' experience who seemed to have more of an advanced understanding.

TEACHER SKILL BASED ON CAREER LENGTH

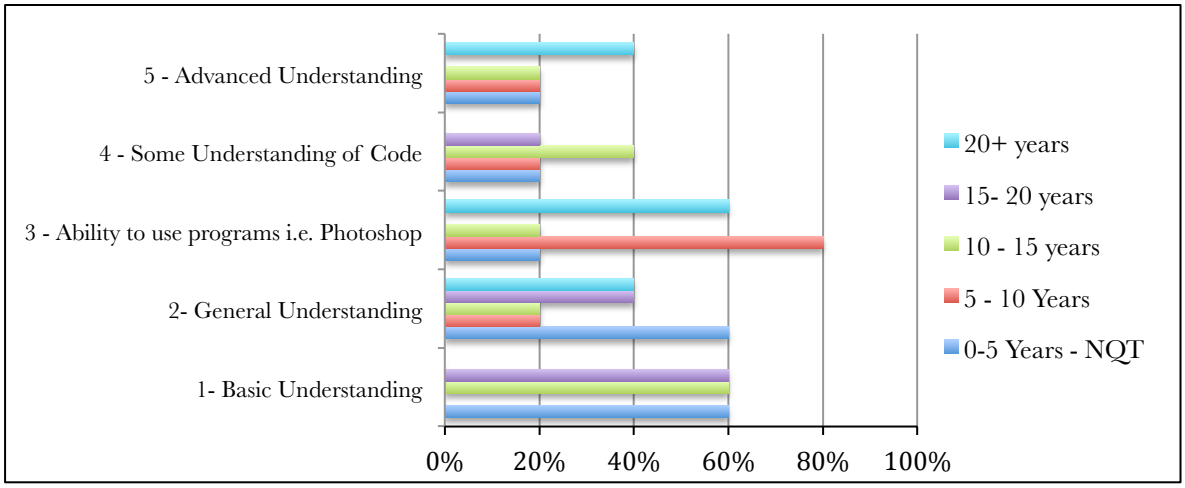

Figure 4-45

4.5.4.6 Age Range

Figure 4-46

		Age Range
Youngest	Score – 76%	11
Oldest	Score – 77%	66
Average		36

Table 4-31

There was a variety of age in those who responded, the youngest being 11, and scoring 76%. Conversely, the oldest respondent was 66, and scored 77%. The average age of respondents was 36.

4.5.4.7 Variation 2 – Moderate

The moderate test was seemed to have a better score rate than the other two tests. However the range of participants was much shorter, with more Art Teachers taking part than any other grouping.

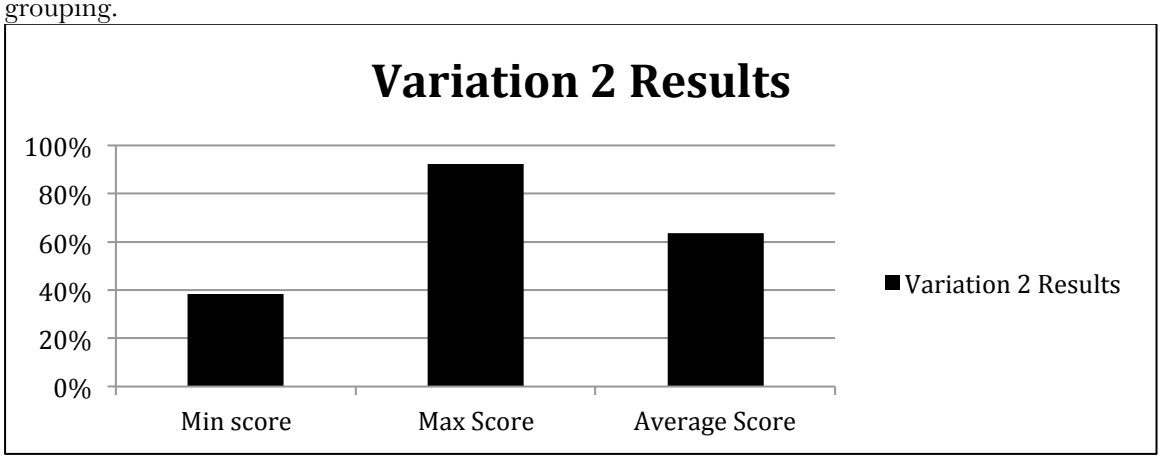

Figure 4-47

Figure 4-48

The highest score was 92%, and the lowest was 38%, just 2% short of a pass rate. The average score was 64%. The age range was much smaller than other iterations of the test, ranging from 27-42 (Figure 4-48). As the highest age was 42, it would be unlikely that someone taking this test would be teaching for more than 20 years, though 15-20 years is plausible, and 40% of teacher respondents were in this category.

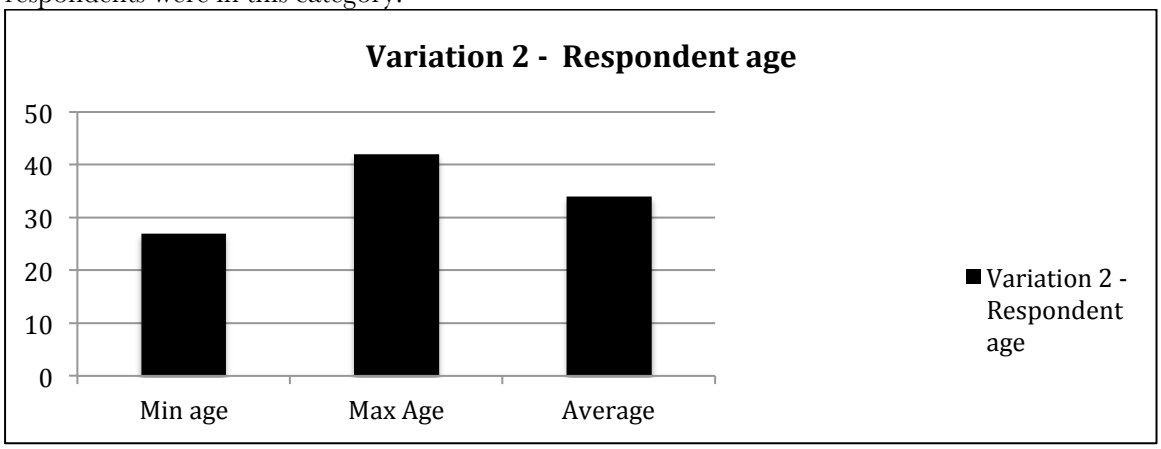

Figure 4-49

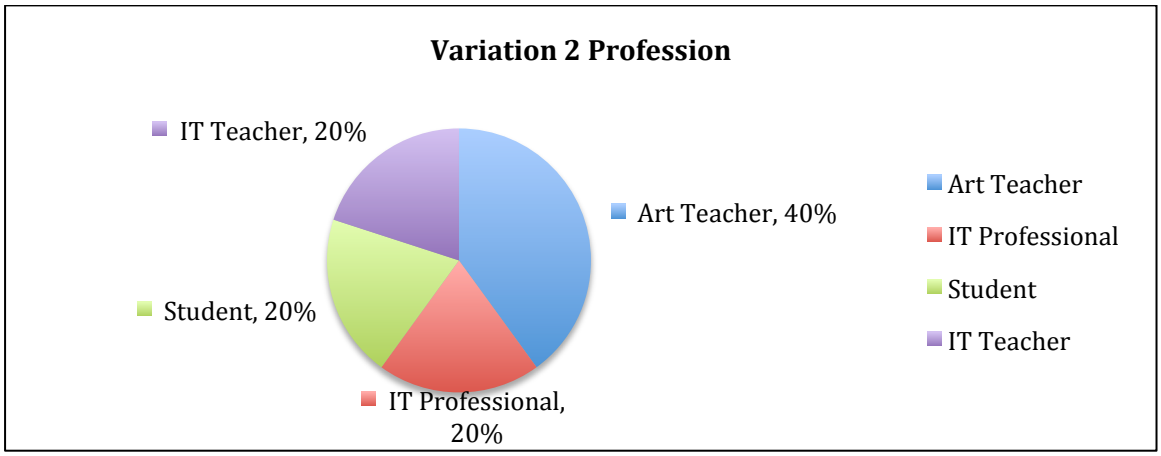

Figure 4-50

40% of respondents were Art Teachers, while another 40% were either IT teachers or IT professionals (Figure 4-50). Based on career length only 20% were NQT (Figure 4-51).

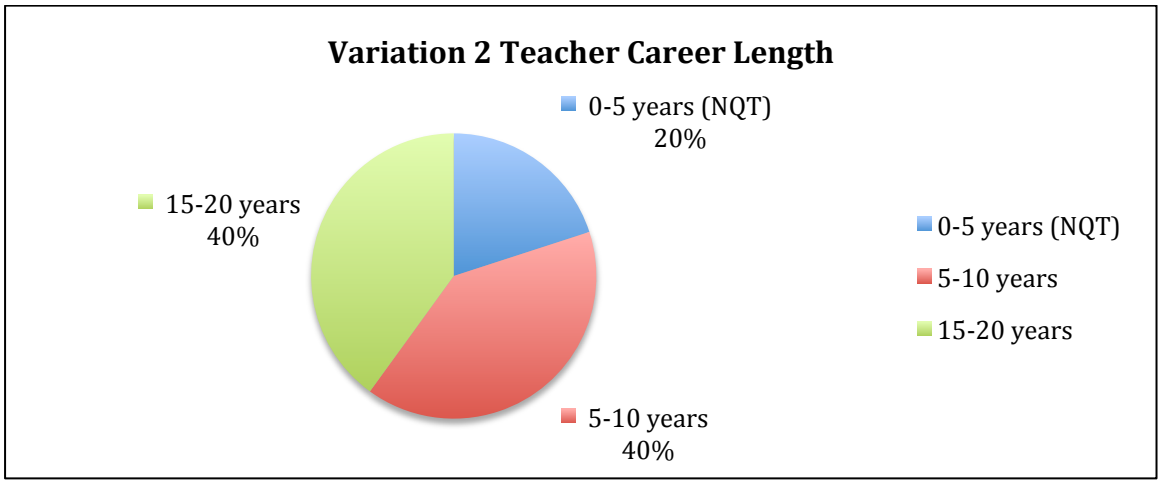

Figure 4-51

As visible in Figure 4-52, there was a mixed ability, with those with either Advanced or an ability to use programs being the main respondent levels. This is clearly reflected in the maximum scores.

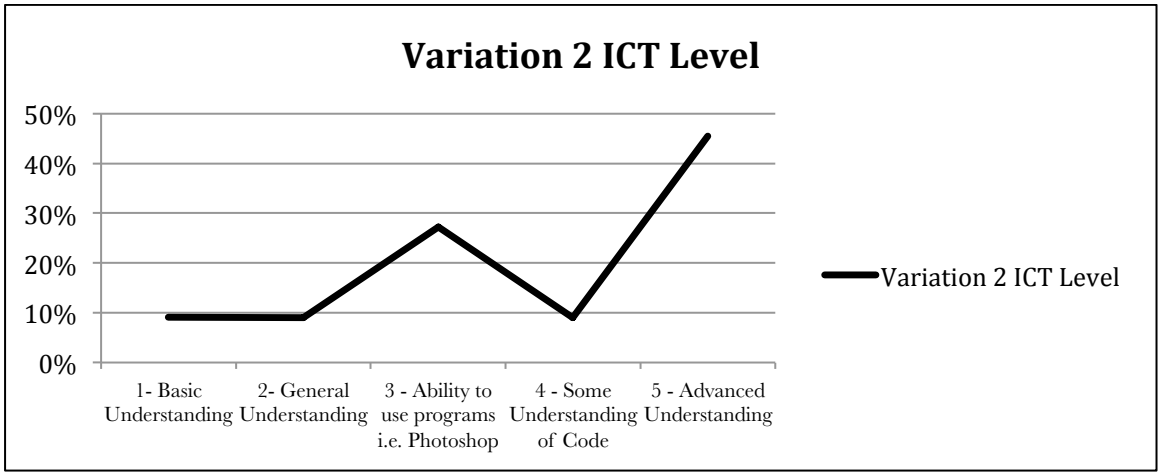

Figure 4-52

4.5.4.8 Variation 3 – Challenging

At the time of writing, there were only seven respondents, so this is not enough to form a strong analysis of the test, however the pass rate for this iteration of the test was 66%, with 33% failing. This iteration of the aptitude test was of similar difficulty to the full test, being that only the most difficult questions were asked. As there are only a handful of responses, the data gathered could not be classed as cohesive, and will not be included in the research.

4.5.5 Analysis and Findings of Results

The aptitude tests supported the initial findings of the thesis, and supported both the research question and the hypothesis. They also reflected quite well Art Teachers' potential to deliver P&C and other areas of an IT/Computing syllabus in post-primary schools.
Surprisingly, IT teachers did not fare better than Art Teachers, and in some instances, fared more poorly in results, meaning that those who are teaching ICT as it currently stands in schools, may not be best-positioned to deliver the future Programming and Coding, or prospective Computer Science syllabi to post-primary students.

4.6 Conclusion

The research that was carried out highlighted many important areas of analysis, which could be further investigated or built upon.

5 Chapter 5 – Conclusions and Future Work

5.1 Introduction

In Chapter 1 it is hypothesised that the majority of newly qualified teachers, as well as those teaching less than fifteen years, would be willing to up skill, learn and teach a new subject such as P&C as part of ICT Education. Further to this, it could be theorised that there is variety of skill in computer literacy, use and knowledge – among both Art Teachers and ICT Teachers. Some may be familiar with coding though use of programs like Flash, After Effects or through coding semantic HTML and CSS for web sites. Presumably, knowledge of coding paradigms and methodologies may be limited and in fact quite low, among both Art and ICT Teachers. It would be interesting to discover if teachers are already updating skills in this area through self-tuition or via Continuous Professional Development (CPD) programmes.

5.2 Research Findings

The Survey of Art Teachers somewhat tallied expectations. Surprisingly, the survey of ICT teachers rather surprisingly revealed that many would need help and further training to teach P&C as a subject, and the levels of those who feel not as confident to teach programming.
Research showed that many Art teachers think they are suitably recognised to teach subjects other than Art, but figures from the Teaching Council revealed that no Art Teacher is presently recognised as qualified to teach anything other than Art.
Research further proved that there was somewhat of a will for Art Teachers to up skill. The vast majority of both ICT and Art Teachers would deem having skills in coding and programming, would make one more employable in a school. Art Teachers could become a viable teaching population to fill a gap in students' education, should they attain computing skills. The merging of computing and art illustrates the beauty of the concept of STEAM for Ireland. This could achieve a range of positive outcomes: serving the needs of students more effectively (Bequette & Bequette, 2012), giving an underutilised and vulnerable set of teachers the potential for greater stability and job security. Better IT literacy could equip the IT industry better skilled workers, which is good for local economy and new economically stable Ireland.

5.3 Future Research Potential

Initial findings suggest that there is scope to further explore the potential to assess aptitudes not just for Art Teachers, but prospective Computer Science students, assessing if there is an aptitude.
The government could use a mechanism like the Springboard programme, where teachers can be adequately fast tracked through a conversion course. It may be beneficial to all teacher groups, but the priority in this paper was Art Teachers as well as current ICT Teachers.
By liaising with the teaching council, and third level institutions, a suitable course could be developed. This would, in theory enable high quality IT skills and methodologies to be developed so that not only Art Teachers, but any post-primary teacher could adopt Programming and Coding or Computer Science as a subject in schools – following international practice, and the recommendations of the Hays report, *"Women in IT"*, while addressing some of the issues highlighted by Cosgrove (Hays, 2014; Cosgrove, 2013).

5.3.1 Advice for Art Teachers

Art teachers may develop the awareness that, to have a positive impact on the employability of students with whom they work, whether these students leave school and seek to move directly into the workforce or choose instead to go to college. By working to promote STEAM approached over STEM approaches in their workplaces, and through their subject association groups, like ATAI and CESI, they can progress the creative potential of the next generation in profound ways.
Art Teachers are in a unique position that they have only one subject, so they could be freer to distribute around a timetable (from a management perspective), compared to core subject teachers. Art Teachers are also under-employed, in that research shows there is approximately two to three Art Teachers for the number of full time roles in Art.

5.3.2 Advice for ICT Teachers

Coding and Programming will become an element of schools in the coming years. Scratch and initiatives like it present the opportunity to develop some really powerful STEAM based learning outcomes. However, with primary level pupils in the UK and no doubt Ireland soon to be engaging in such courses and schemes as Seamus O'Neill's "Scratch from Scratch" programme, as discussed in the literature review, something more robust will be required in the not so distant future. Engaging in CPD via outlets like PDST will be just the start in the developing and training of outstanding ICT education in Ireland.

5.3.3 Advice for Third-Level Institutions

The government could use a springboard like mechanism, where teachers can adequately be fast tracked via a conversion course in a shorter time scale should such a HDip or PGDip conversion course be developed by a third level institution, and accredited by the Teaching Council. Such a move may be beneficial to teachers of other subjects, but the priority of this paper was art teachers and subsequently, those who currently teach computer studies teachers.

5.3.4 Advice for Policy Makers

By combining the Arts and Information technology, learners are engaged on many levels. A robust and thought out programme for ICT and Computer Science must be considered.
Funding should be provided to allow the robust up skilling of teachers, particularly those who are teaching minority subjects. Every school will have more than three teachers for Maths, Irish or English (each class should have five periods a week, in core subjects. Every student in every year group does this. In a school size of 600, with 33 in each class – a worst-case scenario with class size – that is four classes per year group, or 24, in total. This total is multiplied by the number of hours per week, 40 x 5/60, which is 3 hours 40 minutes per class group, which is just short of 80 hours of contact time, not something one teacher could do (maximum contact hours are 22 per week. Notably, teachers of core subjects already teach a second subject. With this in mind, they are already over stretched as regards what they offer. Arguably it should be the case that minority subject teachers be pursued for an up skilling course or initiative. A school is likely to have one, or less (such as, someone with less than full hours in a post) Art teacher, Music teacher, or other minority specialist subject, who usually only have one subject qualification. This is a niche area that should be explored.

5.4 Future Application Growth

It would be beneficial for the future of the application to be able to communicate to the database to dynamically show test results and survey data, this would require AJAX and more complicated front-end tools.
The aptitude test could draw from a larger bank of questions, and allow participants to select their ICT level, so an appropriate test could be generated based on their knowledge or ability.
It would be a good idea to survey all teachers, and test their abilities to compare against Art Teachers, as well as to determine their ability of coding aptitude, to determine if more types of teachers could teach Programming and Coding. The application could also be used in class to test abilities of students.
Initial research was based upon developing an application similar to Codecademy, or Team Treehouse to enable Art Teachers to learn Programming and Coding, and develop their IT skills, however the timeframe of the project did not allow this, however, the author aspires to develop this kind of functionality in a future development of this application.

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7 Appendices

7.1 Appendix A – Correspondence

Coding skills considered Equally Important as Mainstream Subjects

Keith Gregg

Fri 17/10/2014 16:43

Sent Items

To:ambarry@upc.ie <ambarry@upc.ie>;

Bcc:samccormack2@gmail.com <samccormack2@gmail.com>;

Hi Am,

I am a Masters student in NCI - doing thesis research on programming and coding in schools, and how effective it would be to train, in particular art teachers to deliver programming and coding at second level - based on the proposed draft NCCA specification for the short course as published on the NCCA website.

I was wondering if it would be possible to get a copy of the results for my literature review, as this research would greatly help my arguments

Kind Regards,
Keith Gregg

www.keithmiketom.com

Figure 7-1

RE: Coding skills considered Equally Important as Mainstream Subjects
2 messages

Anna-Maria Barry <ambarry@upc.ie> 17 October 2014 at 19:09
To: Keith Gregg <keith.gregg@student.ncirl.ie>

Keith

For sure and the very best of luck with your project.

Attaching relevant info.

Link to press release - http://www.upc.ie/pdf/pressrelease/coding_skills.pdf

Kind regards,

Anna Maria Barry

Corporate Communications General Manager

UPC Ireland

Mobile: +353 86 22 720 72

Figure 7-2

7.1.1 Correspondence to ICS Skills and CESI

No response from ICS Skills, data take from website, phone conversation. Response e-mail and via phone call. Distributed Survey and Aptitude quiz via CESI.

Thesis research

Keith Gregg

Tue 21/10/2014 19:08

Sent Items

To:computing@ics.ie <computing@ics.ie>; info@ics.ie <info@ics.ie>;

Hi there,

My name is Keith Gregg. I am currently a Masters student in Web Technology at the NCI. I am doing my thesis research on Coding and Programming in schools. I had initially looked at the draft syllabus in Programming and Coding from the NCCA, but through my investigations, I discovered a number of schools are currently teaching the ICS accredited and designed programme, which enables students to engage in and learn Programming and Coding as part of a module.

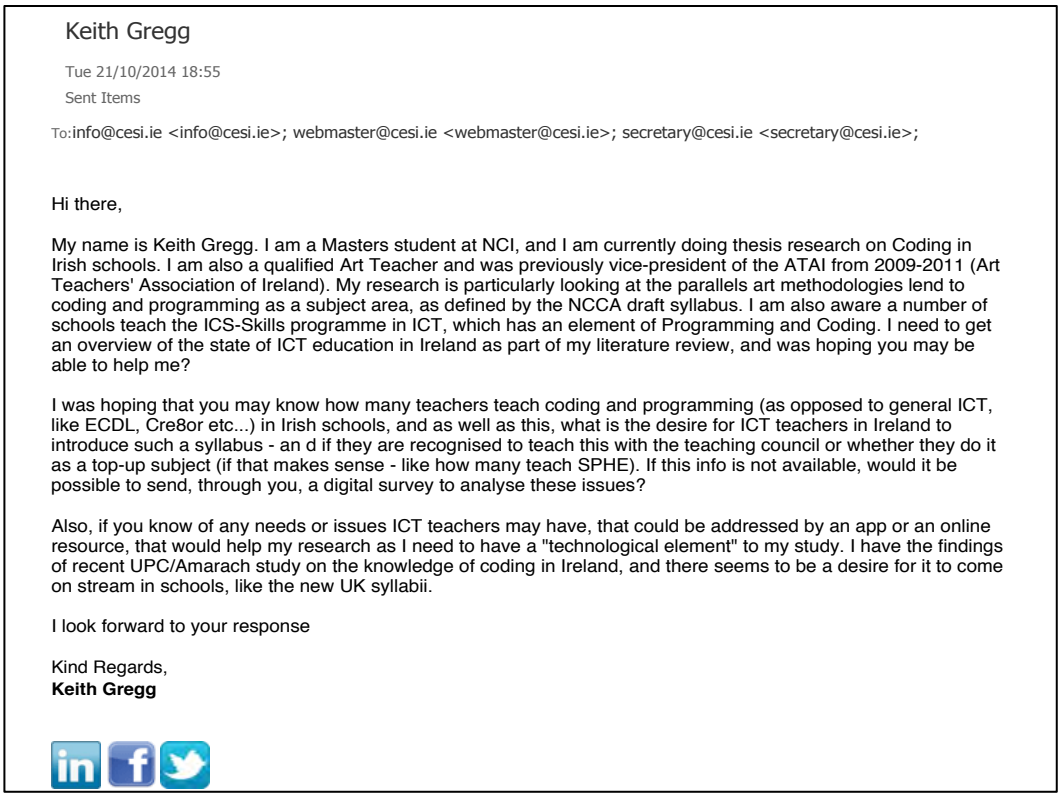
As part of my Literature review, I need to analyse all the different types of ICT, programming and coding currently taught in Irish Schools, to the best of my ability. Would you be able to tell me how many schools currently offer ECDL, but also offer your Coding Curriculum, and teh general feedback you have received, or indeed, if an ICT co-ordinator in a school that would be able to give me such feedback, it would really help with my study.

I look forward to your response

Kind Regards,
Keith Gregg

www.keithmiketom.com

Figure 7-3



Keith Gregg

Tue 21/10/2014 18:55

Sent Items

To:info@cesi.ie <info@cesi.ie>; webmaster@cesi.ie <webmaster@cesi.ie>; secretary@cesi.ie <secretary@cesi.ie>;

Hi there,

My name is Keith Gregg. I am a Masters student at NCI, and I am currently doing thesis research on Coding in Irish schools. I am also a qualified Art Teacher and was previously vice-president of the ATAI from 2009-2011 (Art Teachers' Association of Ireland). My research is particularly looking at the parallels art methodologies lend to coding and programming as a subject area, as defined by the NCCA draft syllabus. I am also aware a number of schools teach the ICS-Skills programme in ICT, which has an element of Programming and Coding. I need to get an overview of the state of ICT education in Ireland as part of my literature review, and was hoping you may be able to help me?

I was hoping that you may know how many teachers teach coding and programming (as opposed to general ICT, like ECDL, Cre8or etc...) in Irish schools, and as well as this, what is the desire for ICT teachers in Ireland to introduce such a syllabus - an d if they are recognised to teach this with the teaching council or whether they do it as a top-up subject (if that makes sense - like how many teach SPHE). If this info is not available, would it be possible to send, through you, a digital survey to analyse these issues?

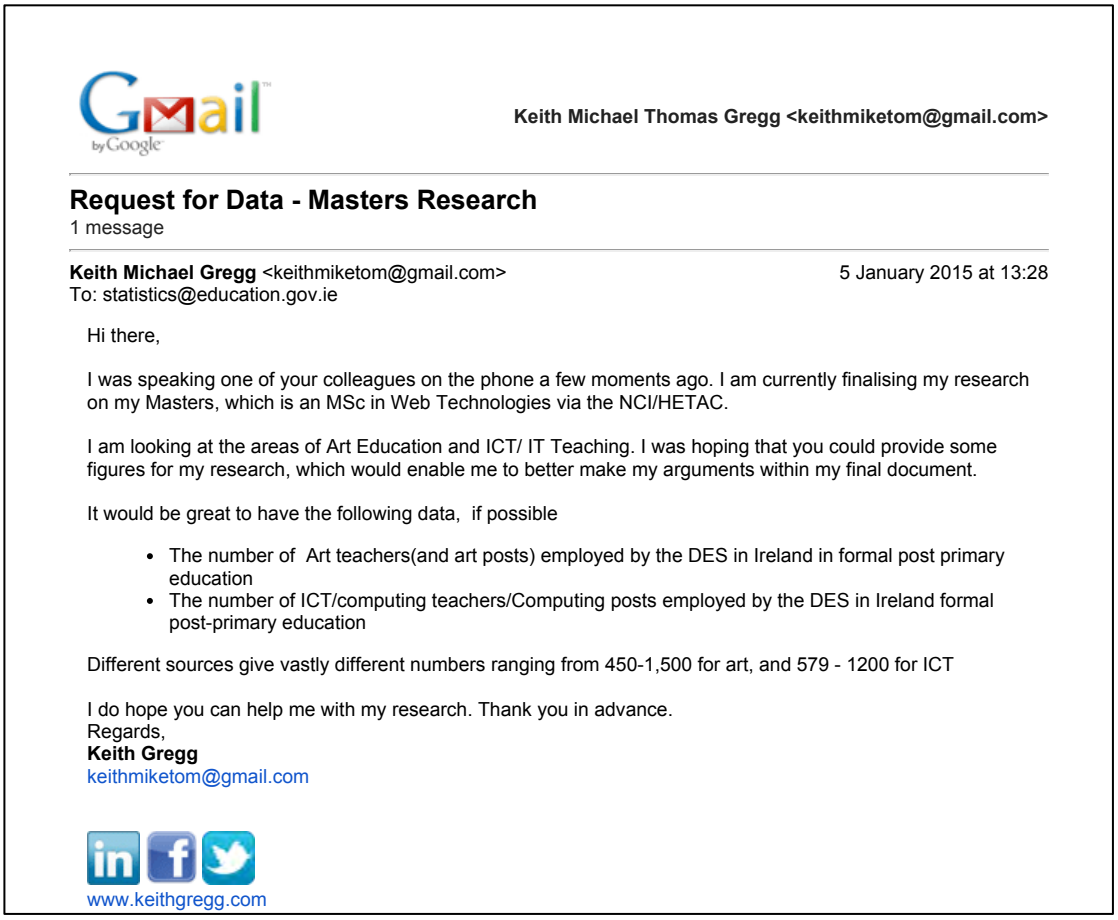
Also, if you know of any needs or issues ICT teachers may have, that could be addressed by an app or an online resource, that would help my research as I need to have a "technological element" to my study. I have the findings of recent UPC/Amarach study on the knowledge of coding in Ireland, and there seems to be a desire for it to come on stream in schools, like the new UK syllabii.

I look forward to your response

Kind Regards,
Keith Gregg

Figure 7-4

7.1.2 Correspondence to DES



Gmail by Google

Keith Michael Thomas Gregg <keithmiketom@gmail.com>

Request for Data - Masters Research
1 message

Keith Michael Gregg <keithmiketom@gmail.com> 5 January 2015 at 13:28
To: statistics@education.gov.ie

Hi there,

I was speaking one of your colleagues on the phone a few moments ago. I am currently finalising my research on my Masters, which is an MSc in Web Technologies via the NCI/HETAC.

I am looking at the areas of Art Education and ICT/ IT Teaching. I was hoping that you could provide some figures for my research, which would enable me to better make my arguments within my final document.

It would be great to have the following data, if possible

- The number of Art teachers(and art posts) employed by the DES in Ireland in formal post primary education
- The number of ICT/computing teachers/Computing posts employed by the DES in Ireland formal post-primary education

Different sources give vastly different numbers ranging from 450-1,500 for art, and 579 - 1200 for ICT

I do hope you can help me with my research. Thank you in advance.
Regards,
Keith Gregg
keithmiketom@gmail.com

www.keithgregg.com

Figure 7-5

7.1.3 Correspondence to Teaching Council

12/23/2014 Gmail - Request for Data - Masters Research

Gmail by Google

Keith Michael Thomas Gregg <keithmiketom@gmail.com>

Request for Data - Masters Research
1 message

Keith Michael Gregg <keithmiketom@gmail.com> 23 December 2014 at 16:46
To: info@teachingcouncil.ie
Bcc: Sandy McCormack <samccormack2@gmail.com>

Hi there,

I was speaking to Jonathan on the phone a few moments ago. I am currently finalising my research on my Masters, which is an MSc in Web Technologies via the NCI/HETAC.

I am looking at the areas of Art Education and ICT/ ICT Teaching. I was hoping that you could provide some figures for my research, which would enable me to better make my arguments within my final document.

It would be great to have the following data, from 2011-date if possible

- The number of registered qualified Art teachers
- The number of Registered Art teachers who are registered with a second subject
- What these second subjects may be (no ITE course provides a second subject for art at present, so my hypothesis is that this is a very low number/subject range.)
- The registered number of ICT teachers
- and the registered number of ICT teachers who also teach art.

A survey I have carried out among a group of 104 teachers suggests that 41% of Art Teachers are qualified and recognised by the teaching council to teach this second subject, and 16% do not know if they are, and I hypothesise that this (41%) number is incorrect.

I do hope you can help me with my research. Thank you in advance.

Regards,
Keith Gregg
keithmiketom@gmail.com

www.keithgregg.com

Figure 7-6

Gmail by Google

Keith Michael Thomas Gregg <keithmiketom@gmail.com>

Art Teachers in Dublin Schools
2 messages

NCAD CPD <cpd@staff.ncad.ie> 12 January 2015 at 13:28
To: Keith Michael Thomas Gregg <keithmiketom@gmail.com>

Hi Keith,
Patsey asked me to pass on some information to you.

At the moment we have 168 schools in Dublin with 267 art teachers. Note that there may be some other schools in Dublin that do not currently have art as a subject and this would not be included in the number above.

Take Care,

Nuala McCarthy
NCAD CPD Admin

Figure 7-7

Elaine McDermott <emcdermott@teachingcouncil.ie> 5 January 2015 at 12:01
To: "keithmiketom@gmail.com" <keithmiketom@gmail.com>

Dear Keith

Thank you for your email in relation to the subjects of Art and ICT.

The statistics outlined below are based on today's date:

The number of registered teachers under Regulation Four (Post-Primary) for the subject of:

- Art 1594
- Computer Skills (IT or ICT) 579

There are currently zero post-primary teachers registered for Art and a second subject. This figure would not be unusual as the recognised Art qualifications are single subjects. In order to register as a post-primary teacher, you must have at least one subject. There may possibly be cases where individuals have completed additional qualifications that may qualify them for a second subject, however they have not pursued recognition with the Council.

I hope this information is of assistance.

Kind Regards

Elaine McDermott

Higher Executive Officer (Acting)

Registration Section

The Teaching Council | Block A, Maynooth Business Campus | Maynooth |Co .Kildare

T: 01 6517900

F: 01 6517901

W: www.teachingcouncil.ie

Figure 7-8

7.2 Appendix B – UPC/Amarach National Survey Results

UPC/Amarach for CoderDojo 1/2

amárach research

UPC –
Coder Dojo

A Presentation Prepared For:
UPC

October 2014

S14-320

PK/MOD

upc

Table of Contents

amárach research 2

- A. Research Methodology
- B. Profile of Sample

MAIN FINDINGS

KEY FINDINGS

A. Research Methodology

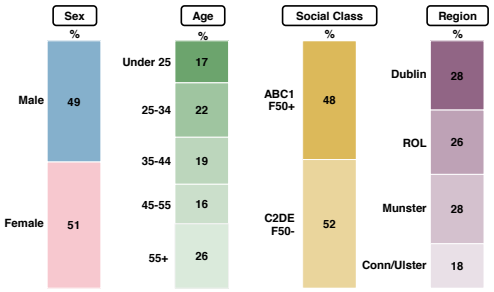
amárach research 3

- A number of questions were placed on the September Amárach Research Omnibus.
- A total sample of 1,000 was achieved with quotas set on gender, age, social class and region to achieve a sample aligned with national population. Due to the high proliferation of the internet among the Irish population, the survey was completed fully online. All participants were aged 16+.
- Interviewing fieldwork dates were September 29th – October 3rd

B. Sample Profile

amárach research 4

(Base: All adults– 1,000)



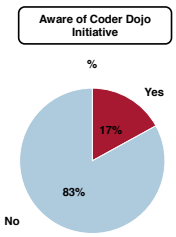
Quotas were set to ensure that the sample attained is aligned to the Irish population, any sampling error is corrected with minor data weighting.

MAIN FINDINGS

Awareness of Coder Dojo Initiative

amárach research 6

(Base: All adults – 1,000)



Almost 1 in 5 adults are aware of the Coder Dojo initiative with males and the Rest of Leinster residents showing most awareness.

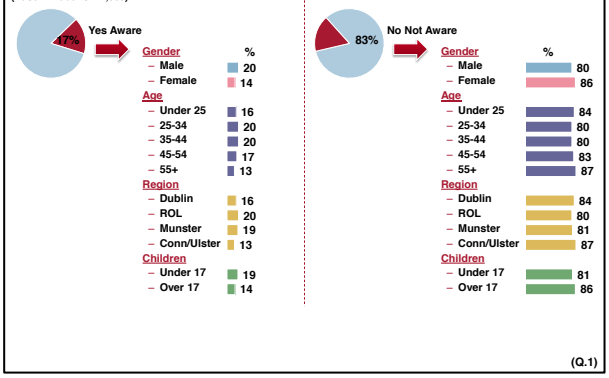
(Q.1)

UPC/Amarach for CoderDojo 2/2

Awareness of Coder Dojo

amárach research 7

(Base: All adults – 1,000)

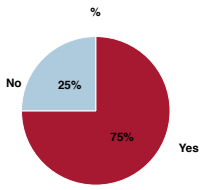


(Q.1)

Send Children to Learn Computer Coding

amárach research 8

(Base: All adults – 1,000)



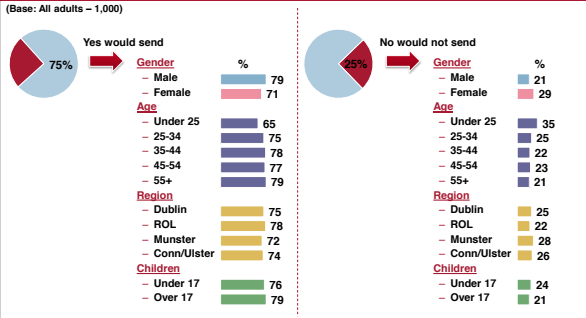
Despite the low awareness of the Coder Dojo initiative, 3 in 4 believe that it would be a good idea to send their child to learn computer coding.

(Q.1)

Send Children to Learn Computer Coding

amárach research 9

(Base: All adults – 1,000)



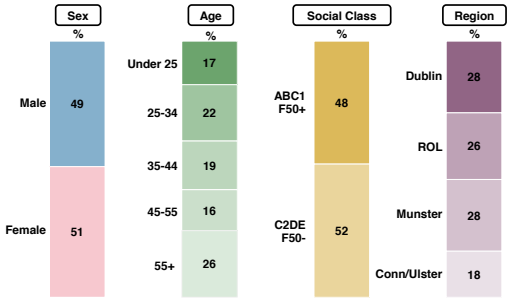
Males are more likely to send their children to learn computer coding as would their older cohorts.

(Q.2)

B. Sample Profile

amárach research 4

(Base: All adults– 1,000)

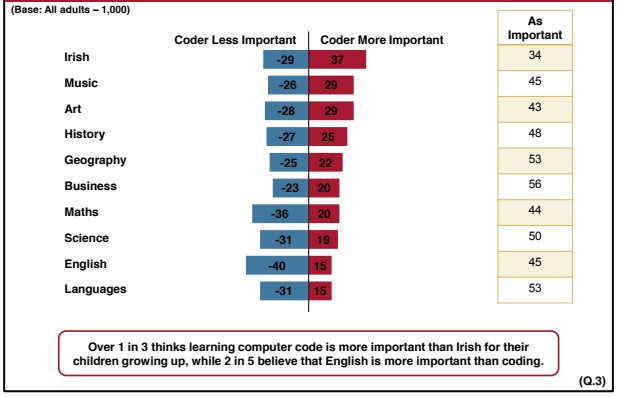


Quotas were set to ensure that the sample attained is aligned to the Irish population, any sampling error is corrected with minor data weighting.

Importance of Coding Versus other Main Stream

amárach research 10

(Base: All adults – 1,000)



Over 1 in 3 thinks learning computer code is more important than Irish for their children growing up, while 2 in 5 believe that English is more important than coding.

(Q.3)

Overview of Findings

amárach research 11

- Just under 1 in 5 are aware of the Coder Dojo initiative with males, 24-44 year olds and the Rest of Leinster residents showing the highest levels of awareness.
- Although there is low awareness, there is a greater interest in the idea, with 3 in 4 stating that they would send their child to learn computer coding with males and the older cohorts more likely to send their child.
- The Majority of subjects, bar Irish, are seen as equally important to children growing up today as computer coding.

7.3 Appendix C – HEA ITE Numbers

Providers of ITE programmes for Second-Level Teachers - Teacher Education Graduate Statistics							
Post-Primary	2008	2009	2010	2011	2012	2013	2014
Concurrent Qualifications (Education Degrees)							
University of Limerick	199	200	237	224	204	275	270
National College of Art and Design	9	16	11	14	9	13	12
Dublin City University	10	19	17	35	43	274	283
St. Patrick's College Thurles	0	34	31	32	35	N/D	N/D
Mater Dei Institute of Education	70	58	56	65	54	324	317
St Angela's College Sligo	28	42	39	40	49	214	231
University of Dublin - Trinity College Dublin	-	-	9	10	10	395	193
Galway-Mayo Institute of Technology	-	-	-	10	14	26	20
University College Cork	-	-	-	41	46	192	204
National University of Ireland, Maynooth (BScEd)	-	-	-	-	-	25	131
National University of Ireland, Galway	-	-	-	-	-	348	363
Totals	316	369	400	471	464	2086	2024
Consecutive Qualifications (HDip Conversion courses)							
University of Limerick	90	87	128	74	88	131	449
University College Dublin	117	136	106	223	205	210	229
National University of Ireland Galway (NUIG)	212	165	208	201	195	-	224
NUIG -Dioploma Iarchéime Oideachais	-	43	34	41	27	-	43
National University of Ireland Maynooth	138	130	159	142	133	141	134
National College of Art and Design (Art)	16	20	20	18	20	19	25
University of Dublin - Trinity College Dublin	131	149	120	131	117	117	-
Dublin City University	0	64	35	39	42	75	156
University College Cork	195	205	215	190	231	208	211
Cork Institute of Technology (Art)	26	27	25	29	28	31	27
Limerick Institute of Technology (Art)	26	28	30	30	28	30	29
Galway-Mayo Institute of Technology	-	-	-	19	-	-	10
St Angela's College Sligo	-	-	-	-	7	7	5
Hibernia College	-	-	-	-	-	-	-
Totals:	925	1054	1080	1137	1121	969	1542
Total Concurrent/Consecutive	1241	1423	1480	1608	1585	3055	3566
Art Totals:	75	91	86	91	85	93	93

Table 7-1 **Source: HEA.ie and NCAD, CIT, LIT.**

7.4 Appendix D – Art Teacher Survey

Career Length

Hi and thanks for taking this survey for me. It is totally anonymous and will help with my research. There are 16 questions and it should take you no more than 5-10 minutes to answer

1) What would best describe the length of your professional teaching career to date?	
0 -5 years (NQT)	
5-10 years	
10-15 years	
15 - 20 years	
20 + years	

Educational Terms Terms and phrases used to describe curriculum

2) What do you associate the following words and phrases with
- Computing and Science
- Relevant to Computing/Science and Art/Craft/Design
- Just Art/Craft Design
- None

	Computing/Science	**Both**	**Art/Craft/Design**	**None**
Problem Solving				
Literacy Development				
Numeracy Development				
Logical Analysis				
Mathematical Skills				
Scientific Analysis				
Brief Design				
Providing Solutions				
Creativity				
Confidence building				
Team work				
Project Management				
Tools for communication				
Self Expression				
Valued by society				
Worthwhile				
Hard to learn				
Must be born with the skills				
Useful to society				
Important to learn				
Necessary for wholistic development				
Increases Vocabulary				
Improves writing skills				
Caters to a variety of learners				

Your Professional Status

3) Do you currently teach a second subject?	
Yes	
No	

4) If Yes, what subject(s) do you teach? *(choose all that apply)*	
History	
Religion	
CSPE	
SPHE	
Technical Graphics	
Design and Communication Graphics	
ICT - Computing such as Programming	
ICT - CoderDojo	
ICT - ECDL - Microsoft Office Skills	
Technology	
ICT - Digital Art such as Photoshop etc…	
ICT - Digital CRE8OR	
Resource or Learning Support	
Other	

5) If yes, are you certified to teach this second subject by the Teaching council?	
Yes	
No	
Don't know	

Your Skills with ICT and knowledge of the field

6) What ICT Skills do you have/tools can you use?					
	Strongly Disagree	Disagree	Aware but not used	Agree	Strongly Agree
Photo manipulation tools such as Adobe PhotoShop, Image Ready, GIMP, Pixlr etc…					
Vector based drawing tools such as Adobe Illustrator or AUTOCAD					
Animation tools such as Animoto, Adobe Flash, Adobe After Effects					
What you see is what you get [WYSIWYG] editors like DreamWeaver and GoLive					
Coding Software like Git, Subversion and Github					
Office tools, like Excel, Word,					

PowerPoint, Prezi					
Educational tools such as Edmodo or Moodle					
Integrated Development Enviornment tools such as Aptana, Visual Studio etc…					

7) Do you have significant knowledge on any of the following computer languages, tools or terminology?					
	Very Insignificant	**Insignificant**	**Neutral**	**Significant**	**Very Significant**
HTML/XHTML					
CSS					
Sass/Less					
JavaScript					
jQuery					
Angular					
Node.js					
CoffeeScript					
Scratch					
C# (C - Sharp)					
Objective-C					
C++					
Perl					
Python					
Ruby/Ruby on Rails					
PHP/Wordpress					
MySQL					
Java					
Visual Basic					
ASP.NET					
Drupal					
Azure					
Cloud					
Git					
Subversion					
Scala					
Jade					
Haml					

NCCA Draft Syllabus

8) Are you aware of the NCCA Junior Cycle Draft Syllabus for P&C? (also see below for brief outline)	
Yes	

No	

Aim of the Course	
The course aims to develop the student's ability to formulate problems logically, to design, write and test code, to develop games, apps, animations and websites and, through these learning activities, to learn about computer science	
Areas of Course	
Strand 1	Computer science introduction - CSI
Strand 2	Let's get connected
Strand 3	Coding at the next level
Strand 4	Problem solving in the real world
Course Learning Outcomes	
Strand 1	
• 1.1 present and share examples of what computers are used for and discuss their importance in modern society and in their lives • 1.2 describe the main components of a computer system (CPU, memory, main storage, I/O devices, buses) • 1.3 explain how computers are devices for executing programs via the use of programming languages • 1.4 write code to implement algorithms • 1.5 test the code • 1.6 develop appropriate algorithms using pseudo-code and/or flow charts • 1.7 discuss and implement core features of structured programming languages, such as variables, operators, loops, decisions, assignment and modules • 1.8 evaluate the results in groups of two or three	
Strand 2	
• 2.1 discuss the basic concepts underlying computer networks • 2.2 describe how data is transported on the Internet and how computers communicate and cooperate through protocols such as HTTP • 2.3 build web pages using HTML and CSS • 2.4 explain how search engines deliver results • 2.5 explain how computers represent data using 1's and 0's • 2.6 investigate how drawings and photos are represented in computing devices	
Strand 3	
• 3.1 creatively design and write code for short programming tasks to demonstrate the use of operators for assignment, arithmetic, comparison, and Boolean combinations • 3.2 complete short programming tasks using basic linear data structures (e.g. array or list) • 3.3 demonstrate how functions and procedures (definition and call) capture abstractions • 3.4 describe program flow control e.g. parallel or sequential flow of control – language dependent • 3.5 document programs to explain how they work • 3.6 present the documented code to each other in small groups • 3.7 analyse code to determine its function and identify errors or potential errors	
Strand 4	
• 4.1 identify a topic or a challenge in computer science that inspires them • 4.2 conduct research on the topic/challenge • 4.3 work in teams of two or three and decide on a topic or challenge on which to build a final software project • 4.4 brainstorm ideas in the requirements-gathering phase • 4.5 discuss aspects of user-interaction design for the project • 4.6 design, implement and test a solution • 4.7 document team contributions and document the code Draft P&C Short Course • 4.8 present to peers for feedback • 4.9 assess the feedback • 4.10 based on feedback, complete the software project and present a convincing argument for the final proposal to their peers	

Table 7-2

Computers in your School

9) What areas of ICT are currently taught in your school?	
EDCL - Office, word, excel, access	
Digital Media Literacy and web safety	
P&C	
Scratch Programming / CoderDojo	
AUTO CAD or Computer aided design	
Graphic Design via Adobe Creative Suite/PhotoShop	
Don't know	

10) What primary subject(s), do your colleagues teaching computers teach in your school?	
Science	
Maths	
Business	
Irish	
English	
Modern Foreign Languages	
History	
Geography	
Religious Education	
Technology	
Music	
Design and Communication Graphics/ Technical Graphics	
Art, Craft and Design	
Other	

11) Do you feel you could teach P&C at second Level, based on the draft NCCA Syllabus?	
Yes	
Yes- With help and training	
No	

Teaching P&C
Attitudes towards P&C

12) Evaluate the following phrases in relation to P&C						
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	N/A
P&C is hard						
P&C has nothing to do with Art, Craft and Design						
Art and Design methodologies could help to teach P&C in a better way						
P&C has much cross curricular potential						

P&C can improve literacy and numeracy						
The NCCA Draft Syllabus is easy to understand						
There are elements I could teach right now, without knowing how to code						
I would be willing to teach P&C						
Texts and general online resources useful for helping to teach P&C						
An online resource specifically tailored to teaching P&C would help me teach and understand it						
Coding is a skill I would like to learn						
P&C could be taught in tandem with Graphic Design						
Knowing Flash makes programming easier to understand						
Animation has many transferable skills to P&C						
My students would love to learn P&C						
P&C is important in Irish Society						
You need impressive computer labs to effectively teach P&C						
I have all the skills I need to start learning P&C						
Learning P&C to teach it would make me more attractive to employers						
Principal will want teachers to teach P&C in schools in the next five years						
P&C will become and important subject in schools						

13) How do you feel you engage with the following types of learning methods?					
	Strongly Disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
Self-taught					
Instructed Class					
YouTube or other video lesson					
Online workbook					
Online Tutorial					
Peer Led initiatives					
One-on-one Tuition					
Group forums					
CPD or In-service					
Books or guides					

Physical workshop					
Online workshop					

14) If there was a resource to help you learn to teach P&C, which would be the most important features of the site/application?	
Self-Taught material bank	
Video Tutorials	
Online work thread - progress marked	
Downloadable books/guides	
Group forum	
Profile page with badges/rewards	
Links to other resources/advanced learning	
Progress tracking	
Commenting	

15) How effective do you feel the following tools would be to learning P&C (ICT) - mark out of 5?					
	1	**2**	**3**	**4**	**5**
Self-Taught Material bank					
Video Tutorials					
Online work thread - Progress marked					
Downloadable books/guides					
Group Forum					
Profile page with badges/rewards					
Links to other resources/advanced learning					
Progress tracking					
Commenting					

16) Do you feel being able to teach P&C (ICT) would make an art teacher more employable?	
Yes	
No	
No Opinion	

This is the end of the survey. Thank you for helping with my research.
Question 16 is the last question.

7.5 Appendix E – CESI/ICT Teacher Survey

CAREER LENGTH

Hi and thanks for taking this survey for me. It is totally anonymous and will help with my research.

There are 14 questions and it should take you no more than 5-10 minutes to answer.

1) What would best describe the length of your professional teaching career to date?	
0 -5 years (NQT)	
5-10 years	
10-15 years	
15 - 20 years	
20 + years	

EDUCATIONAL TERMS

Terms and phrases used to describe curriculum

2) What do you associate the following words and phrases with
- Computing and Science
- Relevant to Computing/Science and Art/Craft/Design
- Just Art/Craft Design
- None

	Computing/Science	Both	Art/Craft/Design	None
Problem Solving				
Literacy Development				
Numeracy Development				
Logical Analysis				
Mathematical Skills				
Scientific Analysis				
Brief Design				
Providing Solutions				
Creativity				
Confidence building				
Team work				
Project Management				
Tools for communication				
Self Expression				
Valued by society				
Worthwhile				
Hard to learn				
Must be born with the skills				
Useful to society				
Important to learn				
Necessary for wholistic				

development				
Increases Vocabulary				
Improves writing skills				
Caters to a variety of learners				

YOUR PROFESSIONAL STATUS

3) What is your Primary Subject?	
Irish	
English	
Maths	
History	
Geography	
Modern Foreign Languages	
Music	
Art	
Technical Graphics/DCG	
Woodwork/Materials Technology	
Metalwork/Engineering	
Technology	
Science	
Religion	
CSPE	
SPHE	
Resource or Learning Support	
ICT - Specific Programs	
ICT - Coding	
Other	
n/a	

YOUR PROFESSIONAL STATUS

4) Do you teach another subject, if so what do you teach? *(choose all that apply)*	
Irish	
English	
Maths	
History	
Geography	
Modern Foreign Languages	

Music	
Art	
Technical Graphics/DCG	
Woodwork/Materials Technology	
Metalwork/Engineering	
Technology	
Science	
Religion	
CSPE	
SPHE	
Resource or Learning Support	
ICT - Specific Programs	
ICT - Coding	
Other	
n/a	

5) If yes, are you certified to teach this second subject by the Teaching council?	
Yes	
No	
Don't know	

YOUR SKILLS WITH ICT AND KNOWLEDGE OF THE FIELD

6) What ICT Skills do you have/tools can you use?					
	Strongly Disagree	**Disagree**	**Aware but not used**	**Agree**	**Strongly Agree**
Photo manipulation tools such as Adobe PhotoShop, Image Ready, GIMP, Pixlr etc…					
Vector based drawing tools such as Adobe Illustrator or AUTOCAD					
Animation tools such as Animoto, Adobe Flash, Adobe After Effects					
What you see is what you get [WYSIWYG] editors like DreamWeaver and GoLive					
Coding Software like Git, Subversion and Github					
Office tools, like Excel, Word, PowerPoint, Prezi					
Educational tools such as Edmodo or Moodle					

Integrated Development Enviornment tools such as Aptana, Visual Studio etc…					

7) Do you have significant knowledge on any of the following computer languages, tools or terminology?					
	Very Insignificant	**Insignificant**	**Neutral**	**Significant**	**Very Significant**
HTML/XHTML					
CSS					
Sass/Less					
JavaScript/jQuery/ CoffeeScript					
Angular					
Node.js					
Scratch/Logo					
C# (C - Sharp)					
Objective-C					
C++					
Perl					
Python					
Ruby/Ruby on Rails					
PHP/Wordpress					
MySQL/PostGres					
Java/Scala					
Visual Basic/ASP.Net					
Drupal					
Azure					
Cloud					
Git					
Jade/Haml					

NCCA DRAFT SYLLABUS

8) Are you aware of the NCCA Junior Cycle Draft Syllabus for P&C? (also see below for brief outline)	
Yes	
No	

Aim of the Course	
The course aims to develop the student's ability to formulate problems logically, to design, write and test code, to develop games, apps, animations and websites and, through these learning activities, to learn about computer science	
Areas of Course	
Strand 1	Computer science introduction - CSI
Strand 2	Let's get connected

Strand 3	Coding at the next level
Strand 4	Problem solving in the real world

Course Learning Outcomes

Strand 1

- 1.1 present and share examples of what computers are used for and discuss their importance in modern society and in their lives
- 1.2 describe the main components of a computer system (CPU, memory, main storage, I/O devices, buses)
- 1.3 explain how computers are devices for executing programs via the use of programming languages
- 1.4 write code to implement algorithms
- 1.5 test the code
- 1.6 develop appropriate algorithms using pseudo-code and/or flow charts
- 1.7 discuss and implement core features of structured programming languages, such as variables, operators, loops, decisions, assignment and modules
- 1.8 evaluate the results in groups of two or three

Strand 2

- 2.1 discuss the basic concepts underlying computer networks
- 2.2 describe how data is transported on the Internet and how computers communicate and cooperate through protocols such as HTTP
- 2.3 build web pages using HTML and CSS
- 2.4 explain how search engines deliver results
- 2.5 explain how computers represent data using 1's and 0's
- 2.6 investigate how drawings and photos are represented in computing devices

Strand 3

- 3.1 creatively design and write code for short programming tasks to demonstrate the use of operators for assignment, arithmetic, comparison, and Boolean combinations
- 3.2 complete short programming tasks using basic linear data structures (e.g. array or list)
- 3.3 demonstrate how functions and procedures (definition and call) capture abstractions
- 3.4 describe program flow control e.g. parallel or sequential flow of control – language dependent
- 3.5 document programs to explain how they work
- 3.6 present the documented code to each other in small groups
- 3.7 analyse code to determine its function and identify errors or potential errors

Strand 4

- 4.1 identify a topic or a challenge in computer science that inspires them
- 4.2 conduct research on the topic/challenge
- 4.3 work in teams of two or three and decide on a topic or challenge on which to build a final software project
- 4.4 brainstorm ideas in the requirements-gathering phase
- 4.5 discuss aspects of user-interaction design for the project
- 4.6 design, implement and test a solution
- 4.7 document team contributions and document the code Draft P&C Short Course
- 4.8 present to peers for feedback
- 4.9 assess the feedback
- 4.10 based on feedback, complete the software project and present a convincing argument for the final proposal to their peers

Table 7-3

COMPUTERS IN YOUR SCHOOL

9) What areas of ICT are currently taught in your school?	
EDCL - Office, word, excel, access	
Digital Media Literacy and web safety	
P&C	

Scratch Programming / CoderDojo	
AUTO CAD or Computer aided design	
Graphic Design via Adobe Creative Suite/PhotoShop	
Don't know	

10) What primary subject(s), do your colleagues also teaching computers teach in your school?	
Irish	
English	
Maths	
History	
Geography	
Modern Foreign Languages	
Music	
Art	
Technical Graphics/DCG	
Woodwork/Materials Technology	
Metalwork/Engineering	
Technology	
Science	
Religion	
CSPE	
SPHE	
Resource or Learning Support	
Other	
n/a	

11) Do you feel you could teach P&C at second Level, based on the draft NCCA Syllabus?	
Yes	
Yes- With help and training	
No	

TEACHING PROGRAMMING &CODING

Attitudes towards P&C

12) Evaluate the following phrases in relation to P&C					
	Strongly Disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
P&C is hard					
P&C has nothing to do with Art, Craft and Design					

P&C has much cross curricular potential					
P&C can improve literacy and numeracy					
The NCCA Draft Syllabus is easy to understand					
There are elements I could teach right now, without knowing how to code					
I would be willing to teach P&C					
Coding is a skill I would like to learn					
P&C could be cross curricular					
Knowing Flash makes programming easier to understand					
Animation has many transferable skills to P&C					
My students would love to learn P&C					
P&C is important in Irish Society					
You need impressive computer labs to effectively teach P&C					
I have all the skills I need to start learning P&C					
Learning P&C to teach it would make me more attractive to employers					
Principals will want teachers to teach P&C in schools in the next five years					
P&C will become a very important subject in schools					

FINAL QUESTIONS Please give answers below.

13) Do you think a coding aptitude test would give confidence to those who may be starting to learn how to code?	
Yes	
No	
Don't know	

14) Do you feel being able to teach P&C (ICT) would make a teacher more employable?	
Yes	
No	
No Opinion	

This is the end of the survey. Thank you for helping with my research. Question 14 is the last question.

7.6 Appendix F – Skills Needed in Programming

I'm not going to claim that programming is easy, but I am going to say that it is not hard for the reasons people usually assume it is. Programming is not a deeply theoretical subject like Chemistry or Physics; you don't need an advanced degree to do well at it. (There are important principles of Computer Science, but it's possible to get a degree after studying them and to have only vague ideas of how to apply them to practical programming. Contrariwise, we'll experience many important Computer Science lessons by the seat of our pants, without bewildering ourselves with abstract notation; there are plenty of successful programmers who don't have Computer Science degrees.)

Comparing programming to some physical tasks, programming does not require some innate talent or skill, like gymnastics or painting or singing. You don't have to be strong or coordinated or graceful or have perfect pitch. Programming *does*, however, require care and craftsmanship, like carpentry or metalworking. If you've ever taken a shop class, you may remember that some students seemed to be able to turn out beautiful projects effortlessly, while other students were all thumbs and made the exact mistakes that the teacher told them not to make. What distinguished the successful students was not that they were better or smarter, but just that they paid more attention to what was going on and were more careful and deliberate about what they were doing. (Perhaps care and attention are innate skills too, like gymnastic ability; I don't know.)

Some things you *do* need are (1) attention to detail, (2) stupidity, (3) good memory, and (4) an ability to think abstractly, and on several levels. Let's look at these qualities in a bit more detail:

- **Attention To Detail**

  In programming, the details matter. Computers are incredibly stupid (more on this in a minute). You can't be vague; you can't describe your program 3/4 of the way and then say ``Ya know what I mean?'' and have the compiler figure out the rest. You have to dot your i's and cross your t's. If the language says you have to declare variables before using them, you have to. If the language says you have to use parentheses here and square brackets there and squiggly braces some third place, you have to.
- **Stupidity**

  Computers are incredibly stupid. They do *exactly* what you tell them to do: no more, no less. If you gave a computer a bottle of shampoo and told it to read the directions and wash its hair, you'd better be sure it was a big bottle of shampoo, because the computer is going to wet hair, lather, rinse, repeat, wet hair, lather, rinse, repeat, wet hair, lather, rinse, repeat, wet hair, lather, rinse, repeat, ...

  I saw an ad by a microprocessor manufacturer suggesting the ``smart'' kinds of appliances we'd have in the future and comparing them to ``dumb'' appliances like toasters. I believe they had it backwards. A toaster (an old-fashioned one, anyway) has two controls, and one of them is optional: if you don't set the darkness control, it'll do the best it can. You don't have to tell it how many slices of bread you're toasting, or what kind. (``Modern'' toasters have begun to reverse this trend...) Compare this user interface to most microwave ovens: they won't even let you enter the cooking time until you've entered the power level.

  When you're programming, it helps to be able to ``think'' as stupidly as the computer does, so that you're in the right frame of mind for specifying everything in minute detail, and not assuming that the right thing will happen unless you tell it to.

  (This is not to say that you have to specify *everything*; the whole point of a high-level programming language like C is to take some of the busiwork burden off the programmer. A C compiler is willing to intuit a *few* things--for example, if you assign an integer variable to a floating-point variable, it will supply a conversion automatically. But you have to know the rules for what the compiler will assume and what things you must specify explicitly.)

- **Good Memory**

  There are a lot of things to remember while programming: the syntax of the language, the set of prewritten functions that are available for you to call and what parameters they take, what variables and functions you've defined in your program and how you're using them, techniques you've used or seen in the past which you can apply to new problems, bugs you've had in the past which you can either try to avoid or at least recognize by their symptoms. The more of these details you can keep in your head at one time (as opposed to looking them up all the time), the more successful you'll be at programming.
- **Ability To Abstract, Think On Several Levels**

  This is probably the most important skill in programming. Computers are some of the most complex systems we've ever built, and if while programming you had to keep in mind every aspect of the functioning of the

computer at all levels, it would be a Herculean task to write even a simple program.

One of the most powerful techniques for managing the complexity of a software system (or any complex system) is to compartmentalize it into little ``black box'' processes which perform useful tasks but which hide some details so you don't have to think about them all the time.

We compartmentalize tasks all the time, without even thinking about it. If I tell you to go to the store and pick up some milk, I don't tell you to walk to the door, open the door, go outside, open the car door, get in the car, drive to the store, get out of the car, walk into the store, etc. I especially don't tell you, and you don't even think about, lifting each leg as you walk, grasping door handles as you open them, etc. You never (unless perhaps if you're gravely ill) have to worry about breathing and pumping your blood to enable you to perform all of these tasks and subtasks.

We can carry this little example in the other direction, as well. If I ask you to make some ice cream, you might realize that we're out of milk and go and get some without my asking you to. If I ask you to help put on a party for our friends, you might decide to make ice cream as part of that larger task. And so on.

Compartmentalization, or *abstraction*, is a vital skill in programming, or in managing any complex system. Despite what I said in point 3 above, we can only keep a small number of things in our head at one time. A large program might have 100,000 or 1,000,000 or 10,000,000 lines of code. If it were necessary to understand all of the lines together and at once to understand the program, the program would be impossible to write or understand. Only if it is possible to think about small pieces in isolation will it ever be possible to work with a large program.

Compartmentalization, powerful though it is, is not automatic, and not necessarily an instant cure for all of our organizational problems. We carry a lot of assumptions around about how various things work, and things work well only as long as these assumptions hold. To return to the previous example, if I ask you to go the store and get some milk, I'm assuming that you know which kind to get, where the store is, how to get there, how to drive if you need to, etc. If some of these assumptions weren't valid, or if there were several options for any of them, we might have to modify the way I gave you instructions. I might have to tell you to *drive* to the store, or to go to *Safeway*, or to get some *two percent* milk.

Therefore, we can't simply compartmentalize all of our processes and subprocesses and forget about complexity problems forever. We have to remember at least some of the assumptions surrounding the compartmentalization scheme. We have to remember what we can and can't expect from the processes (people, computer programs, etc.) which we call on to do tasks for us. We have to make sure that we keep our end of the bargain and don't fall down on any of the commitments and promises we've made on the tasks we've been asked to do and which others are assuming we'll keep.

Thinking about the mechanics of a design hierarchy, while also using that hierarchy to avoid having to think about every detail of it at every level all of the time, is one of the things I mean by ``thinking on several levels.'' It's tricky to do (obviously, it's tricky even to describe), but it's the only way to cut through large, complex problems.

What's hard about programming (besides maybe having trouble with the four traits above) is mostly picky little detail and organizational problems, and people problems. A large program is a terribly complex system; a large programming project worked on by many people has to work very hard at peripheral, picayune tasks like documentation and communication if the project is to avoid drowning in a flood of little details and bugs.

Read sequentially: prev next up top

Source: http://www.eskimo.com/~scs/cclass/progintro/sx1.html

7.7 Appendix G – QQI NTQ Chart

National Framework of Qualifications from QQI

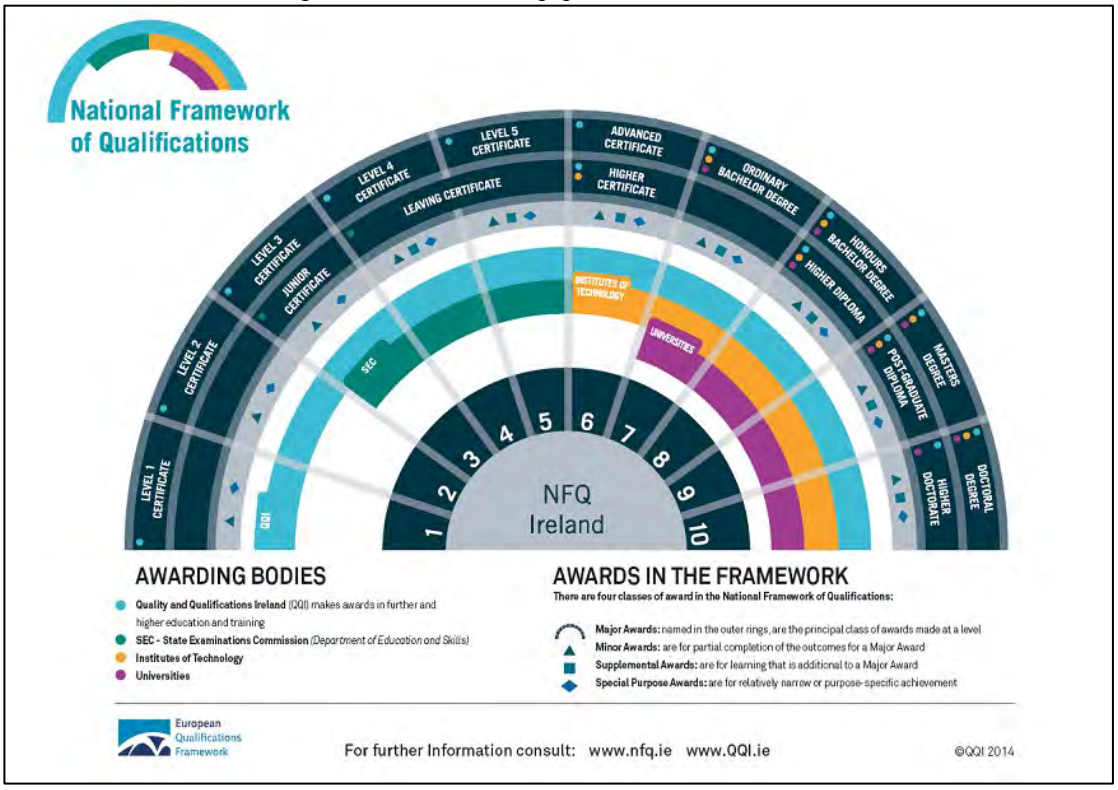


Figure 7-9 ***source: www.qqi.ie/Website%20Images/NFQ_Fan_Page.jpg***

7.7.1 Ten-level system

The National Framework of Qualifications (NFQ) is a ten-level system (1–10) giving an academic or vocational value to qualifications obtained in Ireland.

NFQ levels help indicate how an award can be used for training, education and employment opportunities (see fan diagram).

Each level is based on nationally agreed standards of what a learner is expected to know and be able to do after receiving an award.

QQI is Ireland's guardian of the NFQ system. We are responsible for the quality assurance of providers of education and training. We also have responsibility for the validation of qualifications and also make some awards ourselves.

NFQ serves several purposes.

1. It ensures awards obtained in Ireland are quality-assured and recognised internationally
2. It is part of a system for comparing Irish and international awards
3. It supports lifelong learning by recognising knowledge and skills within a comparative framework even if they are not recognised by a formal award
4. It provides a system of establishing eligibility in learning processes for access, transfer and progression
5. It recognises awards made by professional bodies (see Qualifications Recognition Service below)

7.7.2 International

NFQ is linked to similar frameworks in Europe. This helps people considering employment or study opportunities outside Ireland.

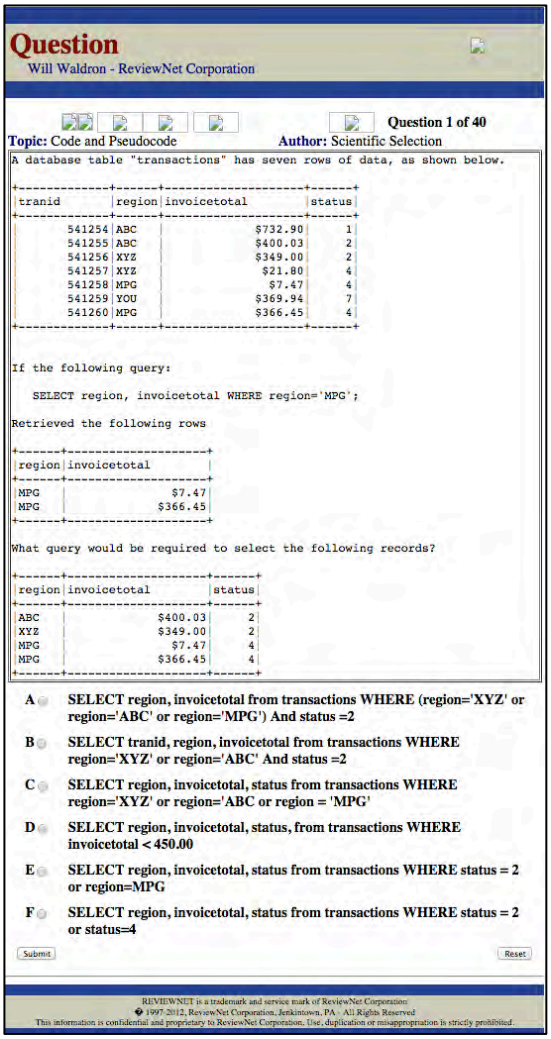
There are two qualifications frameworks at European level:

1 The Framework for Qualifications of the European Higher Education Area also known as the 'Bologna Framework'. This deals with higher education awards (NFQ 6-10)

2 The European Qualifications Framework (EQF), which deals with all NFQ levels including schools, Further Education and Training, and Higher Education.

7.8 Appendix H – Industry Programming Aptitude Tests

Commerical Aptitude Samples 2/2



Question
Will Waldron - ReviewNet Corporation

Question 1 of 40
Topic: Code and Pseudocode Author: Scientific Selection

A database table "transactions" has seven rows of data, as shown below.

tranid	region	invoicetotal	status
541254	ABC	$732.90	1
541255	ABC	$400.03	2
541256	XYZ	$349.00	2
541257	XYZ	$21.80	4
541258	MPG	$7.47	4
541259	YOU	$369.94	7
541260	MPG	$366.45	4

If the following query:

```
SELECT region, invoicetotal WHERE region='MPG';
```

Retrieved the following rows

region	invoicetotal
MPG	$7.47
MPG	$366.45

What query would be required to select the following records?

region	invoicetotal	status
ABC	$400.03	2
XYZ	$349.00	2
MPG	$7.47	4
MPG	$366.45	4

A SELECT region, invoicetotal from transactions WHERE (region='XYZ' or region='ABC' or region='MPG') And status =2

B SELECT tranid, region, invoicetotal from transactions WHERE region='XYZ' or region='ABC' And status =2

C SELECT region, invoicetotal, status from transactions WHERE region='XYZ' or region='ABC or region = 'MPG'

D SELECT region, invoicetotal, status, from transactions WHERE invoicetotal < 450.00

E SELECT region, invoicetotal, status from transactions WHERE status = 2 or region=MPG

F SELECT region, invoicetotal, status from transactions WHERE status = 2 or status=4

Submit Reset

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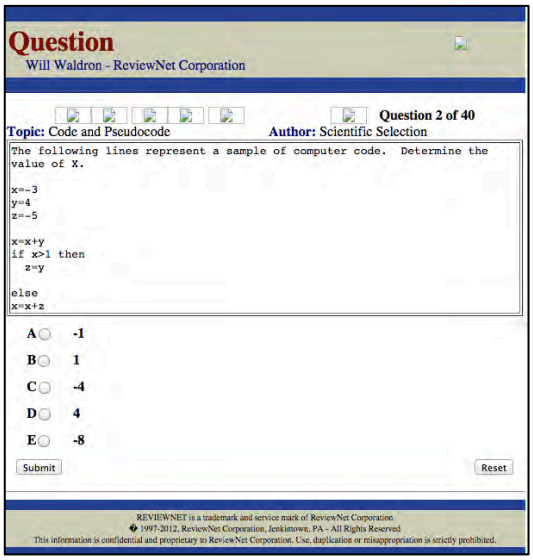

Question
Will Waldron - ReviewNet Corporation

Question 2 of 40
Topic: Code and Pseudocode Author: Scientific Selection

The following lines represent a sample of computer code. Determine the value of X.

```
x=-3
y=4
z=-5

x=x+y
if x>1 then
  z=y

else
x=x+z
```

A -1
B 1
C -4
D 4
E -8

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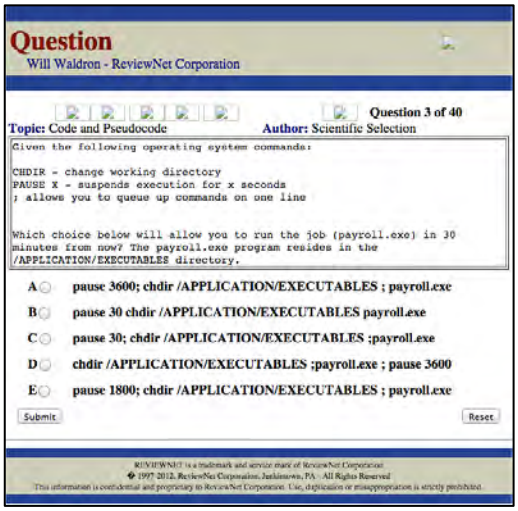

Question
Will Waldron - ReviewNet Corporation

Question 3 of 40
Topic: Code and Pseudocode Author: Scientific Selection

Given the following operating system commands:

```
CHDIR - change working directory
PAUSE X - suspends execution for x seconds
; allows you to queue up commands on one line
```

Which choice below will allow you to run the job (payroll.exe) in 30 minutes from now? The payroll.exe program resides in the /APPLICATION/EXECUTABLES directory.

A pause 3600; chdir /APPLICATION/EXECUTABLES ; payroll.exe
B pause 30 chdir /APPLICATION/EXECUTABLES payroll.exe
C pause 30; chdir /APPLICATION/EXECUTABLES ;payroll.exe
D chdir /APPLICATION/EXECUTABLES ;payroll.exe ; pause 3600
E pause 1800; chdir /APPLICATION/EXECUTABLES ; payroll.exe

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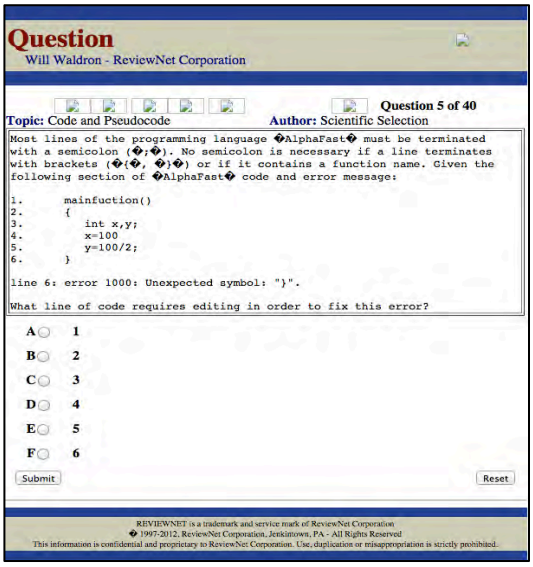

Question
Will Waldron - ReviewNet Corporation

Question 5 of 40
Topic: Code and Pseudocode Author: Scientific Selection

Most lines of the programming language ©AlphaFast® must be terminated with a semicolon (®;®). No semicolon is necessary if a line terminates with brackets (®{®, ®}®) or if it contains a function name. Given the following section of ©AlphaFast® code and error message:

```
1.      mainfuction()
2.      {
3.         int x,y;
4.         x=100
5.         y=100/2;
6.      }

line 6: error 1000: Unexpected symbol: "}".
```

What line of code requires editing in order to fix this error?

A 1
B 2
C 3
D 4
E 5
F 6

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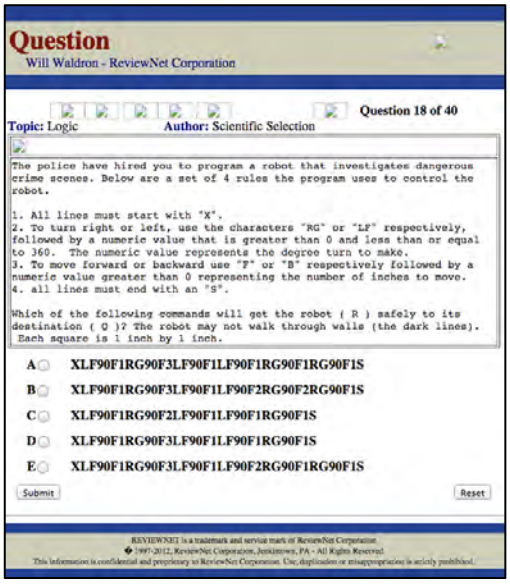

Question
Will Waldron - ReviewNet Corporation

Question 18 of 40
Topic: Logic Author: Scientific Selection

The police have hired you to program a robot that investigates dangerous crime scenes. Below are a set of 4 rules the program uses to control the robot.

1. All lines must start with "X".
2. To turn right or left, use the characters "RG" or "LF" respectively, followed by a numeric value that is greater than 0 and less than or equal to 360. The numeric value represents the degree turn to make.
3. To move forward or backward use "F" or "B" respectively followed by a numeric value greater than 0 representing the number of inches to move.
4. all lines must end with an "S".

Which of the following commands will get the robot (R) safely to its destination (O)? The robot may not walk through walls (the dark lines). Each square is 1 inch by 1 inch.

A XLF90F1RG90F3LF90F1LF90F1RG90F1RG90F1S
B XLF90F1RG90F3LF90F1LF90F2RG90F2RG90F1S
C XLF90F1RG90F2LF90F1LF90F1RG90F1S
D XLF90F1RG90F3LF90F1LF90F1RG90F1S
E XLF90F1RG90F3LF90F1LF90F2RG90F1RG90F1S

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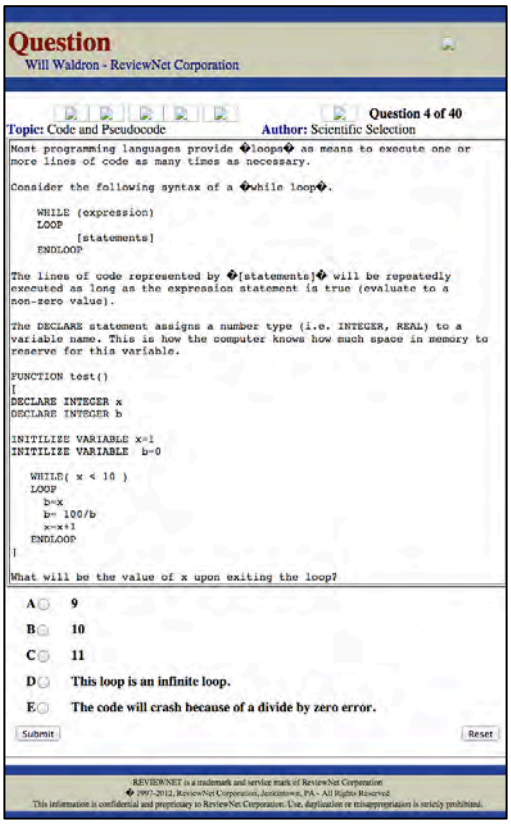
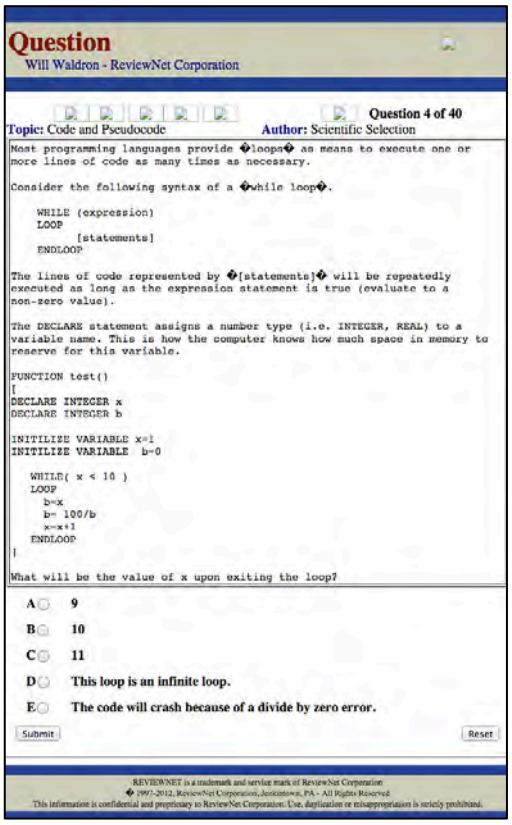
Commerical Aptitude Samples 2/2





7.9 Appendix I – SMART Objectives

- **Specific**
  The criterion stresses the need for a specific goal rather than a more general one. This means the goal is clear and unambiguous; without vagaries and platitudes. To make goals specific, they must tell a team exactly what's expected, why it's important, who's involved, where it's going to happen and which attributes are important.
    - A specific goal will usually answer the five 'W' questions:
    - What: What do I want to accomplish?
    - Why: Specific reasons, purpose or benefits of accomplishing the goal.
    - Who: Who is involved?
    - Where: Identify a location.
    - Which: Identify requirements and constraints.
- **Measurable**
  The second criterion stresses the need for concrete criteria for measuring progress toward the attainment of the goal. The thought behind this is that if a goal is not measurable it is not possible to know whether a team is making progress toward successful completion. Measuring progress is supposed to help a team stay on track, reach its target dates and experience the exhilaration of achievement that spurs it on to continued effort required to reach the ultimate goal.
    - A measurable goal will usually answer questions such as:
    - How much?
    - How many?
    - How will I know when it is accomplished?
    - Indicators should be quantifiable
- **Attainable**
  The third criterion stresses the importance of goals that are realistic and also attainable. Whilst an attainable goal may stretch a team in order to achieve it, the goal is not extreme. That is, the goals are neither out of reach nor below standard performance, since these may be considered meaningless. When you identify goals that are most important to you, you begin to figure out ways you can make them come true. You develop the attitudes, abilities, skills and financial capacity to reach them. The theory states that an attainable goal may cause goal-setters to identify previously overlooked opportunities to bring themselves closer to the achievement of their goals.
    - An achievable goal will usually answer the question How?
    - How can the goal be accomplished?
    - How realistic is the goal based on other constraints?
- **Relevant**[
  The fourth criterion stresses the importance of choosing goals that matter. A bank manager's goal to "Make 50 peanut butter and jelly sandwiches by 2pm" may be specific, measurable, attainable and time-bound but lacks relevance. Many times you will need support to accomplish a goal: resources, a champion voice, someone to knock down obstacles. Goals that are relevant to your boss, your team, your organization will receive that needed support.
    - Relevant goals (when met) drive the team, department and organization forward. A goal that supports or is in alignment with other goals would be considered a relevant goal.
    - A relevant goal can answer yes to these questions:
    - Does this seem worthwhile?
    - Is this the right time?
    - Does this match our other efforts/needs?
    - Are you the right person?
    - Is it applicable in the current socio- economic environment?
- **Time-bound**
  The fifth criterion stresses the importance of grounding goals within a time-frame, giving them a target date. A commitment to a deadline helps a team focus their efforts on completion of the goal on or before the due date. This part of the SMART goal criteria is intended to prevent goals from being overtaken by the day-to-day crises that invariably arise in an organization. A time-bound goal is intended to establish a sense of urgency.
    - A time-bound goal will usually answer the question
    - When?
    - What can I do six months from now?
    - What can I do six weeks from now?
    - What can I do today?

Paul J. Meyer describes the characteristics of S.M.A.R.T. goals in *Attitude is Everything*
http://books.google.ie/books/about/Attitude_Is_Everything.html?id=C2V0OwAACAAJ&redir_esc=y

7.10 Appendix J – Statements of Learning

Innovation & Identity
Schools developing Junior Cycle

Table 2.
Statements of Learning

	The student
1	communicates effectively using a variety of means in a range of contexts in L1[1]
2	reaches a level of personal proficiency in L2 and one other language in reading, writing, speaking and listening
3	creates, appreciates and critically interprets texts (including written, oral, visual and other texts)
4	recognises the potential uses of mathematical knowledge, skills, and understanding in all areas of learning
5	uses mathematical knowledge, reasoning and skills in devising strategies for investigating and solving problems
6	describes, illustrates, interprets, predicts and explains patterns and relationships
7	improves their observation, inquiry, and critical-thinking skills
8	develops an understanding of the natural world
9	values what it means to be an active citizen, with rights and responsibilities in local and wider contexts
10	learns how to think and act sustainably
11	understands the distribution of social, economic, and environmental phenomena
12	values local and national heritage and recognises the relevance of the past to current national and international issues and events
13	makes informed financial decisions and develops good consumer skills
14	takes initiative, is innovative and develops entrepreneurial skills
15	uses appropriate technologies in meeting a design challenge
16	applies practical skills as they develop models and products using a variety of materials and technologies
17	creates, presents and appreciates artistic works
18	brings an idea from conception to realisation
19	uses ICT effectively and ethically in learning and in life
20	takes action to safeguard and promote their wellbeing and that of others
21	appreciates and respects how diverse values, beliefs and traditions have contributed to the communities and culture in which they live
22	develops moral, ethical and responsible decision making and a sense of personal values
23	understands the importance of food and diet in making healthy lifestyle choices
24	participates in physical activity confidently and competently

15

[1] L1 is the language medium of the school (Irish in Irish-medium schools). L2 is the second language (English in Irish-medium schools).

Figure 7-10 ***source: http://ncca.ie/framework/doc/statement_of_learning.pdf***

7.11 Appendix K – Aptitude Test Questions

DETAILS

Your details will be used for research numbers only.
No personal data will be shared.
This is the full aptitude test and it has 30 Questions.
Your result will be shown at the end.

The test may take some time to do, so please do bear this in mind. You may also need a pen, paper or calculator, should you wish to use them.

Enjoy, and thank you for helping with this research!

1) Please state your name
2) Please enter your email address
3) How old are you?

4) What is your professional background?	
Art Teacher	
IT Teacher	
Other Teacher	
IT Professional	
Student	
Other (Please Specify)	

5) If a teacher, how long have you been teaching?	
0-5 years (NQT)	
5-10 years	
10-15 years	
15-20 years	
20-25 years	
25 years +	
Not Applicable	

6) What is your location?	
Dublin	
Rest of Leinster	
Munster	
Ulster	

Connaught	
UK	
USA	
Canada	
Australia	
Other (Please Specify)	

7) What is your ICT Level	
1- Basic Understanding	
2- General Understanding	
3 - Ability to use programs i.e. Photoshop	
4 - Some Understanding of Code	
5 - Advanced Understanding	

QUESTION 1

If the hour hand of a clock is turned anticlockwise from 2pm to 9am, through how many degrees will it have turned?	
120	
180	
150	
570	
130	
330	

QUESTION 2

If in the "DaintyGull" coding language the following are examples of the code pattern:

- NOBRUOB stands for BOURBON
- YDNEW stands for WENDY
- UHCAKIP stands for PIKACHU

How would you code PRETZEL in "DaintyGull" code?

TACOCAT	
LEZTERP	
UCHAKIP	
RETLEZP	
ZELPRET	

QUESTION 3

Five children are sitting on a bus to a Miley Cyrus concert. Shea is sitting next to Pam, who is not next to Tracy. Kel is sitting next to Rachel, who is sitting on the extreme left, and Tracy is not sitting next to Kel.

Which children are sitting adjacent to Shea?

Rachel and Pam	
Keli and Pam	
Only Pam	
Pam and Tracy	

QUESTION 4

In the old dynatsic pre valyrian language these are several phrases.

- "Oghar Kelii" means Cat Hairs
- "Keli aegion" means Iron Cat
- "Zaldrizes aegion" means Iron Dragon

What phrase could translate to "Dragon foot"?

Keli mourghulis	
Valar doharies	
Deks zaldreizes	
Keli zaldreizes	
Keli deks	

QUESTION 5

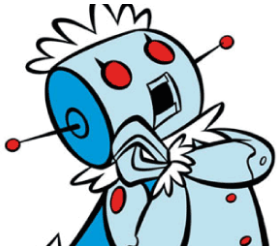
Bod, Aunt Flo, PC Copper, Farmer Barleymow, Frank the Postman, and Alberto Frog are holding a competition to see who could jump the highest.
Though it was the 70's, no one observed everyone at the same time, they had to figure it out from each others' observations.
As it is the 70's, none of them will lie.

- Aunt Flo and Frank the Postman can jump as high was each other
- Bod can jump higher than Farmer Barleymow and Alberto
- PC Copper cannot jump as high as Alberto Frog
- Farmer Barleymow can jump higher than Aunt Flo

Who jumped the highest?

Aunt Flo	
PC Copper	
Farmer Barleymow	
Bod	
Frank the Postman	
Alberto Frog	

QUESTION 6



Your robot maid is required to activate "dinner", wait 60 minutes, then run the "servedinner" function, when you arrive home.
She needs to perform three specific instructions at the right time, and in the right order for this to be successful.

- MOVFOL - move folder directory
- WAIT X - stops the execution of a task for X seconds
- ; - allows you to separate commands on one line

What is the correct sequence of commands for the operation (servedinner.exe) to run correctly? The process starts from entering the Apps/dinact folder.

WAIT 60; MOVFOL /Apps/ops; servedinner.exe	
MOVFOL /Apps/dinact; WAIT 3600; servedinner.exe	
MOVFOL /Apps/ops WAIT 60 servedinner.exe	
MOVFOL /Apps/ops; servedinner.exe; WAIT 1800	
WAIT 3600; MOVFOL /Apps/ops; servedinner.exe	

QUESTION 7

	A	B	C	D	E
1	3	5	7	17	12
2	44	6	8	2	22
3	11	51	5	8	18
4	9	5	6	3	2

What is C2 multiplied by A3, plus D2, then divided by A4?

10	
19.5	
19	
7	
9.5	

QUESTION 8

You did it! You climbed to the top of Mt Everest! You are facing North.

You turn 90 degrees to the left to take a selfie with Paula. Then you turn 180 degrees to the right to take a selfie with John.
You then reverse direction, and turn a further 45 degrees left to take a selfie with Wendy. You reverse direction and turn a further 270 degrees to the right with excitement and do a fist bump in the air!

In which direction are you now facing?

South	
South East	
East	
North West	
South West	
North East	

QUESTION 9

Consider the following:

FRIEND = FPIBNZ
MASTER = _____

Based on how FRIEND is changed, how would you represent MASTER?

MYSQEN	
CMQNNO	
MSYNEQ	
MSYEQN	

QUESTION 10

Lloyd has just turned 30. He wants to save for retirement.

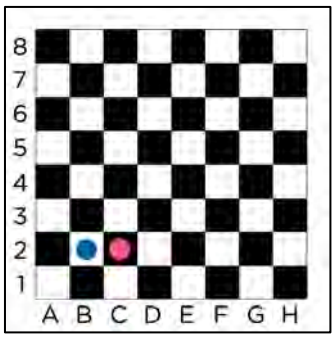
- Until he is 40 he will save €50 euro a month.
- From the age of 40 to 50, he will save €30 a week.
- From the age of 50 to 65, he will save €70 every fortnight.

How much will he have saved when he reaches retirement age, at 65?

62, 300	
48, 900	
55, 900	
45, 600	
41, 300	

QUESTION 11

Elaine Paige (blue) and Barbara Dickinson (red) are performing in their music video for "I know him so well".



Elaine is a star, and will not move, so Barbara has to do all the dancing. Each square is one step.

- She is facing EAST and takes three steps forward
- She turns NORTH and take two steps forward
- She faces NorthWest and takes 4 steps diagonally
- She faces NORTH again and takes two steps backwards
- Facing WEST, she takes another three steps backwards, turns 90 degrees clockwise and takes two steps forward from there

What are her co-ordinates?

E8	
E4	
C4	
B8	
C2	
B2	

Question 12

Three girls are waiting for the number 42 bus. They are lined up in a row - each has a different name, and is wearing a different dress.

Jane was to the left of Helen but not necessarily next to her. The girl in the blue dress was to the right of the girl in the red dress. The girl in the green dress was to the left of Betty. Betty was to the left of the Helen.

What was the order of the girls?

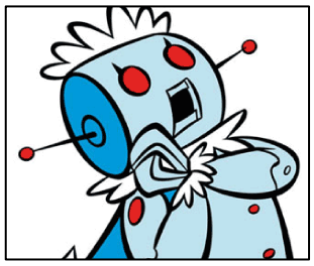
Helen, Jane, Betty	
Betty, Jane, Helen	
Jane, Betty, Helen	
Helen, Betty, Jane	
Betty, Helen, Jane	

Question 13

Mark thinks of a number. He squares it, then takes away 5, next multiplies it by 4, takes away 7, divides it by 3 and finally adds 6. His answer is 9.
What number did he start with?

6	
9	
4	
3	
2	

Question 14



Your robot receptionist is required to run the shutdown system, 30 minutes after everyone leaves work.
She needs to perform three specific instructions, at the right time and in the right order for this to be successful. A list of commands is highlighted below.

- MOVFOL - move folder directory
- WAIT X - stops the execution of a task for X seconds
- ; - allows you to separate commands on one line

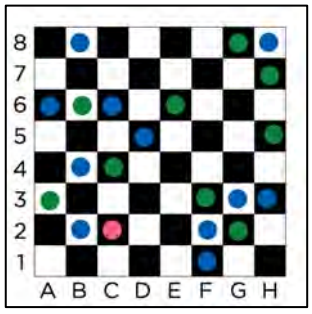
What is the correct sequence of commands for the process (shutdown.exe) to run correctly? It is located in the Apps/ops folder.

WAIT 30; MOVFOL /Apps/ops; shutdown.exe	
MOVFOL /Apps/ops; shutdown.exe; WAIT 3600	
WAIT 30 MOVFOL /Apps/ops shutdown.exe	
WAIT 1800; MOVFOL /Apps/ops; shutdown.exe	
WAIT 3600; MOVFOL /Apps/ops; shutdown.exe	

QUESTION 15

Sandra thought of a number, added 7, multiplied by 3, took away 5 and divided by 4 to give an answer of 7. What was the starting number?	
11	
7	
4	
3	
5	

QUESTION 16



Elaine's dancers (blue) have jsut been really rude to Barbara, so she is leaving. She needs to dance out, however, so as not to have to come back.

She has to leave in three moves as she is having none of it. There must be at least one clear step between Barbara and the dancers at ALL times. She can leave via any of the doors on row 8. The green props block some of the ways she can leave.

How does she get out, without being near those awful dancers, in three movements? She is facing North.

Turn East. Take one Step, Face North East, take three steps. Turn 90 degrees anti clockwise, and run three steps to freedom.	
Take one step backwards, turn 90 degrees anticlockwise and take two steps backwards. Turn 270 degrees and take 8 steps to freedom	
Turn North, and walk one step forward. Turn 45 right and walk confidently 4 steps. Turn left 45 degrees and walk 3 steps forward.	

QUESTION 17

In the “kittywake” language...

- "Kew xaas huma deko" means she is petting cats
- "Kew tepo qua" means she sells toys
- "Sul lim deko "means I like cats

Which words in “kittywake” mean 'cats' and 'she'

Deko & Kew	
Xaas & Deko	
Kew & Xaas	
Deko & Lim	
Lim & Sul	

Question 18

Consider the following:

- Y knows as much as Q
- P knows more than A
- Z knows less than C
- A knows as much as Y

Who knows the most?

C	
A	
P	
Q	
Y	

Question 19

If in the "VileTrout" code language, where all words are seven letters long:

- ZELPRET stands for PRETZEL
- CHUPIKA stands for PIKACHU
- BONBOUR stands for BOURBON

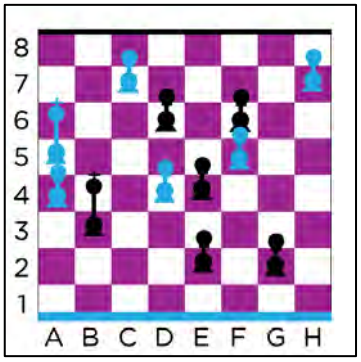
How would you code FIFTEEN in "VileTrout"?

TEENFIF	
TENFIFT	
EENFIFT	
BONTEEN	
ZELFIFT	

Question 20

In a game of chess:

- A Black pawn can move two space forward if black at row 2
- A White pawn can move two space forward if black at row 7
- Otherwise, a pawn can only move one space, forward
- A pawn can take a piece diagonally
- One a pawn reaches the opposite side of the board, It can release the Queen.
- A King can move one space in any direction.
- A King can not be adjacent to the opposite king



There are currently only five pawns on each side. Who will be first to release their queen without losing a pawn?

Blue, in three moves	
Black in three moves	
Black in four moves	
Blue in four moves	
Blue in six moves.	

QUESTION 21

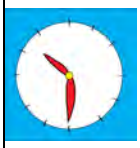
The following represents computational functions. Determine the value of p

- x= -3
- y = 4
- z = -5

```
p = x+y
if  p > 1 then
        z = y
otherwise
p = x+z
```

-4	
1	
-1	
-8	
5	

QUESTION 22



What is the measurement of the angle between the hour hand and the minute hand, when the clock reads 10:30pm?

120	
180	
135	
145	
115	

QUESTION 23

Lyndsey is 10 years old. She begins to saves five euro every week. Once a year, while she is a child but up until she is 16 years old from her 10th birthday, her Grandmother puts 100 euro into her account on her birthday.

Until and including her 18th birthday from her 10th birthday, her brother will put 50 euro into her account on her birthday.

Until and including her 21st birthday, form her 10th birthday, her sister will put 20 euro into her account on her birthday.

The bank is very generous, and give her 1% interest on what she has, the day after her birthday every year.
She opens the account with the €170 gifts her family gave her. How much will Lyndsey have when she is 21 to the nearest €50?

€8,400	
€4,300	
€4,550	
€3,900	
€4,150	

QUESTION 24

Dave was given a large bag of sweets and ate one third of the sweets before stopping, as he was feeling sick. The next day he ate one third of the remaining sweets. The following day he ate one third of the remainder, before counting the sweets he had left, which totaled eight. How many sweets was he given in the beginning?	
27	
35	
17	
100	
61	

QUESTION 25

In the old dynastic pre Valyrian language these are several phrases. • "Darys Keli" means Cat King • "Keli Morhulis" means Dead Cat • "Deks aegion" means Iron Foot What phrase could translate to "Darys Zaldreizes"	
Dog King	
Dead King	
Dragon King	
Iron King	
Slave King	

QUESTION 26

Three computers were lined up in a row, each is a different make, and runs its own operating system. The Dell was to the left of the iMac but not necessarily next to it. The blue OS computer was to the right of the red OS computer. The green OS computer was to the left of the Chromebook. The Chromebook was to the left of the iMac. What was the order of the computers?	
iMac, Dell, Chromebook	
Chromebook, Dell, iMac	
Dell, Chromebook, iMac	
iMac, Chromebook, Dell	
Chromebook, iMac, Dell	

QUESTION 27

Penny is lost in Paris and cannot find the "Syndicat d'initiative". She finds a map. She knows basic French, so asking someone for help is not possible. She realises from looking at the map that she needs to get to the place marked "Q".

There are two potential routes she can see (one of the routes is not right - she is bad at map reading).

To get to "Q", Penny has to take several buses. She is at a stop along the seine. The busses go South or North of the river. She must take Route X 3 Stops Southbound and exchange to:

- Route Y going over 4 Stops North
  - or
- Route Z going over 5 stops South

If she can take a combination of:

- Route X and Route Y
  - or
- Route X and Route Z

To get to point Q on the map. If she ends up one or more stops North of the Seine, she has gone the wrong way.

What bus combinations should she take?

Route X and Route Y	
Route Y and Route Z	
Route X and Route Z	

QUESTION 28

What is the measurement of the angle between the hour hand and the minute hand, when the clock reads 2:30am?	
120	
180	
135	
145	
105	

QUESTION 29

The Sapphire code language is used to program bank payments.
Killian is learning how to code, so he can pay his staff. The rule of the Sapphire language is that every bit of functionality must be given a name [i.e. _____funciton( )], followed by content of the function in a block of curly brackets { } and everytime you finish a line within that block, it must end in a semi-colon ;

Killian got an UNEXPECTED $END error, meaning part of his code below is incorrect.

```
1.      daintyfunction()
2.          {
3.            recog a, b, c;
4.            a = 100;
5.            b = a/2;
6.            c = 17
7.           }
```

!LINE 7 UNEXPECTED $END: Unexpected symbol "}"

Based on the above two statements on how Sapphire works, where is the error in the outputted lines of code.

1	
2	
3	
4	
5	
6	
7	

QUESTION 30

Sarah did it! She made her way to King Jareth's Castle to rescue Toby, only to find she is lost in a circular room, with 8 doors.

She needs to find the right door. On Entering the room, the North-facing door she entered just shut. The door directly in front of her bricks up and disappears also, as it is not the right door.
She hears a bang, and turns 90 degrees to the left But it is just the bag lady... she then turns her back against the bag lady and faces the opposite door, but that one is incorrect too...
Sarah then reverses direction, and turns a further 45 degrees left and eliminates the door with the Caterpillar on it. An awful noise fills the room as Sarah gets closer to the right door. It is not the door behind her as that has a cheshire cat on it, and the one to her left is an image of King Jareth, with a picture of Sarah in his hand. The correct door must be the picture of Toby in the Crystal ball, to her right.

What direction is the correct door to Sarah's right?

North	
North West	
East	
South East	
West	
North East	

7.11.1 Variations

The test was divided into three smaller variations. Each variation took a number of questions from the main aptitude test. It was divided based on question type, with more visual questions in Variation 1, a mixture of question types in Variation 2, and more abstract questioning in Variation 3. In the variation tests, questions are marked level 1-13 instead of question number. This is to differentiate them in laying the tests out.

TEST VARIATIONS		
Type	**Question Bank Order from main test**	**Link**
Variation 1: 13 Questions, easier:	Q3, Q1, Q7, Q2, Q11, Q4, Q12, Q10, Q5, Q22, Q13, Q24, Q8	http://goo.gl/WMuBAA
Variation 2: 13 questions moderate:	Q14, Q5, Q9, Q26, Q21, Q16, Q27, Q10, Q15, Q17, Q28, Q24, Q30	http://goo.gl/3ExGhV
Variation 3: 13 questions, less visual, more difficult:	Q18, Q26, Q19, Q10, Q6, Q24, Q9, Q21, Q20, Q28, Q23, Q29, Q30	http://goo.gl/86G1b

Table 7-4

7.12 Appendix L – Application Code

7.12.1 Code Repository

The code repository can be found at: https://github.com/keithmiketom/codability

7.12.2 jQuery used to render CESI charts

```
$(function () {
    $(document).ready(function () {
$('#chartcesi1').highcharts({
            chart: {
                plotBackgroundColor: null,
                plotBorderWidth: null,
                plotShadow: false
            },title: {
                text: 'What would best describe the length of your professional teaching
career to date?'
            },
            tooltip: {
                pointFormat: '{series.name}: <b>{point.percentage:.1f}%</b>'
            },
            plotOptions: {
                pie: {
                    allowPointSelect: true,
                    cursor: 'pointer',
                    dataLabels: {
                        enabled: false
                    },
                    showInLegend: true
                }
            },
            series: [{
                type: 'pie',
                name: 'Career Length',
                data: [
                    {
                        name: '0-5 Years NQT',
                        y: 20,
                        sliced: true,
                        selected: true
                    },
                    ['5-10 Years',    11.43],
                    ['10-15 Years',     20],
                    ['15-20 Years',   8.57],
                    ['20+ Years',   40]
                ]
            }]
        });
       $('#chartcesi2').highcharts({
        chart: {
            type: 'column'},
        title: {text: 'What do you associate the following words and phrases with:'},
        subtitle: {text: 'Part 1'},
        xAxis: {categories: ['Problem Solving', 'Literacy Development','Numeracy
Development', 'Logical Analysis', 'Mathematical Skills', 'Scientific Analysis', 'Brief
Design', 'Providing Solutions', 'Creativity', 'Confidence Building', 'Team Work', 'Project
Management'] },yAxis: {min: 0, title: {text: 'Respondents'}},
        tooltip: {headerFormat: '<span style="font-size:10px">{point.key}</span><table>',
            pointFormat: '<tr><td style="color:{series.color};padding:0">{series.name}:
</td>' +'<td style="padding:0"><b>{point.y:.1f} </b></td></tr>',
            footerFormat: '</table>',: true, useHTML: true},
        plotOptions: {
            column: {pointPadding: 0.2, borderWidth: 0}},
  series: [{name: 'Just Science/Computing',data: [13, 8, 15, 18, 21, 22, 3, 11, 2, 2, 2,
4]
```

```
        }, {name: 'Both', data: [34, 37, 34, 30, 27, 23, 35, 38, 36, 42, 41, 41 ]
        }, {name: 'Just Art/Design', data: [3, 3, 2, 2, 3, 2, 12, 2, 13, 5, 5, 3 ]
        }, {name: 'None', data: [1, 3, 0, 1, 0, 4, 1, 0, 0, 2, 3, 3 ] }]});
              $('#chartcesi2b').highcharts({
        chart: {
            type: 'column'
        },
        title: {text: 'What do you associate the following words and phrases with'},
        subtitle: {text: 'Part 2'},
        xAxis: {
            categories: [
                'Tools for Communication',
                'Self Expression',
                'Valued by Society',
                'Worthwhile',
                'Hard to Learn',
                'Must be born with skills',
                'Useful to Society',
                'Important to Learn',
                'Neccessary for wholistic development',
                'Increases Vocabulary',
                'Improves writing skills',
                'Caters to a variety of learners'
            ] },
        yAxis: {min: 0, title: {text: 'Respondents'}},
        tooltip: {
            headerFormat: '<span style="font-size:10px">{point.key}</span><table>',
            pointFormat: '<tr><td style="color:{series.color};padding:0">{series.name}:
</td>' +'<td style="padding:0"><b>{point.y:.1f} mm</b></td></tr>',
            footerFormat: '</table>', shared: true, useHTML: true},
        plotOptions: {
            column: {
                pointPadding: 0.2,
                borderWidth: 0
            }
        },
        series: [{
            name: 'Just Science/Computing',: [3, 1, 19, 5, 19, 1, 8, 8, 2, 4, 10, 3 ]
        }, {name: 'Both', data: [42, 31, 29, 43, 12, 5, 41, 38, 39, 37, 29, 40 ]
        }, {name: 'Just Art/Design', data: [5, 19, 3, 2, 3, 17, 2, 1, 9, 3, 3, 8 ]
        }, {name: 'None', data: [1, 0, 0, 1, 17, 28, 0, 3, 1, 7, 9, 0 ] }]
    });
        $('#chartcesi3').highcharts({
            chart: {
                plotBackgroundColor: null,
                plotBorderWidth: null,
                plotShadow: false
            },
            title: {text: 'What is your Primary Subject?'},
            tooltip: {pointFormat: '{series.name}: <b>{point.percentage:.1f}%</b>'},
            plotOptions: {pie: {allowPointSelect: true, cursor: 'pointer',
                    dataLabels: {enabled: false},
                    showInLegend: true}},
            series: [{
                type: 'pie',
                name: 'I teach',
                data: [
                    ['Irish',   6.12],
                    ['English',   4.08],
                    ['Maths',   16.33],
                    ['History',   4.08],
                    ['Geography',   14.29],
                    ['MFL',   4.08],
                    ['Music',   0],
                    ['Art',   4.08],
```

```
                    ['DCG',   0],
                    ['Science',   18.37],
                    ['Woodwork',   4.08],
                    ['Metalwork',   0], ['Technology',   0], ['Religion',   0], ['CSPE',
0], ['SPHE',   2.04], ['Resource/LS',   2.04], ['ICT - Programs', 4.08], ['ICT - Coding',
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$('#chartcesi4').highcharts({chart: {plotBackgroundColor: null, plotBorderWidth: null,
plotShadow: false},title: {text: 'If you teach a second subject, what do you teach?'},
tooltip: {pointFormat: '{series.name}: <b>{point.percentage:.1f}%</b>'},
               plotOptions: {pie: {
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                     cursor: 'pointer', dataLabels: {enabled: false},showInLegend: true}},
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                    data: [ ['Irish',   2.22], ['English', 3.33], ['Maths', 12.22],
['History', 6.67], ['Geography', 1.11], ['MFL', 1.11],['Music', 1.11], ['Art', 1.11],
['Technical Graphics', 1.11], ['Woodwork', 1.11]['Metalwork', 1.11],['Technology',
4.44],['Science', 4.44], ['Religion', 4.44],['CSPE', 7.78], ['SPHE', 4.44],
['Resource/LS', 2.22], ['ICT Programs', 20], ['ICT Coding', 8.89], ['Other/Business',
7.78], ['n/a', 3.33]]
                }]});
$('#chartcesi3b').highcharts({
        chart: {
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        },
        title: {
            text: 'What is your second subject?'
        },
        subtitle: {
            text: 'Number view'
        },xAxis: {
            categories: [
                'Irish',
                'English',
                'Maths',
                             'History',
                             'Geography',
                             'MFL',
                             'Music',
                             'Art',
                             'TG/DCG',
                             'Woodwork',
                             'Metalwork',
                             'Technology',
                             'Science',
                             'RE',
                             'CSPE',
                             'SPHE',
                             'Resource',
                             'ICT Programs',
                             'ICT Coding',
                             'Other | Business',
                             'n/a']},
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            }
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            pointFormat: '<tr><td style="color:{series.color};padding:0">{series.name}:
</td>' +
                '<td style="padding:0"><b>{point.y:.1f} </b></td></tr>',
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            shared: true,
```

```
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        },
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                borderWidth: 0
            }
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        series: [{
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            data: [2, 3, 11, 6, 1, 2, 1, 1, 1, 1, 0, 4, 4, 4, 7, 4, 2, 18, 8, 7, 3 ]}]
    });
$('#chartcesi5').highcharts({
            chart: {
                plotBackgroundColor: null,
                plotBorderWidth: null,
                plotShadow: false
            },
            title: {
                text: 'Are you registered to teach your second subject with teaching
council?'
            },
            tooltip: {
                pointFormat: '{series.name}: <b>{point.percentage:.1f}%</b>'
            },
            plotOptions: {
                pie: {
                    allowPointSelect: true,
                    cursor: 'pointer',
                    dataLabels: {
                        enabled: false
                    },
                    showInLegend: true
                }
            },
            series: [{
                type: 'pie',
                name: 'registered?',
                data: [
                      ['Yes', 61.3],
                    ['No',   22.73],
                    ['Don\'t know', 15.91 ]


                ]
            }]
        });
            $('#chartcesi6').highcharts({
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            },
            title: {
                text: 'What ICT Skills do you have/tools can you use? '
            },
            subtitle: {
                text: 'Source: CESI Survey'
            },
            xAxis: {
                categories: [
                    'Photo Manupulation',
                    'Vector based ',
                    'Animation Tools',
                    'WYSIWYG editors',
                    'Coding tools',
                    'Office tools',
```

```
                    'Edmodo/Moodle',
                    'IDE'
                ]
            },
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                title: {
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                }
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                    borderWidth: 0
                }
            },
            series: [{
                name: 'Strongly Disagree',data: [2, 8, 7, 7, 14, 1, 1, 17 ]
            }, {name: 'Disagree', data: [2, 8, 3, 2, 16, 0, 0, 11]
            }, {name: 'Aware of but not used', data: [10, 20, 14, 9, 8, 1, 4, 9]
            },{name: 'Agree', data: [18, 6, 15, 23, 6, 5, 11, 6]
            }, {name: 'Strongly Agree', data: [13, 3, 6, 4, 1, 38, 29, 2] }]});
$('#chartcesi7').highcharts({
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        },
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            text: 'Do you have significant knowledge on any of the following computer
languages, tools or terminology?'
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        subtitle: {
            text: 'Part 1'
        },
        xAxis: {
            categories: [
                '(X)HTML',
                'CSS',
                'Sass/ LESS',
                'JavaScript/  jQuery/  CoffeeScript',
                'Angular.js',
                'Node.js',
                'Scratch/ Logo',
                'C#',
                'Objective-C',
                'C++',
                'Perl'
            ]
        },
        yAxis: {
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            }
        },
        tooltip: {
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```

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</td>' +
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            footerFormat: '</table>',
            shared: true,
            useHTML: true
        },
        plotOptions: {
            column: {
                pointPadding: 0.2,
                borderWidth: 0
            }
        },
        series: [{
            name: 'Very Insignificant', data: [6, 13, 27, 19, 34, 33, 5, 26, 29, 23, 29 ]
        }, {name: 'Insignificant', data: [5, 5, 10, 10, 7, 6, 5, 9, 8, 11, 8 ]
        }, {name: 'Neutral', data: [11, 11, 6, 8, 4, 6, 6, 7, 5, 7, 6 ]
        },{name: 'Significant', data: [19, 13, 2, 6, 0, 0, 16, 2, 3, 3, 0 ]
        }, {name: 'Very Significant', data: [4, 3, 0, 2, 0, 0, 13, 1, 0, 1, 2 ]}]
    });
          $('#chartcesi7b').highcharts({
        chart: {
            type: 'column'
        },
        title: {
            text: 'Do you have significant knowledge on any of the following computer
languages, tools or terminology?'
        },
        subtitle: {
            text: 'Part 2'
        },
        xAxis: {
            categories: [
                'Python',
                'Ruby/ Rails',
                'PHP/ Wordpress',
                'MySQL/ Postgres',
                'Java/ Scala',
                'VB/ ASP.net',
                'Drupal',
                'Azure',
                'Cloud',
                'Git',
                'Jade/ HAML'
            ]
        },
        yAxis: {
            min: 0,
            title: {
                text: 'Respondents'
            }
        },
        tooltip: {
            headerFormat: '<span style="font-size:10px">{point.key}</span><table>',
            pointFormat: '<tr><td style="color:{series.color};padding:0">{series.name}:
</td>' +
                '<td style="padding:0"><b>{point.y:.1f} </b></td></tr>',
            footerFormat: '</table>',
            shared: true,
            useHTML: true
        },
        plotOptions: {
            column: {
                pointPadding: 0.2,
                borderWidth: 0
```

```
            }
        },
        series: [{
            name: 'Very Insignificant', data: [19, 30, 8, 22, 21, 18, 23, 34, 15, 32, 34 ]
        }, {
            name: 'Insignificant', data: [13, 9, 3, 7, 9, 10, 10, 6, 3, 4, 6]
        }, {name: 'Neutral', data: [8, 3, 12, 10, 6, 9, 3, 4, 13, 5, 3 ]
        },{name: 'Significant', data: [3, 3, 14, 3, 6, 7, 6, 0, 9, 3, 1 ]
       }, {name: 'Very Significant', data: [2, 0, 8, 3, 3, 1, 3, 1, 5, 1, 1]}]
    });
$('#chartcesi8').highcharts({
            chart: {
                plotBackgroundColor: null,
                plotBorderWidth: null,
                plotShadow: false
            },
            title: {
                text: 'Are you aware of the NCCA Draft Syllabus in Programming and
coding?'},
            tooltip: {
                pointFormat: '{series.name}: <b>{point.percentage:.1f}%</b>'
            },
            plotOptions: {
                pie: {allowPointSelect: true, cursor: 'pointer',
                    dataLabels: {enabled: false},showInLegend: true}
            }, series: [{type: 'pie', name: 'Are you aware?',
                data: ['No',   31.11], ['Yes', 68.89]] }] });
            $('#chartcesi9').highcharts({
                chart: {
                    plotBackgroundColor: null,
                    plotBorderWidth: null,
                    plotShadow: false
                },
                title: {text: 'What areas of ICT are currently taught in your school?'
                },tooltip: {pointFormat: '{series.name}: <b>{point.percentage:.1f}%</b>'
                },plotOptions: {
                    pie: {allowPointSelect: true, cursor: 'pointer',
                        dataLabels: {enabled: false},showInLegend: true}},
                series: [{
                    type: 'pie',
                    name: 'What areas of ICT',
                    data: [
                        ['Digital Media Literacy',   25],
                        ['Programming and Coding',    12.8],
                        ['Scratch/CoderDojo',    18.94],
                        ['AUTOCAD',   14.39],
                        ['Digital Graphics',     4.55],
                        [ 'ECDL', 24.24 ],
                        ['Don\'t know',   0.76]] }]});
$('#chartcesi10').highcharts({
                  chart: {
                      plotBackgroundColor: null,
                      plotBorderWidth: null,
                      plotShadow: false
                  },title: {
                      text: 'Do you feel you could teach Programming and Coding at second
Level, based on the draft NCCA Syllabus?'
                  },tooltip: {pointFormat: '{series.name}: <b>{point.percentage:.1f}%</b>'
                  },plotOptions: {pie: {allowPointSelect: true, cursor: 'pointer',
                          dataLabels: {enabled: false},showInLegend: true}},
                  series: [{type: 'pie', name: 'Opinion',
                      data: [ ['Yes', 16.67], ['Yes - with help and training', 76.19 ],
                          ['No',   7.14]] }]});
             $('#chart9cesi').highcharts({
        chart: {type: 'column'},
```

```
        title: {text: 'What primary subject(s), do your colleagues teaching computers
teach in your school?'
        },subtitle: {text: 'Detailed Column Chart overall'
        },xAxis: {categories: [
                'Irish', 'English', 'Maths', 'History', 'Geography', 'MFL', 'Music',
'Art', 'TG/ DCG', 'Woodwork', 'Metalwork/ Engineering', 'Technology', 'Science',
'Religion', 'CSPE', 'SPHE', 'Resource', 'Business + other', 'n/a'] },yAxis: {
            min: 0,
            title: {text: 'Respondents'}},
        tooltip: {headerFormat: '<span style="font-size:10px">{point.key}</span><table>',
            pointFormat: '<tr><td style="color:{series.color};padding:0">{series.name}:
</td>' +'<td style="padding:0"><b>{point.y:.1f}</b></td></tr>',
            footerFormat: '</table>', shared: true, useHTML: true},
        plotOptions: {column: {pointPadding: 0.2, borderWidth: 0}},
        series: [{name: 'Total',
            data: [2, 9, 14, 8, 5, 3, 4, 5, 15, 9, 7, 9, 11, 4, 3, 2, 7, 15, 3 ]
}]});              $('#chart91cesi').highcharts({
        chart: {type: 'column'
        },title: {text: 'What primary subject(s), do your colleagues teaching computers
teach in your school?'},subtitle: {text: 'Detailed Column Chart by career length'},
        xAxis: {categories: [
                'Irish', 'English', 'Maths', 'History', 'Geography', 'MFL', 'Music',
'Art', 'TG/ DCG', 'Woodwork', 'Metalwork/ Engineering', 'Technology', 'Science',
'Religion', 'CSPE', 'SPHE', 'Resource', 'Business + Other',
                'n/a'] },yAxis: {min: 0, title: {text: 'Respondents'}},
        tooltip: {headerFormat: '<span style="font-size:10px">{point.key}</span><table>',
            pointFormat: '<tr><td style="color:{series.color};padding:0">{series.name}:
</td>' +'<td style="padding:0"><b>{point.y:.1f}</b></td></tr>',
            footerFormat: '</table>', shared: true, useHTML: true
        },plotOptions: {column: {pointPadding: 0.2, borderWidth: 0}
        },series: [ {: '0-10',
            data: [1, 2, 2, 3, 0, 0, 1, 0, 4, 0, 1, 2, 3, 1, 1, 1, 2, 2, 0 ]
        }, {name: '10-15',
            data: [0, 0, 3, 0, 1, 0, 0, 1, 2, 1, 0, 1, 3, 0, 0, 1, 0, 5, 1 ]
        },{name: '15-20', data: [0, 0, 2, 1, 0, 0, 0, 1, 1, 1, 2, 2, 1, 1, 0, 0, 2, 2, 0]
        },{name: '20+', data: [1, 7, 7, 4, 4, 3, 3, 3, 8, 7, 4, 4, 4, 2, 2, 0, 3, 6, 2 ]
        }]});
$('#chart11cesi').highcharts({
                chart: {plotBackgroundColor: null, plotBorderWidth: null, plotShadow:
false
                },title: {text: 'What primary subject(s), do your colleagues teaching
computers teach in your school?'
                },tooltip: {pointFormat: '{series.name}: <b>{point.percentage:.1f}%</b>'
                },plotOptions: {pie: {allowPointSelect: true, cursor: 'pointer',
dataLabels: {enabled: false},showInLegend: true}},series: [{type: 'pie', name: 'What
primary subject(s), do your colleagues teaching computers teach in your school?', data: [
['Irish', 1.35],
                                        ['English', 9.46],
                                        ['Maths', 9.46],
                                        ['History', 5.41],
                                        ['Geography', 5.41],
                                        ['MFL', 4.05],
                                        ['Music', 4.05],
                                        ['Art', 4.05],
                                        ['TG/DCG', 10.81],
                                        ['Woodwork', 9.46],
                                        ['Metalwork/Engineering', 5.41],
                                        ['Technology', 5.41],
                                        ['Science', 5.41],
                                        ['Religion', 2.7],
                                        ['CSPE', 2.7],
                                        ['SPHE', 0],
                                        ['Resource', 4.05],
                                        ['Business + Other', 8.11],
                                        ['n/a', 2.7]] }]});
```

```
    $('#chartcesi12').highcharts({
        chart: {type: 'column'},
        title: {text: 'Evaluate the following phrases in realtion to Programming and
Coding (P+C)' }, subtitle: {text: 'Part 1'}, xAxis: {categories: ['P+C is Hard',
                'P+C has nothing to do with Art',
                'P+C has much cross Curricular potential',
                'P+C can improve literacy and numeracy',
                'The NCCA Draft Syllabus is easy to understand',
                'There are elements I could teach without knowing code',
                'I would be willing to teach P+C',
                'Coding is a skill I would like to learn',
                'Programming and Coding could be cross curricular'] },
        yAxis: {min: 0, title: {text: 'Response'}},
        tooltip: {headerFormat: '<span style="font-size:10px">{point.key}</span><table>',
            pointFormat: '<tr><td style="color:{series.color};padding:0">{series.name}:
</td>' +'<td style="padding:0"><b>{point.y:.1f}</b></td></tr>',
            footerFormat: '</table>', shared: true, useHTML: true},
        plotOptions: {column: {pointPadding: 0.2, borderWidth: 0}},
        series: [{name: 'Strongly Disagree', data: [3, 10, 1, 1, 1, 1, 2, 1, 1 ]
        }, {name: 'Disagree', data: [14, 19, 0, 0, 5, 2, 2, 2, 0 ]
        }, {name: 'Neutral', data: [17, 10, 6, 5, 15, 10, 2, 7, 4 ]
        }, {name: 'Agree', data: [8, 3, 20, 19, 16, 18, 14, 12, 22 ]
        }, {name: 'Strongly Agree', data: [0, 0, 15, 17, 5, 11, 22, 20, 15 ]
 }] });
    $('#chartcesi12b').highcharts({
        chart: {
            type: 'column'
        },
        title: {
         text: 'Evaluate the following phrases in realtion to Programming and Coding'
        },
        subtitle: { text: 'part 2'},
        xAxis: {
            categories: [
                'Knowing Flash makes P+C easier',
                'Animation has transferable skills to P+C',
                'My Students would love to learn P+C',
                'P+C is important in Irish Society',
                'You need impressive labs to teach P+C',
                'I have all the skills needed to start learning P+C',
                'Learning P+C to teach would make me more employable',
               'Principals will want teachers to teach P+C in schools in next 5years',
                'P+C will become an important subject in schools'] },
        yAxis: {min: 0, title: {text: 'Response'}
        },tooltip: {headerFormat: '<span style="font-
size:10px">{point.key}</span><table>',
            pointFormat: '<tr><td style="color:{series.color};padding:0">{series.name}:
</td>' +'<td style="padding:0"><b>{point.y:.1f}</b></td></tr>',
            footerFormat: '</table>', shared: true, useHTML: true
        },plotOptions: {column: {pointPadding: 0.2, borderWidth: 0}},
        series: [{name: 'Strongly Disagree',data: [5, 0, 0, 0, 6, 3, 1, 1, 1 ]
        }, {name: 'Disagree', data: [3, 3, 4, 2, 22, 10, 2, 1, 1  ]
        }, {name: 'Neutral', data: [28, 9, 7, 11, 9, 6, 8, 5, 12 ]
        }, {name: 'Agree', data: [6, 26, 22, 15, 5, 12, 20, 16, 14 ]
        }, {name: 'Strongly Agree', data: [0, 4, 9, 14, 0, 11, 11, 19, 14 ] }]
    }); $('#chartcesi13').highcharts({chart: {plotBackgroundColor: null, plotBorderWidth:
null, plotShadow: false},title: {text: 'Do you think a coding aptitude test would give
confidence to those who may be starting to learn how to code?'},
            tooltip: {pointFormat: '{series.name}: <b>{point.percentage:.1f}%</b>'
            }, plotOptions: {pie: {allowPointSelect: true, cursor: 'pointer', dataLabels:
{
                        enabled: false}, showInLegend: true}},series: [{type: 'pie', name:
'Opinion',data: [{name: 'Yes', y: 43.9, sliced: true, selected: true}, ['No',   19.51],
['No Opinion',   36.59]] }]});
```

```
$('#chartcesi13b').highcharts({
            chart: {plotBackgroundColor: null, plotBorderWidth: null, plotShadow: false
            },title: {text: 'With no opinion excluded.'
            },tooltip: {pointFormat: '{series.name}: <b>{point.percentage:.1f}%</b>'
            },plotOptions: {pie: {allowPointSelect: true, cursor: 'pointer',
                    dataLabels: {enabled: false},showInLegend: true}},
            series: [{type: 'pie', name: 'Opinion',
                data: [{name: 'Yes', y: 69.23, sliced: true, selected: true},
                    ['No', 30.77]] }]});
$('#chartcesi14').highcharts({
            chart: {plotBackgroundColor: null, plotBorderWidth: null, plotShadow: false
            },title: {text: 'Do you feel being able to teach programming and coding (ICT)
would make a teacher more employable?'
            },tooltip: {pointFormat: '{series.name}: <b>{point.percentage:.1f}%</b>'
            },plotOptions: {pie: {allowPointSelect: true, cursor: 'pointer',
                    dataLabels: {enabled: false},showInLegend: true}},
            series: [{
                type: 'pie', name: 'Opinion',
                data: [{name: 'Yes', y: 90.24, sliced: true, selected: true},
                      ['No', 7.32], ['No Opinion', 2.44]] }]});});});
```

7.12.3 Rails Logic

7.12.3.1 Models

```
class Question < ActiveRecord::Base
  attr_accessible :question
    has_many :answers
  accepts_nested_attributes_for :answers
  def answer
   uncorrect
   answers.select {|c| c.correct}[0]
  end
  def uncorrect
   answers.each {|c| c.correct = false}
  end
  def answer= answer
   if !answer.nil?
    answer.correct = false
   end
   if answers.include? answer
    answer.correct = true
   else
    answers << answer
    answer.correct = true
   end
  end
end
class Detail < ActiveRecord::Base
  attr_accessible :age, :email, :ictlevel, :lengthteach, :name, :profession, :research
validates_uniqueness_of :email
  PROFESSIONS = [ "Art Teacher", "Other Teacher", "IT Professional", "Student", "Other"]
  TEACHLENGTH = [ "n/a", "0-5 years (NQT)", "5-10 years", "10-15 years", "15-20 years",
"20-25 years", "25 years +"]
  LOCATION = ["Dublin", "Leinster", "Munster", "Connaught", "Ulster", "Northern Ireland",
"UK", "Australia", "USA", "Canada", "Other"]
  PROFICIENCY =[ "select", "1 - Basic Understanding", "2 - General Understanding", "3 -
Ablility to use program like Photoshop", "4 - Some Understanding of Code", "5 - Advanced
Understanding"]
end
class Answer < ActiveRecord::Base
  attr_accessible :answer, :correct, :question_id
  belongs_to :question
end
class Admin < ActiveRecord::Base
devise :database_authenticatable, :registerable,
```

```
        :recoverable, :rememberable, :trackable, :validatable
attr_accessible :email, :password, :password_confirmation, :remember_me
end
```

7.12.3.2 Controllers

```
class AptitudeController < ApplicationController
  def index
  end
  def start
   total = params[:number].to_i
   all = Question.find(:all).map {|x| x.id}
   session[:questions] = all.sort_by{rand}[0..(total-1)]
   session[:total]   = total
   session[:current] = 0
   session[:correct] = 0
   redirect_to :action => "question"
  end
  def question
   @current = session[:current]
   @total   = session[:total]
   if @current >= @total
    redirect_to :action => "end"
    return
   end
   @question = Question.find(session[:questions][@current])
   @answers = @question.answers.sort_by{rand}
   session[:question] = @question
   session[:answers] = @answers
  end
  def answer
   @current = session[:current]
   @total   = session[:total]
   answerid = params[:answer]
   @question = session[:question]
   @answers  = session[:answers]
   @answer = answerid ? Answer.find(answerid) : nil
   if @answer and @answer.correct
    @correct = true
    session[:correct] += 1
   else
    @correct = false
   end
   session[:current] += 1
  end
  def end
   @correct = session[:correct]
   @total   = session[:total]
   @score = @correct * 100 / @total
  end
end
class AnswersController < ApplicationController
  before_filter :set_answer, only: [:show, :edit, :update, :destroy]
  respond_to :html
  def create
   @question = Question.find(params[:question])
   answer = params[:answer]
   correct = params[:correct] == "1"
   new  =  Answer.create(:answer  =>  answer,  :correct  =>  correct,  :question_id  =>
@question.id)
   if new.correct
    @question.answer = new
   end
   redirect_to question_path(@question)
  end
  def destroy
```

```
   @question = Question.find(params[:question])
   @answer = Answer.find(params[:answer])
   @answer.destroy
   redirect_to question_path(@question)
  end
end
class SiteController < ApplicationController
  def about
  end
  def index
  end
  def learn
  end
end
class ResultsController < ApplicationController
  def index
  end
  def atai
  end
  def cesi
  end
  def survey
  end
  def test
  end
  def individual
  end
end
class LearnsController < ApplicationController
  before_filter :set_learn, only: [:show, :edit, :update, :destroy]
  respond_to :html
  def index
    @learns = Learn.all
    respond_with(@learns)
  end
  def show
    respond_with(@learn)
  end
  def new
    @learn = Learn.new
    respond_with(@learn)
  end
  def edit
  end
  def create
    @learn = Learn.new(params[:learn])
    @learn.save
    respond_with(@learn)
  end
  def update
    @learn.update_attributes(params[:learn])
    respond_with(@learn)
  end
  def destroy
    @learn.destroy
    respond_with(@learn)
  end
  private
    def set_learn
      @learn = Learn.find(params[:id])
    end
end
class DetailsController < ApplicationController
  before_filter :set_detail, only: [:show, :edit, :update, :destroy]
  before_filter :authenticate_admin!
```

```
  respond_to :html
  def index
    @details = Detail.all
    respond_with(@details)
  end
  def show
    respond_with(@detail)
  end
  def new
    @detail = Detail.new
    respond_with(@detail)
  end
  def edit
  end
  def create
    @detail = Detail.new(params[:detail])
    @detail.save
    respond_with(@detail)
  end
  def update
    @detail.update_attributes(params[:detail])
    respond_with(@detail)
  end
  def destroy
    @detail.destroy
    respond_with(@detail)
  end
  private
    def set_detail
      @detail = Detail.find(params[:id])
    end
end
```

7.12.3.3 Views

7.12.3.3.1 Survey Results view

```
<h1>Art Teacher Survey Results</h1>
<p>In September 2014, I carried out a survey of Art Teachers, through the <abbr title="Art
Teachers' Association of Ireland">ATAI</abbr>. I wanted to gauge the level of <abbr
title="Information, Communications Technology">ICT</abbr> Skill and communication of Art
Teachers in Ireland.</p>
<div class="survey">
               <a href="/results/index">Results Index</a>          |              <a
href="/results/cesi">Cesi survey results</a>        |       <a
href="/results/test">Aptitude Test results</a>
</div>
<div id="data"></div>
<div id="chartcontainer"class= "charts2"></div>
<div id="chart2container"  class= "charts" ></div>
<div id="chart3container" class= "charts2"></div>
<div id="chart5container"  class= "charts" ></div>
<div id="chart35container"class= "charts3"></div>
<div id="chart36container"class= "charts3"></div>
<div id="chart55container"class= "charts3"></div>
<div id="chart56container"class= "charts3"></div>
<div id="chart4container"class= "charts3"></div>
<div id="chart6container" class= "charts"></div>
<div id="chart7container" class= "charts"></div>
<div id="chart8container" class= "charts"></div>
<div id="chart9container" class= "charts3"></div>
<div id="chart91container" class= "charts3"></div>
<div id="chart29container" class= "charts3"></div>
<div id="chart39container" class= "charts3"></div>
<div id="chart11container" class= "charts2"></div>
<div id="chart10container" class= "charts"></div>
```

```
<div id="chart12container" class= "charts3"></div>
<div id="chart13container" class= "charts3"></div>
<div id="chart16container" class= "charts3"></div>
```

7.12.3.3.2 Details form (for future development)

```
<%= simple_form_for(@detail) do |f| %>
  <%= f.error_notification %>
  <div class="form-inputs">
    <%= f.input :name, :label => 'Please tell me your name' %>
        <%= f.input :age, collection: 10..80, :label => 'How old are you?' %>
    <%= f.input :email, :label => 'Please submit email, so we can send you results' %>
   <%= f.label :profession, 'What Profession/background are you from?'%>
     <%=    f.select    :profession,    Detail::PROFESSIONS,    :label    =>    'What
Profession/background are you from?', :required => true %><br /><br />
   <%= f.label :lengthteach, 'If a teacher, how long have you been teaching?'%>
     <%= f.select :lengthteach, Detail::TEACHLENGTH, :label => 'If a teacher, how
long have you been teaching?', :required => true %><br /><br />
   <%= f.label :location, 'What area do you live/work in?' %>
     <%= f.select :lengthteach, Detail::LOCATION, :label => 'What area do you
live/work in?', :required => true %>
    <br /><br />
   <%= f.label :ictlevel, 'From a scale of one to five, 1 being no competence, and 5 being
very competent, how competent are your ICT skills?' %>
     <%= f.select :ictlevel, Detail::PROFICIENCY, :label => 'What area do you
live/work in?', :required => true %>
    <p>Please click the box to allow your anonymous results being included in this
research study.</p>
    <%= f.check_box :research, :name => 'Do you consent', :checked => 'checked', as:
:boolean %>
  </div>
  <div class="form-actions">
    <%= f.submit 'Submit', aptitudes_path %>
  </div>
<% end %>
```

7.12.3.3.3 Application Layout

```
<!doctype html>
<!-- paulirish.com/2008/conditional-stylesheets-vs-css-hacks-answer-neither/ -->
<!--[if lt IE 7]> <html class="no-js lt-ie9 lt-ie8 lt-ie7" lang="en"> <![endif]-->
<!--[if IE 7]>    <html class="no-js lt-ie9 lt-ie8" lang="en"> <![endif]-->
<!--[if IE 8]>    <html class="no-js lt-ie9" lang="en"> <![endif]-->
<!--[if gt IE 8]><!--> <html class="no-js" lang="en"> <!--<![endif]-->
<head>
  <meta charset="utf-8">
  <!-- Use the .htaccess and remove these lines to avoid edge case issues.
       More info: h5bp.com/i/378 -->
  <meta http-equiv="X-UA-Compatible" content="IE=edge,chrome=1">
  <title>Codability</title>
  <meta name="description" content="">
       <link rel="shortcut icon" href="/favicon.ico">
       <link rel="apple-touch-icon" href="/apple-touch-icon.png">
  <!-- Mobile viewport optimized: h5bp.com/viewport -->
  <meta name="viewport" content="width=device-width">
<%= stylesheet_link_tag "application" %>
  <%= csrf_meta_tags %>
  <%= javascript_include_tag 'modernizr' %>
  <!-- Initializes the modernizr and actually perform the checks. Enable this
       if you need the modernizr, but remember to only do the actual checks
       that you need. -->
  <%= javascript_tag "Modernizr.load();" %>
</head>
<body>
  <!-- Prompt IE 6 users to install Chrome Frame. Remove this if you support IE 6.
       chromium.org/developers/how-tos/chrome-frame-getting-started -->
```

```
  <!--[if lt IE 7]><p class=chromeframe>Your browser is <em>ancient!</em> <a
href="http://browsehappy.com/">Upgrade to a different browser</a> or <a
href="http://www.google.com/chromeframe/?redirect=true">install Google Chrome Frame</a> to
experience this site.</p><![endif]-->
  <!-- Add your site or application content here -->
        <div id="wrap">
         <div class="header-container">
             <header class="wrapper clearfix">
                 <h1 class="title"><a href="/">Codability &lt; &gt;</a></h1>
                 <nav>
                     <ul>
                         <li><a href="/results/index">Research</a></li>
                         <li><a href="/details/new">Test</a></li>
                         <li><a href="/learns">Learn</a></li>
                     </ul>
                 </nav>
             </header>
         </div>
         <div class="main-container">
             <div id="main" class="main wrapper clearfix">
                <% if notice %>
        <p class="alert alert-success"><%= notice %></p>
                              <% end %>
                              <% if alert %>
                                <p class="alert alert-danger"><%= alert %></p>
                              <% end %>
<%= yield %>
                        </div> <!-- #main -->
         </div> <!-- #main-container -->
       </div>

         <div id="footer"class="footer-container">
             <footer class="wrapper">
                 <h3>About</h3>
                 <p>This project was part of the MSc in Web Technologies at the National
College of Ireland. </p>
       <p class="navbar-text pull-right">
         <% if user_signed_in? %>Logged in as <strong><%= current_user.email %></strong>.
<%= link_to 'Edit profile', edit_user_registration_path, :class => 'navbar-link' %> |
<%= link_to "Logout", destroy_user_session_path, method: :delete, :class => 'navbar-link'
%><% else %>
<%= link_to "Sign up", new_user_registration_path, :class => 'navbar-link'  %> |
<%= link_to "Login", new_user_session_path, :class => 'navbar-link'  %>
<% end %></p>
             </footer>
         </div>
<!--     JavaScript     at     the     bottom     for     fast     page     loading:
http://developer.yahoo.com/performance/rules.html#js_bottom -->
  <%= javascript_include_tag 'application' %>

  <% if Rails.env.production? %>
  <!-- Asynchronous Google Analytics snippet. Change UA-XXXXX-X to be your site's ID.
       mathiasbynens.be/notes/async-analytics-snippet -->
  <script>
    var _gaq=[['_setAccount','UA-XXXXX-X'],['_trackPageview']];
    (function(d,t){var g=d.createElement(t),s=d.getElementsByTagName(t)[0];
    g.src=('https:'==location.protocol?'//ssl':'//www')+'.google-analytics.com/ga.js';
    s.parentNode.insertBefore(g,s)}(document,'script'));
  </script>
  <% end %>
</body>
</html>
```

7.12.3.4 Routes

```
Codability::Application.routes.draw do
```

```
  devise_for :admins
  devise_for :users
  get "aptitude/start"
  get "aptitude/end"
  get "aptitude/question"
  get "aptitude/answer"
  get "aptitude/index"
  resources :answers
  resources :questions
  resources :details
  get "results/atai"
  get "results/cesi"
  get "results/survey"
  get "results/test"
  get "results/individual"
  get "results/index"
  resources :learns
  get "site/about"
  get "site/index"
  get "site/learn"
#test functionality
  get "aptitude/index"
  post "aptitude/start"
  get "aptitude/question"
  post "aptitude/question"
  post "aptitude/answer"
  get "aptitude/end"
  post "answers/create"
  post "answers/destroy"
  root :to => 'site#index'
end
```

7.12.3.4.1 Gemfiles

```
source 'https://rubygems.org'
gem 'rails', '3.2.17'
# Bundle edge Rails instead:
# gem 'rails', :git => 'git://github.com/rails/rails.git'
gem 'sqlite3'
group :production do
  gem 'pg'
end
gem 'rails_12factor', group: :production
# Gems used only for assets and not required
# in production environments by default.
group :assets do
  gem 'sass-rails',   '~> 3.2.3'
  gem 'coffee-rails', '~> 3.2.1'
  # See https://github.com/sstephenson/execjs#readme for more supported runtimes
  # gem 'therubyracer', :platforms => :ruby
  gem 'uglifier', '>= 1.0.3'
end
#Added Gems
gem "rails-boilerplate"
gem 'devise'
gem 'simple_form'
gem 'chart-js-rails'
gem 'humanize_boolean'
gem 'lazy_high_charts'
#convert xls to  yaml
gem 'heart_seed'
gem 'jquery-rails'
ruby '2.0.0'
```