RECOGNITION OF LEARNING GAINED THROUGH INFORMAL AND NON-FORMAL CODING ACTIVITIES

Deirdre Goggin, Dr Irene Sheridan, Linda O'Sullivan
Contents
1. Introduction ......................................................................................................................2
2. Digital Literacy and Digital Competence .........................................................................2
   2.1. Computer programming or coding ...........................................................................5
   2.2. Skills Acquisition through Coding ..........................................................................6
   2.3. Skills Identification and Evidencing structures .......................................................8
3. Recognition of Prior Learning ........................................................................................11
   3.1. Poland .....................................................................................................................12
   3.2. United Kingdom (England and Northern Ireland) ..................................................12
   3.3. Ireland ..................................................................................................................13
   3.4. Spain .....................................................................................................................13
   3.5. Summary ..............................................................................................................14
4. Mechanisms to Access Higher Education ......................................................................15
   4.1. Poland .....................................................................................................................15
   4.2. United Kingdom .....................................................................................................16
   4.3. Ireland ..................................................................................................................17
   4.4. Spain .....................................................................................................................18
   4.5. Summary ..............................................................................................................19
5. Research Methodology ...................................................................................................19
6. Findings and analysis ......................................................................................................20
7. Conclusions and Recommendations ..............................................................................23
8. Bibliography ...................................................................................................................25
1. Introduction

The project for which this report was developed focuses on the CoderDojo volunteer coding initiative and includes consideration of how the skills acquired could be recognised in educational contexts. CoderDojo is a global movement of free, volunteer-led, community based programming clubs for young people between the ages of seven and seventeen. The movement was founded by James Whelton and Bill Liao, an entrepreneur and philanthropist. From the first “dojo” founded in Cork in Ireland in 2011, the movement has grown significantly and by May 2015 there were over 675 verified “dojo”s in 57 countries globally (CoderDojo, n.d.).

The project which is funded under the Erasmus+ Strategic Partnership initiative involves a consortium, which includes partners in Poland, Spain and the United Kingdom as well as Ireland. In addition to proposing to develop toolkits to support the broader roll-out and adoption of CoderDojo in Europe, the CoderDojo Training in ICT Programming Skills project proposes to explore the potential to recognise or even accredit learning which is gained in the CoderDojo setting and to further investigate how this learning might be used to support young people in accessing or advancing in higher education within the partner states.

In the context of the project this report addresses, digital skills and digital literacy as well as frameworks and systems that might be applied to identify and assess evidence of the attainment of those skills. It considers the mechanisms through which higher education is generally accessed within the partner states and briefly considers recognition of prior learning mechanisms. A research methodology and research instrument are developed and deployed by the project partners within their CoderDojo settings to support the evidence of attainment of skills and some conclusions are drawn from the research findings.

2. Digital Literacy and Digital Competence

In an increasingly digital world there is a growing divide between those who are considered to be digitally literate and those who are not. In addition among those who are digitally literate there is a divide between those capable of engaging with technology and those capable of developing applications; between those who can engage with a variety of devices and those who are capable of developing software themselves; between users and creators.
As technology becomes more pervasive in our economy and society it has a growing impact in education, health, culture and work. In terms of the workplace impact it is clear that the current skills deficits and mismatches are generating significant demand for skilled information technology workers and the ability to meet this demand can have substantial impact on economic development for many European economies.

Developing appropriate technological skills among young people has been the focus of many government, industry-led and voluntary schemes and has given rise to a diverse set of initiatives around Europe. However, little has been published on the learning outcomes of these initiatives. This research will focus on the moves to support coding among young people and will, through a review of the extant literature and empirical research, seek to identify the knowledge, skills and competence that may be developed. The research will then consider mechanisms to evidence, recognise and, where appropriate, evaluate the learning gained in the context of formal education systems or workplace competencies.

Before seeking to identify the skills that might be attained through voluntary CoderDojo programming activities, consideration of the broad themes and language of digital skills attainment is useful. Prensky claims that:

...the single skill that will, above all others, distinguish a literate person is programming literacy, the ability to make digital technology do whatever, within the possible one wants it to do -- to bend digital technology to one's needs, purposes, and will, just as in the present we bend words and images. Some call this skill human-machine interaction; some call it procedural literacy. Others just call it programming. (Prensky, 2008)

While much is written on the subject of digital literacy there is no generally agreed definition. Li and Ranieri point out that when Gilster first used the term ‘digital literacy’ it was defined as ‘the ability to understand and use information in multiple formats from a wide range of courses when it is presented via computers’ (Gilster, 1997) (Li & Ranieri, 2010). In more recent times Stordy reports 685 publications over three years relating to literacy and digital technologies, stressing different concepts and highlighting 35 different types of literacy (Stordy, 2015). Considering literacy as both a personal evidenced cognitive ability and a social constructed practice, Stordy goes on to propose that digital literacies can be thought of as:
This consideration of the context or the application setting aligns well with the ECDL Foundation’s view that a person’s required and evidenced digital proficiency relates to the context in which it is to be applied, is subjective and sits within an evolving technological landscape (ECDL Foundation, 2011). The changing landscape and the evolution of technology itself presents difficulties in terms of the static definition of literacy and competence levels. In their working document the European Commission relates the concepts of literacy and competence by defining digital literacy as the skills required to achieve digital competence, the confident and critical use of ICT for work, leisure, learning and communication... and notes that it is underpinned by basic technical use of computers and the internet (European Commission, 2010). The recommendations of the working document include the closer linking of digital literacy with media literacy through the EU Media Literacy Charter (Anon., n.d.).

The ECDL Foundation suggests a framework of digital proficiency which progresses through awareness, literacy, competence and expertise and goes on to suggest that while literacy is required for social interactions, competence and expertise tend to relate to particular workplace settings and job roles.

Figure 1: Digital Proficiency Levels (adapted from ECDL Foundation, 2011)

The complexity of the language and the overlapping concepts can make these terms difficult to navigate. In most of the literature the term digital literacy is
considered in the broadest sense and it tends to relate to information and media literacy, internet literacy and ICT literacy. The concepts of information and media literacy are used in the context of using digital tools to find, process and organise information and interpret, use and create media respectively. Internet literacy relates to the ability to successfully interact with a networked environment (European Commission Joint Research Centre, 2011).

However, considering this question of terminology, Li and Ranieri use the terms literacy and competence interchangeably and suggest that the terms are equivalent favouring the term ‘competence’ in their research (Li & Ranieri, 2010). Generational impacts are also considered in the literature. Prensky clearly differentiated between digital natives and digital immigrants identifying those born after the mid-1980s as the first generation to grow up with digital technology (Prensky, 2001). While this is a useful concept, its identification of what Prensky considers a ‘singularity’ fails to take account of the multiplicity of advances large and small which have impacted on digital proficiency at a personal and global level over a number of years.

2.1. Computer programming or coding

While it is commonly accepted that the use of technology and the ability to interface with the World Wide Web and the networked world is important to 21st Century living skills, the ability to, as Prensky puts it, ‘bend technology to one’s needs’ is clearly a higher level skill set that goes beyond the ability to use devices. As Everitt points out while computers were relatively uncommon in the 1980s, the ability to programme them was not just desirable it was both required and expected. Early computers had less well-developed interfaces and very limited applications, meaning that those who had made the not-inconsiderable investment were highly motivated to expand the capabilities and a wave of computer programming magazines supporting BASIC coding became available to support the DIY culture (Everitt, n.d.). In these earlier days of computing there was little to separate the user from the programmer, however, as devices have achieved higher levels of complexity and sophistication the underlying code has become less and less accessible to the user and there is often little need to consider the acquisition of programming skills for most users. Our interaction with computers has been mostly limited to the development of our ability to optimise our use of the sophisticated application suite with which most personal computers come equipped. Developing
digital fluency, on the other hand, points to the ability to create, design and develop rather than browse and use (Resnick, et al., 2009).

Steadman notes that the impetus to introduce coding or computing into the curriculum is straightforwardly economic and is based on the need to compete at a global level and on an aspiration that we can provide the context for the development of the ‘next big thing’ in technology (Steadman, 2014). While it is clear that not all technology consumers will need to be able to code, there is an expectation that learning to code will enhance their interactions with technology as well as contribute to other skills development, and increase the resilience of their employability (Firth, 2014). The next section of this report considers some of the skills that can be gained through coding activities in formal, non-formal or informal settings and includes a consideration of how the acquisition of these skills might be supported.

2.2. Skills Acquisition through Coding
The consideration of which skills are acquired and how they are acquired in learning to code is often related to the context within which the learning takes place. Scratch’s inventor Mitchell Resnick is quoted as stating that Scratch teaches children to ‘think creatively, reason systematically, and work collaboratively’ (Flanagan, 2015). Research on the earlier Logo language found that using the Logo programming language boosted the ability for abstract thought.

The concept of the social or collaborative learning environment fostered by the Scratch on-line community aligns well with a constructionist theory, focusing on the applied nature of the learning through programming in response to specific needs or the development of a meaningful product. This constructionist learning places importance on the development of individual cognitive skills in the context of engagement with others. Denner et al. explore the creation of computer games by middle school girls in the development of understanding of computer science concepts (Denner, et al., 2012). Salen claims that writing successful computer games involves ‘systems-level thinking, iterative critical problem-solving, art and aesthetics, writing and storytelling, interactive design, game logic and rules and programming skills’ (K., 2007, p. 307). Firth claims that learning to code contributes to the ability for abstract thinking and problem solving (Firth, 2014). Many authors refer to the ability to develop computational thinking through learning to programme and this is often linked to the development of transferable problem-solving abilities.
(Resnick, et al., 2009) (Reilly, 2013) (Ly & Koh, 2014). Exploring the rationale for the integration of computer programming into the school curriculum European Schoolnet identifies: (European Schoolnet, 2014)

• Logical thinking skills
• Coding and programming skills
• Problem-solving skills
• Employability in the ICT sector
• Attracting more students to study computer science in higher education
• Other key competencies

Computational thinking can encompass logic, precision, rigour and creativity and while it can be developed through programming activities, it is considered to be both broader and deeper and with general transferability (Bateman, 2014). Research which has sought to identify complex algorithmic thinking development through computer game play in young children has identified algorithmic thinking, problem decomposition, pattern generalisation and abstraction and pattern recognition as types of computational thinking skills (Lee, et al., 2014). Ke’s research illustrated that the use of Scratch-based computer game making developed positive dispositions toward mathematics in middle-school children (Ke, 2014).

The European Commission elaborates on the kinds of skills that are necessary for active participation in the digital information society, often termed ‘21st Century Skills’, including digital competence (European Commission Joint Research Centre, 2011). Researchers codify these skills sets in different ways but they may be generally considered to encompass three elements (Partnership for 21st Century Skills, n.d.):

• Personal and cognitive development: Critical thinking, problem-solving, creativity, collaboration, decision making
• Digital and media skills: Information literacy, Media literacy, ICT proficiency
• Active Citizenship: Flexibility and adaptability, personal accountability and goal-setting, productivity, leadership
There is general agreement that developing the ability to write code is likely to be of growing importance. Equally there is a recognition that a complex array of skills can be gained in developing these competencies.

Other researchers contribute to the understanding of the appropriate settings in which the acquisition of these skills can be supported. In extensive research on programming performance of elementary students, Feng and Chen conclude that non-specific goals and structuring scaffolds lead to superior comprehension of programming and that problem-solving performance is improved by non-specific goals and problematizing scaffolds. They further conclude that problematizing scaffolds are superior to structuring scaffolds in the development of self-regulation behaviour (Feng & Chen, 2014). Lye and Koh also point to the importance of a constructionism-based problem-solving environment and the need for careful scaffolding and support for self-reflection (Lye & Koh, 2014). So while it may be evident that skills can be obtained, the context and the support for the skills acquisition is also important and this may well have implications for the CoderDojo movement and ethos.

If the skills which may be acquired through coding activities are to be recognised the process will need to consider the four main stages identified by the European 2012 recommendation on the validation of informal and non-formal learning; Identification, Documentation, Assessment and Certification (European Union, 2012). This collaborative research process sought to identify the skills that may be attained through the CoderDojo activities, building on the literature review and including practitioner perspectives. To support the potential identification, documentation, assessment and ultimately transferability of the skills which might be attained existing structures which support transferability in the identification and evidencing of skills were explored.

2.3. Skills Identification and Evidencing structures

The European Qualifications Framework (EQF) is a translation tool that supports communication and comparison between qualifications systems in Europe. Its eight common European reference levels are described in terms of learning outcomes: knowledge, skills and competences. This allows any national qualifications systems, national qualifications frameworks (NQFs) and qualifications in Europe to relate to the EQF levels. Learners, graduates, education and training providers and employers
can use these levels to understand and compare qualifications awarded in different countries and by different education and training systems. The EQF acts as an important common reference point to support sharing and comparison of learning attainment across the project partnership and beyond. An important principle of the EQF is the learning outcome approach. The learning outcomes approach shifts focus to evidence of the knowledge, skills and competences the learner has acquired by the end of the learning process. This approach underpins the research herein.

As previously mentioned when seeking to validate learning there are a number of stages as identified by the European Council through which one can progress. There are a variety of existing structures at a European level that support the identification and documentation stages of the validation process.

The first framework to be considered is the European Classification of Skills/Competences, Qualifications and Occupations (ESCO) framework which is a European Commission initiative (Commission, 2014). The purpose is the development of a common European terminology which will make it easier to identify the links between skills, competence, education and occupations. It is available through 25 languages so the mobility of learners is central to the system. It complements the learning outcome system and also the development of a European standardised role profile or job description system.

As part of this system there are job specific skills or competences and also those which are more transversal in nature. In the context of CoderDojo there are various skills which the learner acquires which might be translated into a number of roles under the latter category. The transversal skills relate to areas such as application of knowledge, attitudes and values at work, language and communication, social and thinking skills. These skills and competences are relevant to a broader range of roles and occupations than narrower technical skills might be. In relation to skills developed through CoderDojo this framework provides a useful mechanism to record skills against each particular skills area and also to show progress and skill development over time. There are also more specific Information Technology role profiles however they are linked more closely to the labour market and not to the early stage skills development which is more likely to be found in CoderDojo participants. In the context of this project the profiles may be more useful as an
information or advisory tool to keep learners informed of areas which they may consider as future occupations.

The competence listings are developed within the context of the broader ESCO occupations listing and relevant qualifications within the sector. The list is not exhaustive but is being updated to reflect the new developments in the ICT sector. This is in keeping with the ethos of ESCO to ensure sustainable commonality and comparability across countries.

The second framework to be considered is the e-Competence Framework (CEN, 2014) which was first established in 2008 with e-CF 1.0 and has since evolved to its current version e-CF 3.0. The purpose of the e-Competence framework is to establish common standards across descriptions of ICT skills requirements and gaps at a European level. The framework is built around 40 identified e-competences for ICT professionals with significant input from experts and stakeholders. The competences are grouped into five e-competence areas of plan, build, run, enable and manage which are developed over four dimensions. The competence levels run from the EQF levels 3 through to 8 so there are aspects of the framework which are appropriate to the novice in ICT but also to the expert. The framework informs learners how their competence and skills relate to career and role development and what they will need to progress to the next level on the continuum.

These two frameworks provide a gauge for skills identification and development in the context of existing professional qualifications or experience. The frameworks also provide a system to record relevant learning. These frameworks have incorporated competences relevant to ICT which have been useful in developing the research instrument for the identification of learning acquired through the CoderDojo initiative for this project.

There are other relevant frameworks such as Europass and Youthpass which are a repository for skills rather than being linked to particular role profiles. Europass is comprised of the development of a curriculum vitae and the European skills passport (ESP) (Europass, 2005) to support learners in identifying and recording their learning and to enable mobility. Youth pass is more relevant to the recognition of informal and non-formal learning in youth work at a European level (Commission, n.d.). The content of these templates are driven by the learner and linked to the Erasmus + youth actions. These initiatives support the documentation and evidence gathering in keeping with the concept of lifelong and life-wide learning.
This consideration of existing frameworks linked to the European Qualifications Framework underpinned the development of the observational research instrument which was deployed by the partner organisations in this research. Further consideration of how learning which may be acquired in a non-formal or informal setting can potentially articulate into supporting access, exemption or award in formal education settings necessitated a brief exploration of the recognition of prior learning within the partner states.

3. Recognition of Prior Learning

Recognition of Prior Learning or RPL is defined as a process whereby prior learning is given a value (European Commission, 2008; NQAI, 2005; OECD, 2004). RPL can operate to provide recognition for advanced entry and non-standard admissions to educational pathways and is also used to award credit for elements within programmes. Cooper and Harris refer to RPL as “a specialised pedagogic practice that provides tools for navigating access to new learning opportunities” (p. 447, Cooper and Harris, 2013). For the purposes of this research the following definition of RPL extracted from the European Inventory on validation of non-formal and informal learning, country report Ireland 2014 is used; “RPL incorporates prior formal, informal and non-formal learning and that which is validated within the context of a specified destination award from level one to ten on the national framework of qualifications” (p.3, European Commission, Cedefop, ICF International; 2014). Validation is another term that is used in the literature sometimes interchangeably with the term recognition in the European context.

In Europe there is a variation in the maturity and application of both the underlying principles and the practices relating to RPL so that a single common approach is not available. For the purpose of this project a brief consideration of RPL and the means by which informal and non-formal learning which might be gained in the CoderDojo setting might be recognised in other contexts is provided. The background presented here provides an insight into means by which evidence of skills and competences gained outside of formal education and training systems might be recognised in the various countries rather than a full exploration of RPL as it applies within higher or further education systems.
3.1. Poland
As documented in the European Inventory on the Validation of Non-Formal and Informal Learning 2014, Poland report;

“Specific arrangements have been adopted in Polish legislation whereby professional/vocational skills acquired through employment can be validated through examinations leading to a qualification. The regulations from 2012 also introduced mechanisms for awarding partial qualifications in recognition of competences obtained as a result of completing training in a non-school setting; mechanisms also exist for recognising partial qualifications obtained in this way by adults who take up study in schools for adults providing Vocational Education and Training (VET).

Skill audits are carried out under the provision of regulations on the education system and on the promotion of employment and institutions of the labour market. The district labour offices are tasked with conducting skills audits by job counsellors. These audits are available to the unemployed and job seekers. In order to avail of the service they must be registered with the employment office.

In Poland there are regulated professions which have a separate set of standards and which are not part of a uniform system. The standards can be set by regulations which lay down the conditions which must be met to obtain the permission to carry out such a profession. Under the guise of vocational education there are 200 professions which are divided into 251 separate qualifications. Each qualification has its own set of exam procedures and validation rules. “ (European Commission, 2014)

In 2014 the qualification standards for occupations which included the standards of professional competences were not linked to the National Qualification Framework.

3.2. United Kingdom (England and Northern Ireland)
In the UK, skills passports are used to provide employers with a transferable record of an individual’s qualifications and experience. A skills passport is developed online so that it becomes that portable record of an individual career history, current skills and training. The skills are independently verified. The skills passports operate at sector level.

There are three qualification frameworks in place in England and Northern Ireland. The Qualifications and Credit Framework (QCF) came into effect in 2008 and is applicable in England, Wales and Northern Ireland. It is relevant to vocational and pre-vocational education and training areas. It does not include general school qualifications. The framework is based on learning outcomes and what the learner knows, understands or is able to do and is intended to remove barriers to achievement. The National Occupation Standards are the statements of the standards of performance that individuals must achieve when carrying out functions.
in the workplace, together with specifications of the underpinning knowledge and understanding qualifications in the workplace and are based upon the national occupation standards. The responsibility falls under the Department of Education, who have responsibility for education and children services. There is no national institution with specific responsibility for RPL.

3.3. Ireland
In Ireland, skills audits as discussed in the 2014 Ireland country report on the validation of non-formal and informal learning centred on those who were unemployed but who had a relevant skill set which should be valued and considered with the context of Labour Market Activation programmes. The Expert Group on Future Skills Needs report recommended that all adults should be entitled to an assessment of their core skills to make them visible and to promote their participation in further education and training. However in Ireland most of the activity in the RPL process and practice relates to the recognition of prior learning in the context of a destination award rather than in the context of codified workplace competences. (Expert Group on Future Skills Needs, 2011)

There are public and private actors in this process of making learning in the form of knowledge, skills and competence visible and in valuing it within the context of academic programmes. Employers are also very focused on enhancing the skill levels of employees and utilising RPL processes wherever possible to minimise time spent away from the workplace and to ensure that learning gained at and through work is valued in the form of credit on the National Framework of Qualifications. Ireland does not have occupational standards similar to other countries where a skills analysis can be conducted

3.4. Spain
Spain have a skills audit system which is conducted under (SEPE) Public Employment Service. They use two questionnaire types to capture individual’s skills which include professional experience and another for capturing non formal learning / work experience. There is counselling available to help people identify their learning. The counselling process provides support to the candidates in preparing and setting up for the evaluation process and in capturing his/her professional and education history. There is a judgement on an individual’s suitability for the process, a
requirement to pass the assessment phase which includes a justification of professional skills. The process results in a report being presented to the individual where they identify and explain the different training options for a professional certification or a vocational and education training award if there is insufficient learning for a VET Diploma or professional certificate directly.

The Spanish National Framework of Qualifications includes the acquisition of learning through non formal and informal learning. The learning outcome system strengthens the links between the education and employment systems. The Spanish have an inter-ministerial commission created between the ministry of Education and Ministry of Employment. One of the functions of the inter-ministerial commission is to disseminate and promote initiatives in relation to the evaluation and accreditation of professional competences acquired through work experience and non-formal training in European and international areas.

3.5. Summary
Recognition of prior learning processes vary within the partner states and across the wider European Community, with some of the states enshrining the learners rights to have evidence of their learning considered and recognised as a legal entitlement and some states considering the evidence of skills and competence in a structured codified way in the context of workplace roles and others focusing more on academic learning outcomes within destination awards.

If the learning acquired through the CoderDojo initiative is to contribute to the advancement of your people within the education systems then it is necessary to explore the means by which transition from secondary to higher and further education happens within the partner states.

In examining the area of skills acquisition, development and the frameworks which scaffold the identification and documentation of those skills it could be argued that these are more aligned to the needs of the workplace and within employment roles. There are also the formal further education/ vocational education and training and higher education systems which support the concepts of access, transfer and progression. Whilst each system is aligned to the EQF or NQFs the purpose and intentions of the systems can be at odds with each other.
4. Mechanisms to Access Higher Education

In the context of this research project which proposes the utilisation of the skills developed through the CoderDojo movement in accessing higher education it is important to consider what systems and processes currently exist within partner countries to facilitate standard and non-standard entry.

4.1. Poland

In looking at higher education in Poland it is evident that there are a number of different programme and institution types which operate within and outside of the Polish national legislation. A number of universities and other third level institutions operate on the basis of a contest for non-standard entry to a university. A number of these contests are thematic and correlated to an area of future study.

Normally access to first-cycle programmes, leading to a Bachelor’s degree (licencjat or inżynier), is open to holders of a maturity certificate (świadectwo maturalne). Since the introduction of the external maturity examination (egzamin maturalny) in 2005, admission to first-cycle degree programmes are based on results of this examination. Each HEI may specify which results of the maturity exam provide the basis for admission to first-cycle (as well as long-cycle) programmes. Additional entrance examinations may be conducted by HEIs, with the consent of the minister responsible for higher education, only when it is necessary to assess knowledge or skills which are not assessed by the maturity exam or when an applicant holds an upper secondary school leaving certificate obtained abroad.

While respecting these general admission requirements, each HEI may define its own additional admission conditions and procedures, including the number of places available to students, except in medical fields of study. Admission conditions and procedures may be similar across a higher education institution (HEI) or may vary according to the field of study. Different conditions and procedures may be applied by different HEIs for the same fields of study.

In terms of non-standard entry to a university the most popular way is to win a University’s contest. Those contest are usually thematic, and correlated to the field of future study.
4.2. United Kingdom
The higher education system in the United Kingdom is equally as complex as the system in Poland with various different institution types with a variety of funding models and awarding powers.

Institutions determine their own admissions policies and the minimum entry requirements for each programme. (Council, n.d.) For bachelor’s degrees, the minimum entry requirement is usually two or three General Certificate of Education Advanced-level (GCE A level) passes, as well as a minimum number of General Certificate of Secondary Education (GCSE) passes at grade C or above. These remain the most common form of entry qualification held by young entrants to higher education. A wide range of other qualifications is acceptable for entry. They include the International Baccalaureate and some vocational options such as GCE A levels in applied subjects and Edexcel BTEC National Qualifications. There is a points scoring system establishing agreed comparability between different types of qualification across the whole of the UK – the UCAS tariff.

Higher Education Institutions (HEIs) are not obliged to express their entry requirements in terms of tariff points. Those that do may additionally require some or all of the qualifications for entry to be in specific subjects and at specific grades. An applicant who meets the published minimum admission requirements for a particular programme may be offered a place, but this is not guaranteed. Entry is competitive, with wide variations between institutions and programmes in terms of the competition for places. For some highly oversubscribed programmes, such as medicine, dentistry, veterinary science and law, applicants may be required to take an additional admissions test. Most HEIs do not routinely interview applicants for most programmes. However, applicants for entry to professional and vocational programmes such as initial teaching training and medicine are usually required to attend a selection interview, as are all applicants to the universities of Oxford and Cambridge.

Information on programmes and entry requirements is available from the Universities and Colleges Admissions Service (UCAS). UCAS is the single organisation responsible for managing applications to all full-time undergraduate (first cycle) programmes in the UK. UCAS is funded by participating HEIs and from the fees paid by each
applicant.
The Access to Higher Education Diploma provides another route for mature entrants. Most institutions also welcome applications from mature candidates who have had appropriate experience but may lack formal qualifications. Many institutions give credit for prior study and informal learning acquired through work or other experiences: Accreditation of Prior Learning (APL) or Accreditation of Prior Experiential Learning (APEL) are included as part of their systems.

4.3. Ireland
When considering the actors in higher education in Ireland there are a number of perspectives which one can take. In general it can be said that the sector is comprised of the universities, institutes of technology and other higher education providers including smaller private and discipline-specific providers.

Precise quantification of the higher education sector in Ireland is difficult to ascertain due to the range of institution types which make up the sector. The information and data available for the publically-funded higher education sector is captured by the HEA regarding programmes and enrolment of part-time, full-time, and remote students. (HEA, n.d.)

The Central Application Office (CAO) is the national central system used to facilitate general access to higher education in Ireland. The system manages the initial application by students, the change of course preference process, initial and subsequent course offers and acceptance of course offer. The admissions process is managed by the individual higher education institutions and not by the CAO process.

Access to higher education in Ireland is determined through a points system which is calculated based on the level of interest there is in a course in any given year and the number of available places and not based on the level of the difficulty. The Leaving Certificate is the state examination held at the end of second level schooling. Individual’s leaving certificate results are transformed into an overall score, each result is transformed into a numerical value.

There are, however alternative means of entry. In particular students who are classified as ‘mature’ are entitled to apply for entry with or without leaving certificate scores. Several higher education some institutions have developed pathways to entry which reward non-traditional activities outside of the formal
leaving certificate points scoring system. For instance some HEIs have included volunteering or exceptional sporting achievements as part of its high performance entry scheme which can allocate extra CAO points in the case of individual students’ application for entry. The inclusion of extracurricular activities in facilitating entry to higher education could be an opportunity for the CoderDojo movement to negotiate with higher education providers on entry processes which could recognise participation and evidence of attainment.

There are also pathways which have been developed between higher and further education providers which allocate spaces on higher education courses for those who have successfully undertaken linked further education courses. These arrangements are generally made at an institutional level.

It is also of interest to note that Information and Communication Technology (ICT) under the education programme of government in primary and post primary schools is being integrated into the curriculum and system infrastructures. ICT is also proposed as a new subject in the final examinations of the second level schooling system. If ICT is included as one of the leaving certificate subjects then this could be of benefit to the CoderDojo participants who could apply the skill set they have developed.

4.4. Spain

The Spanish system of higher and vocational education is very structured with a number of different avenues considering the learners background, experience and qualifications. Higher education institutions can set their own criteria for admission policies.

The Advanced Vocational training system in Spain is very much focused on the professional field, employment and active participation in social, cultural and economic life.

Bearing in mind that there are different admission paths, the Education Authorities allocate places according to the following criteria:

- Between 60% and 70% of the places are set aside for students with a Bachillerato certificate which is required in order to sit the university entrance exams.
- Between 20% and 30% of the places are reserved for students who have passed the preparatory course.
• Between 10% and 20% of the places are held in reserve for students applying for admission through other channels. (Commission, n.d.)

4.5. Summary
The higher education admissions systems throughout the partner states are complex but all would be capable of supporting mechanisms to consider evidence of learning gained through CoderDojo participation for entry to higher education programmes within the structures of the relevant institutions.

5. Research Methodology
One of the aims of the current project centres on the potential to link the digital competence which might be attained by participants in the CoderDojo coding initiative with formal educational pathways thus potentially encouraging wider participation in third level education. Initially, this required an exploration of the skills that might be attained, and the means by which they might be referenced to a transferable reference framework. In order to explore the skills that might be attained a customised framework was developed to support initial indicators of skills acquired and the associated academic levels. The research was limited in that the partnership extended to four European countries and there were significant constraints on the level of funding and available timeframe. Early insights into CoderDojo activities highlighted the general age profile of participants and an indication of the number of hours of supervised engagement on a weekly basis.

In addressing the need of this project, whilst the existing frameworks informed and directed the research, a customised framework was developed to support the empirical research phase, mindful of the age profile and the identification of demonstrable skills by participants of the CoderDojo movement. In considering all the existing frameworks which support the mobility of learning and learners and in gauging their relevance within an education development context, the European Qualification Framework (EQF) which links to national frameworks of qualifications was selected as a standards based approach which is transferable nationally and internationally. As the project partners are based within four different European countries this framework provides a transferable structure to translate the learning identified to national frameworks where appropriate.

The CoderDojo project skills analysis template was informed by the published standards of knowledge, skill and competence of the EQF levels one to three which
aligns with the age profile of the individuals who actively engage with CoderDojo. It provided a useful observation tool, linking the appropriate EQF level with potential knowledge, skill and competence attainment and prompted the observer to indicate evidence of the learning attained where available. In this way the skills analysis template allowed learning gained to be evidenced in terms of task completion in the absence of a structured curriculum or learning outcome standards which may be outside the ethos of the CoderDojo movement and the focus of this research. The structure employed is an initial step in supporting the transfer to knowledge, skill and competence beyond CoderDojo.

The skills analysis relates the six classifications of knowledge and understanding, applying knowledge and understanding, communication skill, analytical skills, learning skills and autonomy and responsibility to evidence of CoderDojo task completion relative to the EQF level and informed by the age profile of the candidate. The framework was circulated to CoderDojo mentors and input from local participants was used to refine the observation questions. The analysis of the skills acquisition was conducted through observation by CoderDojo mentors in each of the four participating countries recording the accomplishments of the chosen participants, the relevant level on the framework and including indications, where appropriate, of how the learning identified might be evidenced.

6. **Findings and analysis**

The skills analysis template identifies demonstrable knowledge, skills and competences relevant to CoderDojo that align with the European Qualifications Framework Levels 1 to 3. This template was circulated to “dojo”s in a number of different European countries – namely, Ireland, Spain, Poland and the United Kingdom. Mentors in the participating groups were requested to complete skills analysis templates for 10 randomly chosen participants. For each participant this involved recording the age profile and the identified knowledge, skills and competences demonstrated at each level of the framework by the participant together with an outline of indicative evidence where possible.

The skills analysis template, mentioned previously, identifies demonstrable knowledge, skills and competences relevant to CoderDojo that align with the European Qualifications Framework Levels 1 to 3. This template was circulated to
“dojo”s in a number of different European countries – namely, Ireland, Spain, Poland and the United Kingdom.

For each participant this involved recording:

The age profile of the participant – the observer could choose from one of the following four age profiles:

- 7-9 years
- 10-12 years
- 13-15 years
- 16+ years

- The “dojo” name
- The “dojo” country
- The knowledge, skills and competences demonstrated at each level of the framework by the participant together with indicative evidence where possible.

From the skills analysis templates returned, the key findings can be summarised as follows:

- 74% referred to participants aged 12 years and under, i.e. children typically in primary or lower secondary education.
- Over 97% of participants were found to attain knowledge, skills and competences that align with EQF Level 1 irrespective of their age or country of origin.

These participants were able to demonstrate their:

- Knowledge and understanding of:
  - Key terms/concepts associated with computing - such as computer, a computer program, a programming language, operating system, and the internet.
  - File organisation on a variety of different storage platforms.
- Application of knowledge and understanding through their ability to:
- Organise their work into folders on a variety of different storage platforms.
- Create, find, edit and save files in appropriate folders on a variety of different storage platforms.
- Connect to a Wi-Fi network.
  - Communications skills through their ability to verbalise any issue they had with an assigned task to a mentor or peer.
    - Learning skills through their ability to:
      - Boot and login to a computer.
      - Find, edit and save existing work unaided.
      - Connect to a Wi-Fi network unaided.
    - Autonomy and responsibility through their ability to mentor their peers in completing some of the above basic tasks.

All participants aged 13 years and over, i.e. children typically in upper secondary education, while 64% of participants aged 7 to 12 years, attain knowledge, skills and competences that align with EQF Level 2. These participants were able to demonstrate their:

- Knowledge and understanding of basic programming concepts such as program structure, variables, data types, sequence, selection and iteration and could demonstrate them in a visual/high level programming language.
- Application of knowledge and understanding through their ability to develop a basic application by following a step-by-step worksheet.
- Communications skills through their ability to verbalise any issues they had in terms of bugs present in their application to a mentor or peer.
- Analytical skills through their ability to test and debug their application as necessary with assistance from a mentor or peer.
- Learning skills through their ability to independently create their own application using concepts learned through previous structured learning.
- Autonomy and responsibility through their ability to mentor peers to develop applications at a similar level.
The attainment of knowledge, skills and competences that are aligned with EQF Level 3, would appear to be somewhat attainable by participants aged 16 and over, but some evidence can also be found in younger age categories, i.e. 10 -15 year olds. However, it would appear to be almost totally unachievable by participants younger than that. In general, some of these participants were able to demonstrate their:

- Knowledge and understanding through their ability to reuse knowledge acquired in one environment/programming language and adapt to a new environment/programming language.
- Application of knowledge and understanding through their ability to learn a series of new/different skills by following a set of well-defined instructions and then applying these skills to a new, previously unseen, task.
- Communications skills through their ability to communicate their learning and/or difficulties to their mentors/peers.
- Analytical skills through their ability to identify a variety of approaches/solutions to a specific task and the select the best approach and justify the selection.
- Learning skills through their ability to start learning a new programming language/environment without direct supervision.
- Autonomy and responsibility through their ability to effectively mentor “dojo” members at a more junior level.

7. Conclusions and Recommendations

In the context of the project objectives the current research supports the assertion that the CoderDojo participants gain knowledge, skills and competence through their participation in these initiatives along the following lines

- EQF Level 1 are demonstrated by all CoderDojo participants regardless of age or geographic location of the “dojo”.

Page | 23
EQF Level 2 are demonstrated by all CoderDojo participants 13 and over and by almost 75% of participants aged 12 and under.

EQF Level 3 are demonstrated by some, but not all, CoderDojo participants 16 and over and would appear to be almost totally unachievable by younger participants.

These findings provide an indication of the skill level attainment of participants in the different age profiles. The findings align with the expectations of the research team in terms of levels of demonstrable skills attained. The skills analysis reports highlighted the variation in evidence and in availability of evidence of individual’s learning. This may be due in part to the unstructured nature of CoderDojo activities in terms of scaffolding the learning opportunities and collation of records of individual learning. It also poses challenges in terms of defining and supporting the collation of appropriate evidence of learning at the levels of the EQF which is comparable. This raises the question of the potential for the development of optional structures and frameworks to support the collation and evidencing of skills acquisition through participation in these voluntary coding activities, and the possibility of the formal assessment or validation of the evidence of learning. If that approach were to be adopted there would be resulting implications for the ethos of the movement and for the training and development of the mentors and organisers of the CoderDojo centres.

The research highlights the skills which are acquired outside of the formal education system which can have definable outcomes and evidence and shows that there are existing structures in the European context that recognise learning acquired in a non-formal and informal setting. Applying that learning to support the transition from second to third level education is also shown to be possible as the structures for admission to tertiary education in each of the partner countries allow some autonomy at the level of the institutions to define specific skill sets that might be applicable for consideration for admission to particular courses or colleges.

To progress the work further it would be necessary to consider whether formal identification, assessment and validation of coding activities is in keeping with the ethos of the CoderDojo movement and if the already established badge system would be sufficient in terms of recognition.

If formal validation and accreditation is sought then the definition of knowledge, skill and competence through coding activities in a more considered manner with
agreed common goals or intentions and learning outcomes will need to be established. The context within which the learning happens would need to be explored to ensure that there is comparability and equity for all participants. The training of mentors to support the learners, to assist in the assessment of learning and to record accurately the outcomes of activities including the development of portfolios of evidence would need to be considered.

As the age profile of the participants are predominantly in the age bracket of 12 years or under which is a number of years before entry to higher education or the workforce, due consideration will need to be given to the maintenance and currency of skills leading up to their integration into existing systems. This may well relate to the fact that the CoderDojo movement is relatively young and has yet to mature within many of the member states. The movement which began in 2011 has yet to see many of the original 7 year olds progress to higher education.

8. Bibliography


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