RECOMMENDATIONS FOR A SKILLS BASED CURRICULA REFORM AND TO PROMOTE THE IMPLEMENTATION OF TEACHER CPDs

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GLOBAL ROBOTS EXCHANGING ADVENTUROUS THEMES (GREAT)
ERASMUS+ PROJECT NUMBER: **2019-1-UK01-KA201-062030**

GREAT

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ABOUT

GLOBAL ROBOTS EXCHANGING ADVENTUROUS THEMES (GREAT)

This report was compiled as a result of the following analysis carried out by each partner within their countries:

1. Analysis of Teacher Training Requirement
2. Analysis of IT curricula (11-15 years old)
3. Analysis of IT industry requirements
4. Assessment of learning and teaching tools and methods
5. Skills gap between the IT industry requirements and graduates' competencies
6. Recommendations for reform within the IT and English curricula

The report is intended for the attention of educational policy makers, education authorities and educationalists in order to provide a snapshot of the current situation regarding IT curricula and teacher CPDs (Continuous Professional Development) in order to promote curricula reform and to make teacher professional development more effective. It can also be used for meta analytical research.

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ABSTRACT

Introduction

The following Report is based on the analysis carried out by the project partners as part of the Erasmus Plus Strategic Partnerships for school education - Cooperation for innovation and the exchange of good practices project titled “Global Robots Exchanging Adventurous Themes (GREAT)” project number 2019-1-UK01-KA201-062030. Four project partners from the United Kingdom, Turkey, Romania and Finland were taking part in this 30 months project. The purpose of the analysis was to collect information about:

- Current teaching methodologies,
- Content and Language Integrated Learning (CLIL) methods,
- Competencies and digital skills of teachers and students,
- Skills gap between the skills of IT graduates and skills required by the IT industry
- English and coding/programming related resources available,
- IT and English language curricula in partner countries
- Best practices in English language and IT education
- Continuous Professional Development (Teacher CPD) opportunities at partner countries

The aim of the report is to draw attention to the current IT and English language curricula, the skills that the IT industry is demanding, recommendations for curricula reform and to make teacher CPD more effective. This report reflects opportunities for the development of teaching of coding/programming and digital education competences for IT and English language educators at the European level. It also identifies strategies and makes recommendations for progressing this important area of learning. It has to be noted that the data provided does not claim to be complete, neither presents an empirically grounded research, but it presents a snap-shot of IT and English language professional development opportunities.

About the Analysis

AISR has developed this report based on the analysis provided by each partner in order to provide the information about the following main research topics:

1. Analysis of IT curricula (11-15 years old)
2. Analysis of IT industry requirements
3. Assessment of learning and teaching tools and methods
4. Skills gap between the IT industry requirements and graduates' competencies
5. Recommendations for reform within the IT and English curricula

Project Partners

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ANALYSIS OF TEACHER TRAINING REQUIREMENTS

UK

The Education System in Northern Ireland

In Northern Ireland, it is compulsory for children to attend school between the ages of 4 and 16. Education at a local level is administered by Education and Library Boards covering several geographical areas. All schools follow the Northern Ireland Curriculum, which is based on the National Curriculum used in England and Wales. On entering secondary education, all pupils study a broad base of subjects which include geography, English, mathematics, science, physical education, music and modern languages.

Children attend primary school between the ages of 4 and 11. At age 11 pupils transfer to secondary education. Publicly funded secondary education is provided in secondary schools or grammar schools. Entry to grammar schools is through academic selection. Grammar schools set their own transfer tests and invite pupils to sit these tests in their own schools.

Pupils enter secondary education at age 11 or 12 and follow the National Curriculum. At age 16 students sit their GCSE examination which also marks the end of compulsory education. Most students either transfer to sixth form at secondary school, or grammar school, or a Further Education College to study A-levels or vocational qualifications and training or apprenticeship. The results of these examinations help determine entry into higher education (EURES, 2020).

The Entitlement Framework (EF) sets out the minimum number and range of courses a school should offer at Key Stage 4 (14-15 years old) and Post-16. These courses should be economically relevant and individually engaging with clear progression pathways. The Education (NI) Order 2006 (articles 18-22) gives Statutory effect to the EF and requires schools to offer access to at least the specified number of courses at KS4 and Post-16; of which at least one third must be general and one third applied. In order to meet the statutory requirements, from September 2017, the EF requires all post-primary schools to provide pupils with access to a minimum of 21 courses at both phases.

All qualifications that have been approved for use in schools in Northern Ireland will appear in the NI Entitlement Framework Qualifications Accreditation Number (NIEFQAN) file. The NIEFQAN file shows details of GCSE equivalences for level 1 and level 2 qualifications, and A-level equivalences for qualifications at level 3 (GOV.UK, 2020).

The education system in Northern Ireland consists of different types of schools under the control of management committees who are also the employers of teachers:

- Controlled Schools (nursery, primary, special, secondary and grammar schools) are funded and managed by the Education Authority (EA) through school Boards of Governors (BoGs).

Primary and secondary school BoGs consist of representatives of transferors-mainly the Protestant churches-along with representatives of parents, teachers and the EA

- Maintained Schools: Catholic Maintained schools are managed by BoGs nominated by trustees-mainly Roman Catholic-along with parents, teachers and EA representatives. The Council for Catholic Maintained Schools (CCMS) is responsible for the effective management of the Catholic Maintained sector and is the employing authority for teachers in Catholic Maintained schools. The Catholic schools trustee service is funded by Department of Education (DE) to provide support and advice to trustees on area planning.
- Integrated Schools: These schools invite Protestant and Catholic to come together with other traditions to improve their understanding of one another, their own cultures, religions and values. Each grant maintained integrated school is managed by a BoGs consisting of trustees or foundation governors along with parents, teacher and DE representatives.
- Voluntary (grammar) Schools: Each of these schools is under the management of a Board of Governors.
- Irish-Medium: Irish-Medium education is education provided in an Irish speaking school or unit. DE has a duty to encourage and assist in the development of Irish-Medium education. Comhairle na Gaelscolaíochta (CnaG) was established by DE and its remit is to promote, assist and encourage Irish-Medium education. There are Controlled and Maintained Irish-Medium schools and units. Maintained schools are Voluntary schools owned by trustees and managed by boards of governors which consist of members nominated by trustees along with representatives of parents, teachers and the EA.
- Special Schools: A Special school is a Controlled or Voluntary school which is specially organised to provide education for pupils with special needs.
- Independent Schools: An Independent school is a school at which full-time education is provided for pupils aged from four to 16 and is not grant aided. These schools set their own curriculum and admissions policies and are funded by fees paid by parents and income from investments. Each Independent school must be registered with DE and is inspected regularly by Education Training Inspectorate (ETI).
- Institutions of Further and Higher Education: Higher education in Northern Ireland is delivered through universities, university colleges and higher and further education colleges. The public institutions are funded by the DE. The Academy for International Science and Research (AISR) is a privately funded, further and higher education College offering vocational qualifications at undergraduate and postgraduate levels. Universities accredit their own degrees, masters and PhD programmes, while colleges run courses that are accredited by awarding bodies (see below) and universities up to level 5 e.g. foundation degree and the final year (level 6) is completed at a university (DE, 2020).

Some of the Colleges would also run apprenticeship programmes. An apprenticeship can give students the training and qualifications they need to help them get ahead in their chosen career. There are currently three levels to choose from:

I. Level 2
II. Level 3
III. Higher Level Apprenticeships from Level 4 upwards

Currently there are around 150 Level 2 and Level 3 apprenticeships and over 45 Higher Level Apprenticeships to choose from, including:

- computer science
- motor vehicle
- mechanical engineering
- retail
- construction
- accountancy

Awarding Bodies

An Awarding Organisation (Awarding Body) develops and awards qualifications to meet the needs of learners, employers and other stakeholders. The Awarding Bodies in Northern Ireland are regulated and recognised by the Council for Curriculum Examinations and Assessment (CCEA). Regulated qualifications are published on the Register of Regulated Qualifications, which assures users (learners, schools, colleges, etc.) that an awarding organisation has successfully completed independent checks with regards to integrity, governance, resources and competence.

Awarding Bodies can also endorse courses, these courses or training are usually developed by a training organisation. Endorsed Courses do not provide learners with a nationally recognised qualification, but they enhance an organisation's courses/training by seeking external quality assurance from a nationally recognised Awarding Organisation, and learners also receive an achievement certificate from a nationally recognised Awarding Organisation (CCEA, 2020).

AISR currently offers OCN NI and NOCN (Awarding Bodies) accredited and endorsed courses in Northern Ireland, while internationally, it offers undergraduate and postgraduate courses accredited by the Manipur International University (MIU), the University of Excellence in India. AISR is the permanent constituent polytechnic college of MIU. AISR's Quality Regulatory body is the International Curriculum and Assessment Network (ICAN). ICAN is currently undergoing the awarding organisation recognition process by OFQUAL, meaning that ICAN will be regulated by OFQUAL and will be able to offer its vocational qualifications in England. The Office of Qualifications and Examinations Regulation (OFQUAL) is a non-ministerial government department that regulates qualifications, exams and tests in England. AISRs' principal/CEO is an accredited expert in STEM at level 6 and in science at level 7.

Legal Framework

To teach in a primary or post-primary (secondary) school in Northern Ireland, individuals must have a degree and a recognised teacher training qualification. All teachers are required to register with the General Teaching Council for Northern Ireland (GTCNI). There are two routes available to prospective teachers:

- a four year undergraduate Bachelor of Education (BEd), or
- a one year Postgraduate Certificate in Education (PGCE).

To teach in other parts of UK:

- To teach in an English state school, teachers must apply for Qualified Teacher Status (QTS). With a teaching qualification from a university in Northern Ireland, teachers may be able to gain QTS without any further training or assessment. For more information, visit the National College for Teaching & Leadership.

- To teach in Wales, teachers must apply for Qualified Teacher Status (QTS) through the Education Workforce Council (EWC).With a teaching qualification from a university in Northern Ireland, teachers may be awarded QTS in Wales in recognition of their status.
- To teach in a Scottish state school, teachers must be registered with the General Teaching Council for Scotland (GTCS) and need to submit a formal application which will assess their qualifications to make sure they meet the academic study and teacher education criteria.

The Education Authority (EA) is responsible for ensuring that efficient and effective primary and secondary education services are available to meet the needs of children and young people, and support for the provision of efficient and effective youth services. It also provides information, guidance and support for principals, governors and teachers. There are four key stages of a teacher's professional development:

- Initial teacher education (ITE), which is covered in the article on Initial Education
- Induction (the first year of teaching), which is covered in the article on Conditions of Service
- Early professional development (EPD) (the second and third years of teaching); and
- Continuing professional development (CPD).

It is obligatory for beginning teachers to complete both induction and the early professional development (EPD) stage of development. Induction and EPD are documented with:

- A Career Entry Profile (CEP) for completion at the commencement of induction
- An induction action plan, which is monitored by means of an interim review and a summative report
- The planning and evaluation of two Professional Development Activities (PDAs) during EPD. Templates for these documents are included in the Teacher Education Partnership Handbook (2010).

Employed teachers need to register with the Education Authority's Induction and EPD team. EPD normally takes 2 years to complete:

- EPD Year 1 and
- EPD Year 2.

EPD is not optional but an essential part of further training and professional development in which all teachers are required to participate. Teachers need to draw up, in consultation with their Teacher Tutor, a Professional Development Activity (PDA) in EPD Year 1. If their contract with the school extends to 2 terms, then in EPD Year 2, teachers need to draw up their second PDA. Both PDAs should be linked to identified learning and teaching needs, and relevant teacher competences.

Teachers will need to:

- Implement their PDA(s),
- Collect evidence of increasing professional competence and reflective practice in their EPD portfolio for presentation to the Teacher Tutor, Principal and the Chair of the Board of Governors (EA, 2020).

The General Teaching Council for Northern Ireland (GTCNI) is a professional body for teachers in Northern Ireland (NI) and is responsible for important functions that help to define teaching as a profession and has produced important documents to support the professional life of teachers in NI, including:

- Professional registration & the Register of teachers
- The Code of Professional Values and Practice
- The teaching competences Teaching: The Reflective Profession
- Advice on PRSD (Performance Review and Staff Development
- Professional regulation
- Accreditation of Initial Teacher Education programmes provided in Northern Ireland

The Council is funded by teacher subscriptions and therefore have a clear line of accountability. It is a non–Departmental Public Body (NDPB) and the Department of Education is its sponsor department which along with the Minister for Education are accountable to the Assembly for the activities and performance of the GTCNI.

The GTCNI is governed by a 33 members Council–with 14 members elected directly from the teaching professional; 15 members nominated by stakeholder organisations and 4 ministerial appointments made in accordance with the General Teaching Council for Northern Ireland (Constitution) Regulations (Northern Ireland) 2001 (GTCNI, 2020).

Statutory conditions of service require teachers to review their methods of teaching and programmes of work, and to participate in arrangements for their further training as teachers.

There is no legal minimum requirement for the length of time to be spent on CPD. However, conditions of service require teachers to be available for work under the direction of the principal for usually five days when the school is not open to pupils. Every school has a number of INSET (In Service Educational Training) days per year. These days are for staff training and are important for the development of teaching methods. The decision on the dates of INSET days is made by the individual head teacher and governing body of that school. Schools can use up to ten days for staff training and school development:

- To prepare for the year ahead
- To share professional learning and development

INSET days usually include the following training: child protection, SEN (special education needs) and basic ICT.

Performance Management and Staff Development

Performance management is the system of annual performance review, which involves professional dialogue about aims and achievements between teachers and their team leaders, and head teachers and their governing body. Performance management sets a framework to agree and review priorities and objectives and to identify professional development needs in the context of schools' development plans. NASUWT (Teachers' Union) is a signatory to a Centrally Agreed Staff Review and Performance Management scheme (PRSD) that came into existence in all schools in Northern

Ireland with effect from 1 September 2005. The scheme is compulsory for principals, vice-principals and all qualified teachers with the exception of those undergoing Induction and Early Professional Development. It is the only scheme accepted by unions, management and the Department of Education NI (DENI). It consists of three distinct components:

- Planning and Preparation – to include an initial meeting.
- Monitoring – to include data collection and classroom observation.
- Review Discussion – to formulate a Review Statement and set objectives for the following year.

Every school must have a PRSD policy. The Model Policy issued by NASUWT totally conforms to the agreed scheme and is recommended as the appropriate policy for all schools. Each teacher will have a Reviewer with whom s/he agrees three objectives on an annual basis. The objectives should be linked to the School Development Plan and cover the areas of Professional Practice, Pupil and Curriculum Development and Personal and Professional Development. Principals will be reviewed by 2/3 members of the Board of Governors assisted by an External Adviser. They also agree an action plan and objectives for the coming year.

Since September 2007, procedures for determining threshold progression that is moving from the main pay scale to the upper pay scale are on the basis of the principal's professional judgement. Classroom observations and collection of information relevant to the objectives take place at agreed times and with agreed personnel over the course of the annual cycle. The scheme allows for a maximum of 2 classroom observations not exceeding one hour in total. Should a teacher have significant responsibilities outside of classroom teaching and one of their objectives identifies this area then one of the observations may, with agreement, be replaced with a Task Observation. Observations and data collection of whatever nature must focus on the three agreed objectives and no other aspects of a teacher's performance (NASUWT, 2015).

Continuing Professional Development (CPD)

CPD, and teacher education in general, is currently under review by the Department of Education. The Department has been engaged with key stakeholders to build consensus around a vision for Teacher Professional Learning. On 11 March 2016, the Education Minister John O'Dowd, launched the Teacher Professional Learning Strategy which sets out a framework for the way forward. The Teacher Professional Learning Strategy document sets out a strategic vision for the future which is: Every teacher is a learning leader, accomplished in working collaboratively with all partners in the interests of children and young people.

Underpinning this vision there are three key strategic objectives:

- The development of an agreed Teacher Professional Learning Framework;
- The promotion of collaborative working and sharing of best practice through professional learning communities and networks; and
- The strengthening of leadership capacity in our schools.

The Strategy document represents the starting point of a process of engagement, consensus, and implementation. Next steps will include the development of a coherent career-long teacher professional learning framework, which will support teachers and schools to identify and, where possible, lead their own development. The Strategy includes an Action Plan for Year One, with the intention of further Action Plans to be published annually. The continuum of career-long teacher education and professional development is underpinned by the following key documents:

- The Teacher Education Partnership Handbook (2010) draws together guidance for student teachers, beginning teachers, and teacher tutors.
- Teaching: the Reflective Profession (General Teaching Council for Northern Ireland, 2011) sets out the requirements and competences expected of teachers during all phases of development.
- Learning Leaders: a Strategy for Teacher Professional Learning (Department of Education, 2016) aims to aid the development of a structured teacher professional learning framework. The framework is based on revised teaching and leadership competences and linked to improved outcomes for pupils. It also looks to promote collaboration and the sharing of best practice through professional learning communities and strengthening leadership capacity in schools.

The introduction of the strategy follows a review of the Initial Teacher Education (ITE) infrastructure which took place between 2011 and 2014. Aspiring to Excellence, the final report of the review which was published in 2014, reiterated that there should be strong links between ITE and CPD. It also made a case for a substantial investment in CPD for teachers leading to master's level awards endorsed by the General Teaching Council for Northern Ireland (GTCNI). While CPD is not a legal requirement for promotion, keeping up-to-date with new developments would normally be considered necessary for teachers seeking new posts or moving to the upper pay scale.

EPD and CPD can involve a wide range of staff development activities, both formal and informal, designed to improve teachers' practice. In-school activities include:

- Induction,
- Mentoring,
- Sharing good practice,
- Lesson observation and feedback, and
- Whole school development activities.

External activities include:

- Courses of varying length provided by a range of providers (see below). Courses may be held during school hours, in 'twilight' sessions after school, or at weekends or during holidays.
- Conferences,
- Industrial placement or work shadowing, and
- International study visits and exchanges.

Organisational aspects

Boards of governors have a responsibility to promote the personal and collective professional development of school staff. They must develop and implement a training and development policy linked to the outcomes of the performance review scheme, and produce a costed training and

development plan appropriate to the needs of the school. The policy must provide clear guidance for staff in relation, for example, to secondments, attendance at courses during the school day, and any opportunity for teachers to undertake further professional qualifications during school time. Beyond the early professional development (EPD) programme, each school determines its own continuing professional development (CPD) needs, depending on the requirements of the school development plan, the professional needs of the teacher concerned, and the availability of resources in the school to meet them. There are training courses throughout the year for various subjects and those relate to management and promotion. Teachers have the opportunity to request which courses/CPD activities they wish to attend if they can provide evidence that it would be beneficial for their personal CPD. Some training courses would provide sub cover, but not all of them do. If teachers would like to enrol to a Master's teacher programme, it would need to be funded by them. The Council for the Curriculum, Examinations & Assessment (CCEA) also supports teachers to deliver the Northern Ireland Curriculum through a wide range of freely available resources such as events and 'agreement trials', which offer teachers advice on how best to deliver CCEA courses (such as GCSE/GCE qualification where an assessment is marked by a Centre,) and standards expected.

Providers

Providers of EPD and CPD are numerous and varied and include:

- Senior staff within schools, who provide ongoing professional guidance and development for their colleagues, either as part of their day-to-day monitoring or as special, focused training
- The Education Authority (EA), which provides EPD support for beginning teachers, through information and support materials
- The Department of Education (DE) which, for example, funds the Literacy and Numeracy Key Stage 2 and Key Stage 3 CPD Project, a professional development programme for teachers of English and mathematics in these key stages
- Higher education institutions
- Further education colleges
- Independent providers including the Academy for International Science and Research (AISR). AISR has delivered numerous teacher training programmes in topics such as Content and Language Integrated Learning (CLIL), digital technology in the classroom, game based learning, coding for robotics, corporate leadership skills in the classroom, STEM teacher training, and behavioural and effective teaching methods within the classroom. These training activities are commercially available for teachers worldwide and they are also eligible for Erasmus KA1 funding.

Incentives, supporting measures and funding for participation in continuing professional development (CPD) activities

Schools decide for themselves how much of their budget to allocate to CPD. This is based on their specific areas for development as set out in their school development plan (SPD), although some specific initiatives receive government funding.

Each individual teacher's development is planned for in the context of the SDP and monitored by the performance management system. As a result, CPD is integrated into teacher performance management and school self-evaluation to form a coherent cycle of planning.
For teachers, effective professional development is beneficial because it enhances job satisfaction and career opportunities. There is no automatic link between participating in CPD and increased pay, nor is there any entitlement to training leave. However, in practice, learning through CPD will help teachers demonstrate in their performance review that their performance is satisfactory and deserving of pay progression and promotion.

For schools, an incentive to continually evaluate and improve the quality of their teachers is that this is one of the key aspects against which they will be judged during school inspection. This is in line with the Education and Training Inspectorate's Inspection and Self-Evaluation Framework (ISEF).

Some formal CPD activities may attract academic accreditation at master's level (Level 7 of The Frameworks for HE Qualifications of UK Degree-Awarding Bodies, and lead to awards including the postgraduate certificate (PG Cert); the postgraduate diploma (PG Dip); a master's (MA); or doctorate (PhD). Typically, in England, Wales and Northern Ireland:

- a bachelor's degree with honours requires 360 credits, with at least 90 at level 6 of the FHEQ;
- an ordinary bachelor's degree requires 300 credits with 60 at level 6;
- a foundation degree requires 240 credits with 90 at level 5;
- an integrated master's degree requires 480 credits with 120 at level 7;
- a postgraduate taught master's degree requires 180 credits with 150 at level 7; and
- A professional doctorate requires 540 credits with 360 at level 8.

Although there is no automatic entitlement to payment for participation in CPD, there is discretion for schools to make a payment to any teacher who undertakes CPD over and above the contractual requirement to participate in in-service training days. It is for individual schools to decide whether teachers are allowed to attend CPD activities in school time. If the training corresponds to needs identified as part of the review process and is in line with the SDP, attendance in school time would normally be allowed and the cost of the training activity would be covered by the school.

The General Teaching Council for Northern Ireland (GTCNI) has previously provided bursaries to individual teachers who wish to carry out a professional development activity, and also to teachers who wish to work with colleagues on an inter-school basis. No such funding streams are operating currently. Case study reports on how teachers used the bursaries are available from the GTCNI.

AISR provides 3 days of mandatory training for its teachers at no cost on a yearly basis. If teachers wish to engage in further CPD activities, they can do so if the training date doesn't clash with their teaching duties and timetables or if they are able to arrange cover. Such training is funded by the teachers themselves. AISR's teachers are also encouraged to become members of the Association of Teachers and Lecturers (ATL), which is a union for educational professionals, who use their members' experience to influence education policy.

School funding is a major issue in Northern Ireland (NI), as NI is a devolved nation of the UK as such, we have our own educational politics, some of which have been taken from Westminster, for example: GCSE in England and Wales are graded by number 9-1 (9 being the highest and 4 is a standard pass); while in NI the grades for GCSE are A* to U (grade C is the standard pass). There are no direct rules communicated from Westminster. The senior public civil servants in Stormont are managing the budgets from Westminster, which are given to NI and is called a block grant. Public civil servants are not allowed to make any high level, governmental decisions, therefore, they are just overseeing the budgetary requirements for the public sector i.e. they are allocating budget, which is based on student numbers. At the moment, schools have very little access money for training for teachers and extra-curricular workshops for their students. As a result, schools attempt to minimise the amount of CPD activities, because teachers are needed in the school as it is very costly to source substitute teachers to replace permanent staff whilst they are attending CPD activities.

From our experience of teacher training, the teachers' ages usually range between 25 and 35 and they are eager to participate in professional development activities. It is unusual to see teachers over 45 years of age attending our training. This could be due to the fact that they have a wealth of experience and resources built up over the years. However, we recommend that all teachers should participate in CPD activities, especially those, who are in the IT and technology disciplines.

We feel that there is a strong need for mandatory CPD activities for teachers to be able to teach critical evaluation and problem solving. Because students are not capable or confident of such evaluation at 3rd level studies, therefore they may leave their course or fail their examination and give up. This has a knock on effect on that particular college or university the student attends, as the institution loses their budget for that particular student, when a student leaves without completing their course. If student attainment is less than 60% regarding their GCSE or A levels (grade D, E, F, G or U), funding for those students would need to be returned to the Department of Education on a pro rota basis. Therefore, we further recommend the uptake of CD activities for all teachers as this is related to the high attrition rates within colleges and universities.

FINLAND

Finnish teachers can display a high degree of an autonomy in their teaching practice. Pre-service teacher education is a scheme in Finland, which prepares students for their teaching role before they can take up a job. While in-service training refers to training of persons already employed. There is a new ethos within the teaching community, which allows teachers to develop their professional practice and teaching activities. As part of their pre-service teacher education, teachers are taught how to conduct educational research, which gives them the intellectual resources to design curriculum within their school.

Each teacher has a set number of mandatory in-service training days per year, which is three. However, teachers usually spend more time on their professional development activities than the mandatory 3 days. According to Talis' review (OECD, 2013), which is an international survey of teachers, the Finnish teachers have less in-service training than teachers in other countries. In the Finnish educational system, local providers, the municipalities or cities are responsible for educational services. The local provider is also responsible for the quality of educational services at the local level. School development and teachers' professional learning are often integrated. Schools must provide resources for teachers when they are participating in in-service training. Local providers can work together with state-funded projects of the Ministry of Education and Culture and the Finnish National Board of Education, both of which have funding calls for educational staff development. The municipality or city and its local schools can also have a contract with universities and their further education centres or private providers. They can also provide local and school-based training using teachers' expertise and peer-to-peer learning. The memorandum of the Advisory Board for Professional Development of Education Personnel (Niemi, 2015) discussed the challenges and development needs for the professional development of education personnel in the coming years. The aim was to ensure that teachers are provided with systematic and sustainable support for their development. The Finnish National Board of Education (FNBE) (Rajakaltio, 2014) emphasised the following core values for the development of teaching profession competencies:

- Life-long learning
- Knowledge and research-based orientation
- Effectiveness
- Anticipation of future needs and competences in education

Finnish teacher education is based on a strong research orientation. This reflective and critical knowledge creation approach is also important for in-service training. In Finland, there is a strong movement from individual in-service training days towards more long-lasting development projects and programs for teachers.

FNBE (Rajakaltio, 2014) outlined that staff training must integrate the latest research, knowledge from education evaluations, new knowledge creation, and competence development. Most universities have education centres for teachers' in-service training. It is important that research-based and research-informed orientation of pre-service teacher education continues, and teachers can learn the most up-to-date and advanced knowledge of their subject matters as well as pedagogy through in-service training.

The bachelors' and masters programs have been designed to equip teachers with the theoretical and professional competences for managing their work in schools. University centres' in-service training provides more projects and longer development processes than short courses. The aim is that teachers critically reflect on their own work and create small design-based action research projects, which helps them to learn new competencies and to share new ideas with their colleagues. The goal is for in-service training to have a positive effect on students' learning and motivation, as well as teachers' own professional growth and well-being. The Advisory Board for Professional Development of Education Personnel proposes that state-funded professional development should implement the following principles:

- Mentor training supporting the initial phase of new teachers' careers in terms of transitioning from their studies to work.
- Reinforce teachers' research-oriented work.
- In cooperation with their stakeholders, the higher education institutions will develop long-term programs to enhance the professional development of education personnel and new specialist training starting in 2015.
- Create a clear education path model offering management training; the model will support the different career needs of managers and principals.
- Support the generation of peer-to-peer networks ensuring the professional competence required of the profession.

The Finnish school system relies, for example, on its high-quality teacher education; teachers in primary, lower and upper secondary schools must hold a master's degree.

The municipalities, as education providers and employers, together with teachers are responsible for continuous professional development and in-service training. According to Talis survey, Finnish teachers reported spending three days on various CPDs, while other countries' average days spent on teacher CDs was eight (EERA, 2015).

The state-funded fixed-term (2010–2016) national OSAAVA-programme that was launched by the Ministry of Education and Culture in 2010 as a response to observed inequalities. The programme supports education providers (e.g. municipalities, federations of municipalities, private education providers, the State) to develop their educational personnel; ensuring the development of competencies, and improving equal access to CPD. In Talis the reasons that teachers cited most commonly as barriers to professional development were: a conflict with work schedule (52 %) and a lack of incentives for participating in professional development (43 %). The Finnish Talis researchers stated, that one of Finland's main future challenges is to put more effort on research in order to gain knowledge about the barriers to participation (Taajamo et al., 2014).

TURKEY

A new law was decreed in 2012, stating the number of years of compulsory education, which consists of four years of Elementary school, four years of Middle school, followed by four years of compulsory high school education, which is a total of 12 years. Primary education is compulsory for all boys and girls at the age of 5, and is given free of charge in public schools. These schools provide eight (4+4) years of education. There are also private (and paid) schools under State control.

In most of the primary schools, foreign language lessons start from 4th class. Most elementary school students dress similarly in a type of uniform to avoid any social class differences between rich and poor students. If students don't pass the assessment for a class, they have to repeat the same class next year. At the end of the 8 years, successful students go to Secondary education for 4 more years.

The purpose of the **primary education** is to ensure that every child acquires the basic knowledge, skills, behaviours, and habits to become a good citizen, is raised in line with the national moral concepts and is prepared for life and for the next education level parallel to his/her interests and skills.

Secondary education covers general, vocational and technical high schools (Lycees, Lise in Turkish) that provide four years of education (used to be 3 years until 2005). General high schools prepare students for higher learning institutions. Some of the secondary schools and the private secondary schools have foreign language preparatory classes. This kind of private lycees have dual language education (such as Italian High school, German High school, Austrian High school, French High school, and so on).

Vocational and technical high schools provide specialised instruction with the aim of training qualified personnel. Technical lycees include special formations such as electricity, electronics, chemistry, machinery, motors, building, etc. Vocational lycees can be Industrial Vocational Lycees; Girls' Vocational Lycees (home economics etc.), Public Health Vocational Lycees, Commercial Vocational Lycees, Agricultural Vocational Lycees, Meteorology Vocational Lycees, Animal Husbandry Vocational Lycees, Land Registration and Cadastre Vocational Lycees, etc.

The purpose of secondary education is to equip students with the knowledge of traditional culture and problem solving skills in order to contribute to the socio-economic and cultural development of the country and to prepare students for higher education, for a profession, and/or for life. Additionally, there are also part-time evening high schools for those who are in employment and wish to continue their formal education.

Higher Education: Turkish universities are Republican institutions, following Atatürk's principles. Universities, faculties, institutes, higher education schools, conservatories, vocational higher education schools, police and military academies and colleges, and application-research centres are considered as Higher Education institutions.

Universities, faculties and institutes of four-year higher education schools are founded by Law, while the two-year vocational schools, departments and divisions are established by the Council of Higher Education (YÖK). Universities are under the supervision of this Council and their programmes must be regularly accredited. The Council of Higher Education is a fully autonomous national board of trustees

without any political or government affiliation. Universities have their rectors, deans, senate, and administrative boards, as well as student councils.

At the universities, the instruction is generally in Turkish. Some universities use English, French and German as the language of instruction with one preparatory year if necessary. After high school, graduates enter a two-stage examination system known as YGS and LYS (formerly known as ÖSS-Student Selection Examination) in order to be admitted to Higher Education institutions. These nation-wide centralised examinations are administrated by the Student Selection and Placement Centre (ÖSYM) every year, which determines candidates for the enrolment of each university and faculty after evaluating the grades of related subjects, their high school average results and their preferences according to the student capacity of each faculty.

Those with good grades are qualified for the four-year undergraduate programmes and at the end they can gain a Bachelor's Degree (BA), those who have grades at the limit can be admitted to the two-year higher education programmes and at the end they can gain an Associate's Degree (AA). The duration of Dentistry and Veterinary Medicine courses are five years, while Medicine courses last for six years. After a four-years of study, one can go further for a Master's Degree which lasts for two years with research and non-research options. Access to doctoral programs requires a master's degree and have a duration of minimum four years with a doctoral thesis at the end. The graduates of Medicine, Veterinary Medicine and Dentistry can directly apply to PhD/Doctorate programmes.

The purpose of higher education is to equip students with the knowledge and skills needed to gain employment within their sector of study. The higher education curriculum must be aligned to the science policy of the country to enable students to participate in researches activities within the science industry and academia. So that they can write research papers and publish these in recognised research journals within Turkey. The policy of the country is to develop a coherent and effective communication strategy to enable the delivery of high –quality science information to the Turkish society.

According to the Law, higher education institutions are responsible for the training of their own academic staff. Meanwhile, Primary and Secondary school teachers are trained in universities for 4 years. The major source of income of state universities is the funds allocated through the annual State budget, this is equivalent of about 60% of the total university income. In addition to this, a university can generate its own income from the services provided by that university, such as patient care in university hospitals. Student contributions to state universities form only 4% of the total university budget. Meanwhile, the student fees in private foundation (Vakif) universities are much higher.

At present, enrolment in private universities counts for only 5% of the total enrolment numbers. Thus, state universities have the bulk of enrolments of the country as they are less expensive. In 2011 a total of 759,638 students were enrolled in AA, BA, Master's and Doctorate programs of 165 universities; 103 State and 62-Private Universities.

Non-formal education in Turkey is offered by a network of training centres who are supervised by the Ministry of National Education (MEB). Non-formal education services focus on the teaching of reading, writing, balanced nutrition, healthy life style, personal development related skills and also support students in the completion of their education.

There is also Distance Higher Education which is offered at the Open Education Faculty of Anadolu University. This program lasts for 2 or 4 years.

Foreign Students Admission: Foreign students who would like to enrol in the post-graduate programs of the Turkish institutions of higher education can apply directly to universities and must have completed their secondary education in a high school in which the education is equivalent to that of a Turkish lycee; they would also need to have Turkish student visa if applicable. The applications of foreign students are considered by the universities within their limit of the allocated places for foreigners. The students must also take the Foreign Student Entrance Examination (YÖS) which consists of two tests; a "basic learning skills test" where they must score at least 40, and a "Turkish language proficiency test" to see their Turkish language level, if any. Language courses are organised for those who do not speak Turkish. Students must take the Graduate Education Entrance Examination or an international examination (GRE, GMAT, SAT, etc.) required by each university, the equivalency of which is recognised by the concerning university senate. The evaluation of the results of these examinations is carried out by the concerning universities.

TEACHER TRAINING REQUIREMENTS

Students wishing to become teachers must complete High School. Then they must meet the entrance requirements at a university faculty of education and compete the required curriculum before being allowed to teach. Approximately 17,000 prospective primary teachers graduate annually. Students wishing to become primary school teachers need to complete at least a four-year bachelor's degree (Lisans Diplomasi). They must demonstrate that they have the required teaching competencies in order to receive the Primary Education Teachers Certificate.

To teach from grades five to eight, teachers must complete additional training to get a deeper knowledge of specific pedagogy. New teachers must successfully complete a one-year probationary program before they are appointed as regular teachers. Teachers at secondary schools must also complete at least a four-year bachelor's program. In order to be considered for a teaching position at certain secondary schools, such as the Science High Schools, teachers must take a competitive examination.

To teach at a higher education institution, individuals must meet various criteria. According to the Higher Education Law, higher education institutions are responsible for training their own academic staff. To be able to be appointed as a teacher in a public school in Turkey, first all the teacher candidates need to pass a nationwide exam called KPSS. The successful candidates are appointed as trainee teachers. After completing one year of teaching they can be a regular teacher.

Private schools hire the teachers with the same requirements without KPSS exam but they have their own criteria to offer the job.

Elit Grup School: There are two weeks preparation period before each academic year and teachers are given training workshops. This training is delivered by teacher trainers, who are invited to the school. These CPD activities are related to teaching methodologies and are specific to the curriculum area of the attendees.

ROMANIA

In Romania, according to Law 1/2011 (Art. 245), for teaching, management, guidance and control staff, continuous training is a right and an obligation. The continuous training of teaching, management, guidance and control staff and professional training are based on professional standards for the teaching profession, quality standards and professional skills. The career evolution of the teaching staff in pre-university education is achieved by passing the final exam in education (DEFINITIVAT= DEFINITIVE EXAM) and obtaining the teaching degrees II and I.

The teaching staff, as well as the management, guidance and control staff from the pre-university education is obliged to participate periodically in continuous training programs, so as to accumulate, at each consecutive interval of 5 years, considered from the date of passing the final exam in education, minimum 90 transferrable professional credits (Law 1/2011, art. 245).

According to the Methodology regarding the continuous training of the personnel from the pre-university education, the continuous training is realized mainly through:

a. Programs and activities for improving the scientific, psycho-pedagogical and didactic training
b. Training programs in the fields of education management, guidance and evaluation
c. Preparation courses and taking the exams for obtaining the didactic degrees II and I
d. Professional conversion programs
e. Studies corresponding to a specialisation in another field of license.

Continuing education ensures the updating and development of teachers' competencies, including the acquisition of new competencies. The main areas in which the competencies correspond to the teaching profession are:

a) The field of specialisation
b) The field of pedagogy and psychology of education
c) The field of educational management and school legislation
d) The field of information and communication techniques applied in the teaching and learning processes, in the institutional management and data management
e) Inter-trans-disciplinary and cross-curricular fields aiming at alternative and complementary strategies for training, research and innovation, communication and partnerships with the social environment, etc.

According to Law 1/2011 (Art. 477), CPD should include courses on issues related to learning disabilities, in order to acquire skills in identifying them and the ability to apply appropriate teaching strategies. The level of competence targeted by these programmes is evaluated according to:

- The ability of the teacher to utilise the knowledge and skills, general and professional skills and competences in accordance with the national curriculu.
- The teacher's ability to cope with change, complex situations as well as crisis situations.

The main forms of organising the continuous training in pre-university education are:

- Methodological-scientific and psycho-pedagogical activities
- Methodological-scientific sessions of communications, symposia, exchanges of experience and educational partnerships on specialised and psycho-pedagogical issues
- Regular internships in specialised scientific information and in the field of educational sciences
- Courses organised by scientific societies and other professional teaching staff organisations
- Specialised training courses, methodical and psycho-pedagogical training
- Training courses in order to acquire new skills and quality / functions, according to specific training standards
- Exam preparation courses for obtaining teaching degrees
- Training and refresher courses for management, guidance and control staff, according to specific programs
- Training scholarships and study and documentation internships, conducted in the country and abroad
- Postgraduate specialisation courses
- Master's degree studies for teachers who have graduated with a 4-year bachelor's degree
- Postgraduate programs
- Doctoral studies
- Acquiring new didactic specialisations, different from the current specialisation

ANALYSIS OF IT CURRICULA

NORTHERN IRELAND, UK

For the purpose of this report, the only UK IT curriculum that was analysed is the Northern Irish one, due to the facet, that AISR's head office is located in Derry-Londonderry.

At Key Stage 3 (post-primary Years 8, 9 and 10 – ages 11-14), the curriculum builds on the learning experiences that pupils bring from primary school. The "Statutory Curriculum at Key Stage 3" document expands upon the Education (Curriculum Minimum Content) Order (2007 No. 46) by setting out the minimum requirements of the Northern Ireland Curriculum that should be taught at Key Stage 3 with examples, and supplements it by providing a detailed rationale to guide its interpretation. It represents the final approved outcomes of a series of proposals and consultations which informed revisions to the Northern Ireland Curriculum (2006).

As a result of these, each school now has additional flexibility to make decisions about how best to interpret and combine minimum requirements so as to provide a broad and balanced curriculum that will prepare each young person for a rapidly changing world. Science and Technology is a compulsory Area of Learning at Key Stage 3. It has two subject strands:

- Science, and
- Technology and Design.

This Area of Learning aims to stimulate pupils' curiosity, enthusiasm and innovation. The statutory requirements for the subject strands have a common framework that is linked to the curriculum objectives and key elements. This framework facilitates more collaborative and connected learning. It also encourages pupils to relate their learning to life and to work. Schools can choose to organise pupils' learning in Science and Technology by:

- Teaching the subject strands together;
- Connecting learning in the subject strands; and/or
- Teaching the subject strands separately.

If schools teach Science, and Technology and Design as separate subject strands, they should make some connections in Science and Technology. Pupils should have opportunities to develop their Cross-Curricular Skills of Communication, Using Mathematics and Using ICT, and their Thinking Skills and Personal Capabilities through Science and Technology. In Technology and Design, pupils have opportunities to explore a range of topics and develop Whole Curriculum Skills and Capabilities. Pupils learn about:

- Design
- Communication
- Manufacturing
- Control.

Technology and Design encourages pupils to develop creative thinking and problem-solving skills by evaluating design proposals and selecting and using materials that are fit for purpose. Pupils should have opportunities to research and manage information effectively to investigate design issues. They should also think critically and flexibly, and demonstrate creativity and initiative when developing ideas and following them through (CCEA 2022).

Key Elements

The key elements that underpin the curriculum objectives are key issues for modern society. The statutory requirements for this subject strand make these key elements explicit. For further details, see the Statutory Requirements for Technology and Design at Key Stage 3 and the Key Stage 3 Non-Statutory Guidance for Technology and Design. Using ICT is one of the three Cross-Curricular Skills at the heart of the curriculum. Developing pupils' digital skills encourages them to handle and communicate information, solve problems, pose questions and be creative in using digital technology.

The emphasis in Using ICT is on pupils using digital skills appropriately while engaging in meaningful and purposeful activities. Ideally, teachers will provide a context of relevant, real-life situations when developing these skills. Teachers have a responsibility to provide pupils with experiences of using ICT that are appropriate to their subject. They should also help pupils to acquire and develop the skills necessary to become informed and responsible users of digital technology. Teachers can measure standards of pupil competency in digital skills through the Cross-Curricular Skill of Using ICT. Teachers can use the Levels of Progression for Using ICT as a progression framework for all Areas of Learning. This can help pupils to develop their digital skills across the curriculum and acquire the skills relevant to other Areas of Learning.

Assessing the Using ICT skills across the curriculum in a systematic and consistent way can help pupils to manage their own learning and to identify learning targets. It also helps pupils to connect learning from different areas of study. This will embed the independent learning that is desirable at Key Stage 4 and post-16 (CCEA 2022).

Coding is currently not a compulsory part of Using ICT and Technology and Design curricula. In June 2018, CCEA, in partnership with Queen's University Belfast launched "Coding in the Classroom" resources as part of the EU CodeWeek. This resource supports the development of skills in the Python programming language at Key Stage 3 (ages 11-14). This resource is part of a suite of curricula that will help young people prepare for future employment. CCEA has engaged with stakeholders to ensure this pathway is accessible to all students. In recent years, CCEA has collaborated with its stakeholders to provide the following opportunities for teacher up skilling:

- Training workshops on computational thinking and coding with Scratch in the primary classroom;
- CCEA primary coding tasks using Logo, Hopscotch, Scratch, ScratchJr and floor robots;
- Problem solving in Key Stage 3 using computational thinking and the fundamental building blocks of programming sing Snap;
- Transitioning from block-based coding to using Python to teach computational thinking and the theory and foundations of programming throughout Key Stage 3;

- Introduction to the C2k Computer Programming Environment;
- C# and Python training to support the delivery of GCSE Digital Technology (Programming);
- Object Oriented Programming training to support the delivery of GCE Software Systems Development (CCEA 2018).

Key Stage 1 & 2

At the heart of the Key Stage 1 & 2 (Years 3 – 7; ages 5 - 10) curriculum lies an explicit emphasis on the development of skills and capabilities for lifelong learning and for operating effectively in society. Through opportunities to engage in active learning contexts across all areas of the curriculum, children should progressively develop:

Cross-Curricular Skills:

- Communication
- Using Mathematics
- Using Information and Communications Technology

Thinking Skills and Personal Capabilities:

- Thinking, Problem-Solving and Decision-Making
- Self-Management
- Working with Others
- Managing Information
- Being Creative

Coding is currently not a compulsory part of Key Stage 1 & 2 curricula (CCEA 2022).

Curriculum Revision

The revised Northern Ireland Curriculum for ages 4 to 14 was introduced in 2007. Most recently CCEA initiated:

- A programme of curriculum monitoring in 2018/19. Curriculum Monitoring Programme | CCEA
- A Curriculum Symposium in January 2022. CCEA Curriculum Symposium 2022 | CCEA

CCEA's research, alongside a number of other key pieces of evidence suggest that the underlying principles remain appropriate, but there is a need to re-emphasise the importance of delivering the curriculum as originally intended. Therefore, rather than revisions to the curriculum, the focus of CCEA's current work is supporting effective implementation.

The programme of curriculum monitoring in 2018/19 has found that *"Using ICT is less embedded than the other skills. Teachers reported that digital skills are underdeveloped at Key Stage 3 and that some of the current practice in teaching ICT is dated and narrow and does not account for the wide variety of careers that can be accessed through ICT/digital skills. Respondents welcomed the general move towards teaching coding and computational thinking and some felt that there is a case for more opportunity for the development and embedding of digital skills provision, particularly at Key Stage 3 and across the curriculum. However, they felt that pupils still need to learn basic IT skills and the broader*

range of creative technologies. In some schools, pupil learning may be limited by teacher confidence and capability. Teachers reported that they needed access to professional learning opportunities in order to keep up to date with technological developments and that access to equipment and resources such as devices and reliable Wi-Fi can be inhibiting factors"

Coding and robotics would fall under the cross-curricular skill of Using ICT, which should be applied at all key stages and all areas of the curriculum, including contexts for Science and Technology. The intention is that learners should have opportunities to demonstrate deeper understanding by thinking critically and flexibly, solving problems and making informed decisions, using ICT (such as coding and robotics) where appropriate.

The statutory requirements for UICT focus on the process of learning using the 5E's (Explore, Express, Exchange, Evaluate and Exhibit). They are articulated in the grey column (LHS) of the levels of progression:
Levels of Progression for Using ICT | CCEA

The following non-statutory support describes the desirable features for Computational Thinking and Coding (Interactive Design) for Primary:
Using ICT Desirable Features | CCEA

Desirable Features for Exploring Programming at Post Primary:
Using ICT Desirable Features for Key Stage 3 | CCEA

The Desirable Features guidance sets out what is desirable to see at each of the statutory Levels of Progression. As the guidance shows a progression in learner competency in specific types of ICT, it can support teachers to plan appropriate activities for pupils in the different stages of primary and post-primary school.

FINLAND

Compulsory schooling lasts for nine years for pupils between the ages of 7 and 15. Compulsory pre-primary education starts one year before basic education at the age of 6. Municipalities are responsible for arranging education for all 6–15 year olds living in a municipality. Compulsory schooling is provided in a single structure system called basic education. It includes grades 1-9. All schools follow a national core curriculum, which includes objectives and core contents of different subjects. The education providers are most often municipalities as the local education authorities and the schools themselves draw up their own curricula within the framework of the national core curriculum.

New national core curriculum for basic education, which was reformed in 2014 focuses on school culture and integrative approaches to education. It provides a common direction and basis for renewing school education and instruction. The aim is that pupils will:

- Understand the relationship and interdependencies between different learning contents
- Gain a more holistic set of skills set
- Be able to adopt and use these in collaborative learning (FNBE, 2021).

The core curriculum describes seven transversal competence areas. These epitomise the aims of education and reflect the competencies needed in all spheres of life. Competence is constructed of knowledge, skills, values and will. Figure 1 depicts the seven transversal competences:

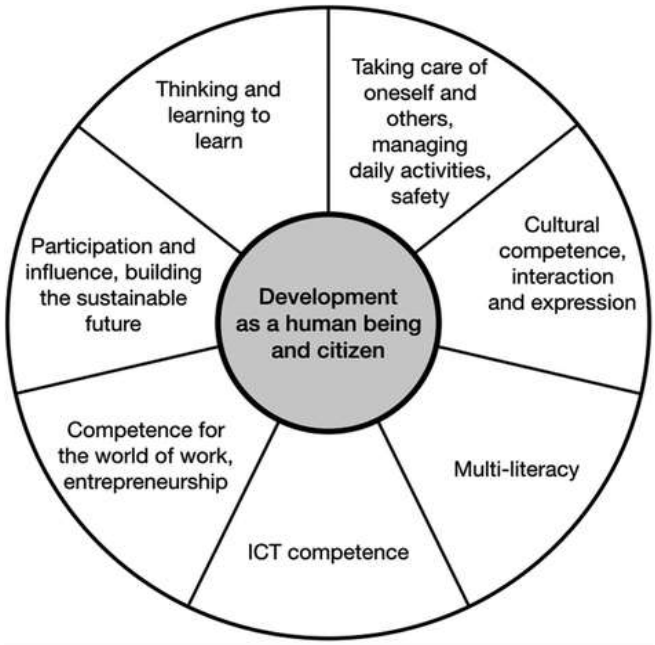


Figure 1 - Lähdemäki J. (2019)
Transversal competencies in the Finnish national curriculum

Digitalisation

According to the new curriculum, all of the subjects studied ideally include developing all of the transversal competences, although the learning objectives of some subjects can emphasize certain competences. This means that all of the subjects should encourage, for example, developing ICT competence. In the curriculum, ICT competence is divided into four main areas of development:

- Students understand the principles and basic concepts of using ICT, and learn to develop practical ICT-skills via producing own content.
- Students are encouraged to use ICT responsibly, safely and ergonomically.
- Students are taught to use ICT in database management and in creative efforts.
- Students gain experiences and practice using ICT in communication and networking (Mediakasvatus, 2021).

Programming has been integrated into the National Core Curriculum as part of both general ICT competence as well as the compulsory subject studies of math, beginning already in the first grade, and crafts, starting from the third grade. There are specifically outlined goals for the ICT competencies for grades 1–2, grades 3–6 and grades 7–9. According to these guidelines, pupils start their journey in the world of programming by learning age-suitable programming, starting from the 3rd grade on focusing how human decisions influence the outcomes in programming and eventually develop their coding skills as part of multiple school subjects.

As for programming in math, the emphasis is on developing algorithmic as well as computational thinking skills. Pupils are learning to first create basic sequences of instructions, then progressing to learn coding their own programs in a visual programming environment, and, finally, learning to apply the principles of 7 algorithmic thinking into programming simple programs. As a learning objective integrated into craft, students practice in grades 3-6 functions based on programming, such as robotics. In grades 7-9, they learn to implement embedded systems or programming in designing and manufacturing products.

In Finland, most schools operate on public funding. The Finnish National Board of Education funds teachers CPDs, some of which also include programming. There are government initiatives to help ease the overall adjustment to the changes brought by the education reform and to support the development of education. In addition to developing teacher training, the Finnish government has, for example, introduced a tutor-teacher system. Every school is granted a tutor teacher, who will support other teachers in the actualisation of the new pedagogy, and to accelerate the digitalisation of teaching (FNBE, 2021).

According to Eurydice's Key Data in Finland, there are national strategies covering training measures and research projects in ICT in schools, e-learning, e-inclusion, digital/media literacy and, e-skills development. There are central steering documents for ICT learning objectives at both primary and secondary education level for using a computer, using office applications, searching for information, and using multimedia. In primary and secondary schools ICT is taught as a general tool for other subjects/or as a tool for specific tasks in other subjects. At primary and secondary education level there are recommendations or suggestions and support in ICT hardware areas and for ICT software categories, recommendations or suggestions are provided for office applications. According to official steering documents, both students and teachers at secondary level are expected to use ICT in all

subjects both in class and for complementary activities. There are no central recommendations on the use of ICT in student assessment. Public-private partnerships for promoting the use of ICT are encouraged for private funding for hardware and software in schools, ICT training for teachers, ICT training for pupils/students, and providing extra-curricular activities.

Apart from the courses and other support provided by the government, there are some grass-root initiatives to support teachers to learn to program. Especially noteworthy is Koodiaapinen, providing free MOOC courses on coding, which has (according to their own statistics) so far trained over 1000 teachers throughout Finland. Also, the University of Helsinki provides free MOOC-courses, freely available for anyone interested in programming (European Schoolnet, 2012).

Somewhat exceptionally, there has been quite a lot of support from the IT-industry to help integrate coding into schools. Several IT companies have sponsored courses in computer programming, providing free workshops in schools for pupils. For example, telecommunications, ICT and online service company Elisa organised an 'Elisa Digikoulu' training' ('Elisa Digital School'), a free one-day workshop, during which instructors shared information on digital skills and introduced coding to pupils. Another initiative, Koodikoulu, organised by Futurice, Reaktor and Koodikerho, provides free materials and support for organising after-school coding clubs. Free materials have also been created to support specifically integrating coding into basic education. The founder of Rails Girls and author of Hello Ruby Linda Liukas has, together with Juhani Mykkänen, co-written a free guide book 'Koodi2016' giving 'first aid' and practical advice for teachers who are uncertain how to approach the new field. As another initiative, a wiki book describing the objectives of programming in 8 basic education has been produced to support teachers in integrating programming into their teaching (YLE, 2015).

Teachers in Finland are relatively low users of ICT (European Schoolnet, 2012).

Integrating technology into education is a challenge in Finland and worldwide. The new national curriculum framework for primary education in Finland introduces information and communication technology (ICT), collaboration, self-expression and communication as important competences, which students should gain at school.
Children are often regarded as information technology savvy, but their IT readiness can be very narrow. The term digital natives can be misleading and results to not teaching children the adequate IT skills. The core curriculum discusses computational thinking and coding as the means to reach the target. It states that programming (coding) should be part of all education and should be connected to the subject matters of various lessons.
Computer science nurtures problem-solving skills, logic and creativity. The world is increasingly run by software and we need more diversity among those people who are building it. Not all students will be software developers or writers, doctors or translators, but we are already surrounded by technology and even more so in the future. The main point is to provide a basic understanding of society, living environment and fields of science and thus provide equal opportunities for all the learners. Understanding how computers work and how to use them well gives children skills and knowledge to succeed in global competition and life generally (Alo Finland, 2018).

TURKEY

The Information Technologies and Software (ITS) course curriculum was last updated in 2017. The secondary school ITS course curriculum at 5th and 6th grades (10-12 years old), aims to develop the necessary technical knowledge, skills and competencies in pupils. The general objectives and basic principles of the National Education system are determined on the basis of the specific objectives of the curriculum, which are expressed as follows:

- To understand technological concepts, systems and processes,
- To use information technologies effectively and appropriately,
- To access, research and use internet based services,
- To create a general understanding and technical knowledge of computer science,
- To acquire and develop problem solving and computational thinking skills,
- To be able to follow and evaluate the reasoning process,
- To acquire collaborative work skills from social environments and to benefit from and share what they have learned,
- To search for learning opportunities on the internet,
- To develop an understanding of algorithm design,
- To be able to choose and apply the appropriate programming approach to solve problems,
- To build technical knowledge in programming,
- To be able to use at least one of the programming languages,
- To carry out research on product design and management,
- To solve problems encountered in daily life to develop innovative and original projects,
- To raise awareness about lifelong learning.

The secondary school ITS curriculum was reformed in 2017 in order to enable students to gain the necessary skills and attitudes in line with the nine key competencies determined by the Turkey Qualifications Framework (TQF). The TQF was formed by taking into consideration the needs and expectations of the Turkish society with the definitions in the European Qualifications Framework. The nine key competency fields include communication in the national languauge, communication in foreign languages, mathematical competences and basic competencies in science / technology, digital competence, learning to learn, social and citizenship competencies, initiative and entrepreneurship, cultural awareness and expression competencies.

The five units of the ITS curriculum are as follows:

- Information Technologies unit: The importance of information and communication technologies in daily life; its positive and negative effects regarding cultural, social and personal aspects; working principles of computer and other components; basic operations on files; issues related to realization and current technologies and applications are discussed.
- Ethics and Security unit: Concepts such as information privacy and security, ethical values, and digital citizenship are discovered.
- Communication, Research and Cooperation unit: How different systems and individuals communicate with each other. Developing understanding, researching and sharing correct

information by using search methods effectively; effective communication and cooperation; using different social environments effectively; gain management skills.

- Product Creation Unit: Presenting knowledge and ideas; preparing information in formats that target the general public e.g. text, sound, images and numbers; choosing and using the right tools and approaches in the structuring processes; using different technological tools; Designing, developing, publishing and presenting the product using various formats such as audio, video, animation or websites
- Problem Solving and Programming unit: Algorithm design (search, sort etc.); Develop problem solving skills; To learn about assignment, sequential logic, how to use decision structure, loops and functions; To be able to use the appropriate programming approach to solve problems (Gündüz and Demir, 2020).

Although coding is not currently a compulsory part of the ITS curriculum, public and private schools can offer elective courses.

Being a private school, Elit Grup Okulları started to offer coding related activities as a result of the GREAT project. In 2019, the school didn't have a dedicated IT teacher employed, therefore, the school sought the support from a local software development company, whose CEO is a former English teacher. Arrangements were made in order for the elective coding activities to be delivered virtually on a weekly basis during the lockdown period. The school's intention was to continue this coding activity once the lockdown was lifted, therefore a permanent IT teacher was hired in the 2020/21 academic year. The elective coding course has been running ever since, as the vision of the school is become the best education provider in İnegöl, Turkey . The GREAT project had an enormous impact on the school and on the students by providing them with the opportunity to learn about block-based coding, python programming, machine learning, artificial intelligence, Arduino projects and to communicate with international students, hence, improving their confidence, communication skills and English language competencies, which was taught by AISR.

Apart from the weekly elective coding course, the school has incorporated the following activities into its IT lessons:

1. Teaching the use of coding software such as Scratch and Arduino
2. The "Lego WeDo education" and Arduino sets are used from Grade 2 to Grade 8.

ROMANIA

As a result of the remarkable changes in the field of informatics and the technology of information and communication, the Romanian Ministry of Education and Research (MEC) adopted a new framework plan for middle school, which was implemented nationwide in the 2017-2018 school year. This framework plan is a document that specifies which subjects must be studied by middle school students and how many hours will be allocated for each subject weekly. Thus, a new compulsory subject is introduced in all classes - Computer Science and ICT (information and communication technologies).

The new school curriculum for middle school encourages students to:

- Use technology responsibly and creatively,
- Address the need to continue digital literacy efforts and
- Reconsider this concept from the perspective of new socio-professional requirements.

It aims to build a set of digital skills that each student can use during their school years and in their future work life. It enables students to learn how to use computing and communication techniques responsibly and efficiently. In addition, students will learn how to solve some basic problems by building information processing algorithms and create computer products that will make use of connections between disciplines.

At middle school and high school level, the study of *computer science* mainly includes algorithms, data structures, mathematical logic, programming languages, compilers, artificial intelligence, software ecosystems, objects, classes, methods, variables, communication protocols and much more. *Information technology* (IT) -also studied at the high school and middle school level - means the use of computer components, printers, scanners, working with files and directories, the use of text editors, spreadsheets, website editors and also blogging platforms.

From an educational point of view, the main difference between the two is that computer science educates students to be authors of computational tools (e.g. software applications) while information technology educates students to be users of information technology (hardware and software). The purpose of teaching computer science in schools is to provide students with a way to see the world appropriate to the computational activities they will later practice. "Computer science is no more about computers than astronomy is about telescopes", said Edsger Dijkstra, a well-known Dutch scientist and pioneer of computer science (A.M. Turing, 2019).

Through computer science, students must acquire a new way of thinking, a new vision of life, technology, knowledge and even human philosophy. Thus, they will be able to develop computational thinking, and make quick connections between their activities and the concepts, methods and techniques of informatics. Over 65% of today's children will have jobs of the future including technology that have not yet been invented. Therefore students must be prepared for such future jobs by providing them with appropriate knowledge and transferable skills.

Teaching computer science and ICT, in Romania, includes the following elements:

- A set of knowledge that includes ideas and concepts with a wide applicability as well as the theoretical framework related to them;

- A set of techniques and methods that can be applied to solve problems and to acquire new knowledge;
- A unique way of thinking and working that offers those who study the discipline a new perspective on the world
- Longevity
- Technological independence.

In the field of informatics and ICT, middle school graduates acquire the following competencies:

- Efficient and safe use of computing devices and the internet as sources of information
- Efficient use of software components
- Being able to identify algorithmic ways to solve real world problems, expressed in natural language
- Being able to identify data with which the algorithms work in order to use them in processing
- With the help of sequences of operations and decisions, being able to describe in natural language some of the algorithms in order to solve simple problems
- Being able to apply specific operations to graphic editors in order to create digital materials
- Being able to implement an algorithm that contains the sequential and/or alternative structure in an interactive graphical environment
- Development of creativity through the use of simple applications for building digital games
- Efficient use of specialised tools in order to create a graphic animation and a presentation
- Being able to apply specific operations for Internet communication
- Being able to use a graphical-interactive environment to practice algorithms
- Being able to represent information processing algorithms for solving problems
- Being able to explain and illustrate various topics by the use of specific operations
- Being able to develop graphic animations and 3D models using specific operations to dynamically illustrate various themes
- Being able to use specialised tools to obtain digital materials
- Being able to edit/write documents using specialised applications
- Being able to use audio and audio-video applications in order to document different topics
- Being able to use collaborative digital applications for the purpose of teamwork development
- Being able to use programming environment for the implementation of algorithms.
- Being able to analyse statements of a simple problem in order to solve it by the use of an algorithm

ANALYSIS OF IT INDUSTRY REQUIREMENTS

NORTHERN IRELAND, UK

Information Technology (IT) is considered a key industry within the UK's fast-growing digital sector, thus skilled graduates can choose from a wide range of careers.

Different areas of IT:

UK's IT industry is the fastest growing industry with over three million people employed in it. It is an excellent time for anyone to specialise in an IT related area, which can range from:

- Applications development
- Computer forensics
- Content management
- Cyber security
- Data analysis and analytics
- Game development
- Geographical information systems (GIS)
- Hardware engineering
- Information management
- IT consultancy (business and technical)
- IT sales

To:

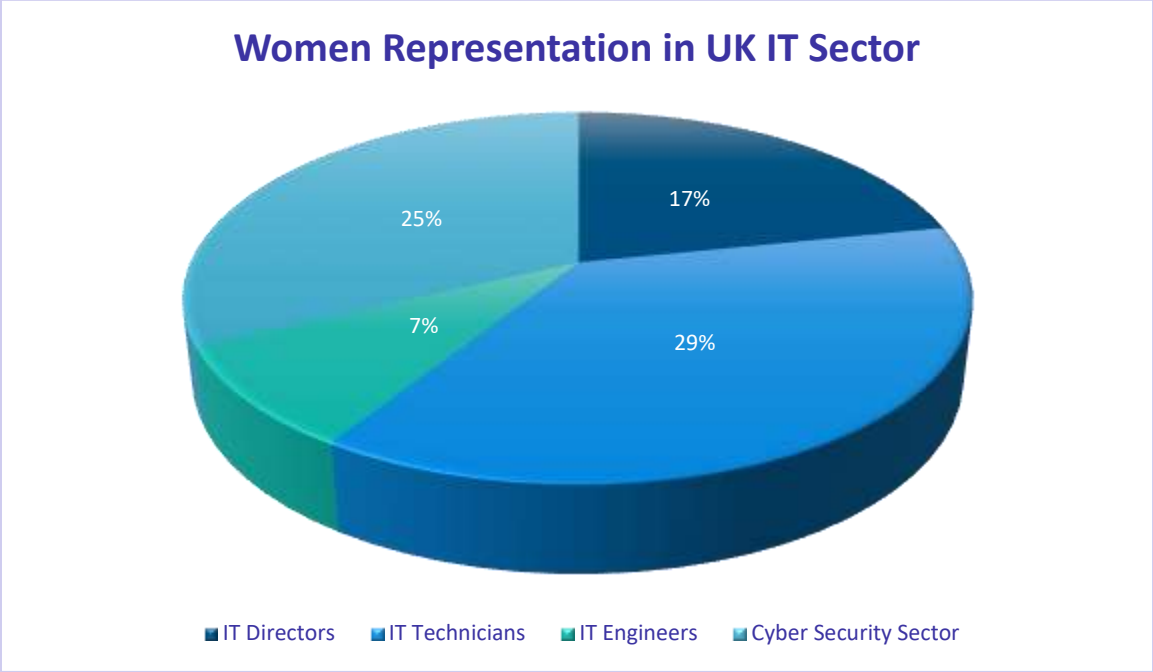
- Multimedia programming
- Risk management
- Software engineering (designing, building, developing and testing)
- Systems/network management
- Technical support
- Telecommunications
- Web design/development
- And much more (Prospects, 2021).

Many IT professionals also choose to work outside the sector, for example, IT departments of education, finance, manufacturing, retail, and public sector organisations.

Most employers expect applicants to have specific technical knowledge and skills of IT through previous experience. However, sometimes any relevant work experience including internship and work placements are accepted.

The gender gap persists

Research published in April 2020 by the Centre for Economics and Business Resources (CEBR) shows continued under-representation of women in UK IT (CEBR, 2014). Overall, according to the research, just one in six UK IT professionals are female. Women represent 17% of IT Directors, 29% of IT technicians, and 7% of IT engineers. Twenty-five percent of the cyber security sector is made up of women according to the analysis (ITPro, 2020).



IR35 delay

IR35 is legislation designed to tackle the problem of contractors being paid through intermediaries such as limited companies, when otherwise they would have been considered employees by HMRC, the British tax office. The UK's IR35 tax rules have been delayed by the Treasury by one year amidst the coronavirus outbreak.

Since 2017, IR35 rules stated that public sector organisations would have to determine the tax status of contract workers, and whether they fell inside or outside the IR35 remit. In July 2019, HMRC stated in the draft finance bill that those rules were to be extended to medium- and large-sized private sector businesses, starting in April 2020, with that deadline delayed to April 2021.

As most of the organisations outsource their IT services, they now must assess the pros and cons of reliance on contract workers, particularly for operational support. Small IT businesses and entrepreneurs may no longer be able to operate under their personal service companies and will need to close down their businesses, which could be harmful in the current climate (CIO, 2020a and CIO, 2020b).

Emerging skills and roles

The pandemic has also accelerated the demand for certain skills and roles across the jobs market, specifically cloud, security roles, automation and artificial intelligence (AI). An international survey carried out by Robert Half found that nearly half (44%) of CIOs and CTOs consider maintaining the IT security of systems and safeguarding company information to be their top strategic priority going into 2021, over cost reduction, process automation and innovation. Therefore, software development, cloud migration, all security related skills and project management experience are on top of the list for hiring managers. Modern enterprises are facing a rapidly growing range of cyber-attacks, thus we can see a growing demand for devops engineers, programme leads, software developers and solutions or network architect roles. Figure 2 shows the Top 5 Skills companies need for an effective cyber-security strategy from 2021:

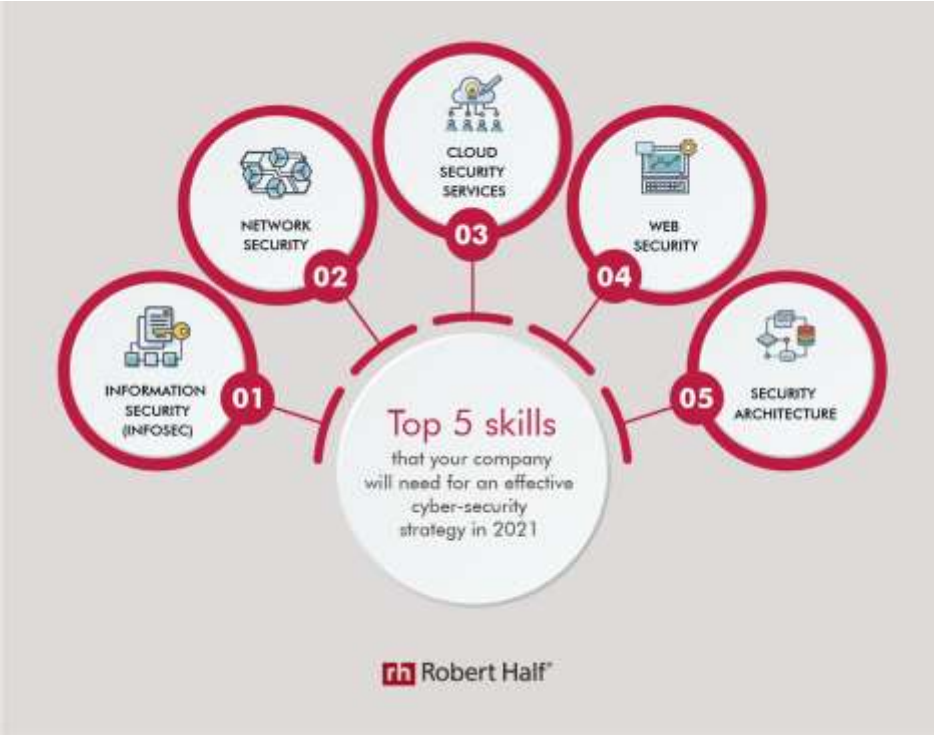


Figure 2. (Robert Hal, 2020)

Microsoft has forecasted 149 million new jobs to be created by 2025 as a result of the pandemic. Software development jobs are predicted to account for 65%, cloud and data 15%, and data analysis and machine learning at 13%, as those in tech jobs capitalise on the advancement of post-pandemic digitalisation. Figure 3 shows the new digital jobs in a post-pandemic world:

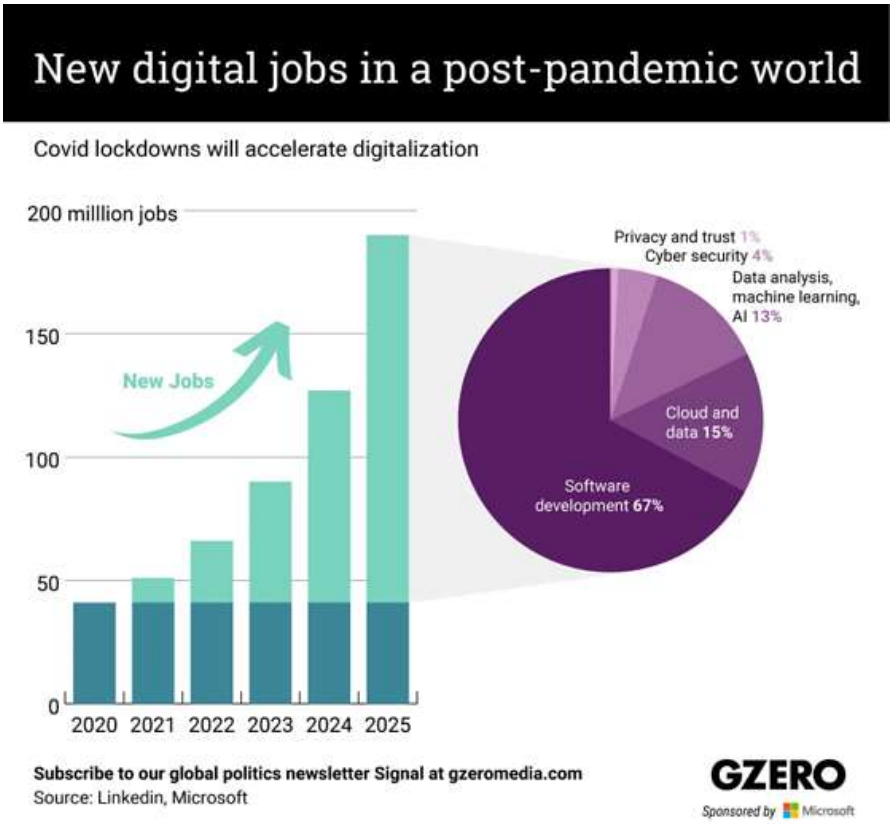


Figure 3.
GCV, 2022

According to LinkedIn's data, the 2020 Emerging Jobs Report UK shines a spotlight on the jobs experiencing tremendous growth in the UK and examines what these trends mean for the workforce. The Emerging Jobs analysis is based on all LinkedIn members with a public profile that has held a full-time position within the UK during the past five years.

The UK's top-three emerging jobs:

- Artificial Intelligence Specialist
- Data Protection Officer
- Robotics Engineer

As companies seek to embrace technology, there is a growing need for emerging jobs talent across all industries. *The UK's top-three industries employing emerging jobs*:

- Information Technology & Services
- Computer Software
- Financial Services

Though the IT services and computer software industries are currently employing a large majority of emerging jobs talent (33% of professionals are employed in these industries), the pharmaceutical industry has the highest year-on-year growth when it comes to hiring for these jobs (+49%).

The great gender divide

Currently 65% of all these emerging roles, across all the industries employing these roles, are held by men. The telecommunications industry has the most imbalance with a male to female ratio of 81:19, but 71% of talent professionals report that achieving gender parity at their company is a top priority. The capital attracts the vast majority of talent in the UK with nearly 45% of professionals working in emerging roles based in London. However, year-over-year growth can also be seen outside of the capital.

Despite the ongoing uncertainty surrounding Brexit, we are seeing professionals from India, the US, and Spain employed in these emerging roles within the UK. However, we're also seeing UK professionals with these roles relocating to the likes of Spain, Germany, and the Netherlands.

What are the skills required for the top 3 jobs?

DevOps engineers:

- Practice on Git tool or Github
- Understanding the CI tools like Jenkins Travis, TeamCity programme leads,
- Conflation management tools like Puppet, Docker, Chef,
- Infrastructure as Code (IAC)
- Working experience in Agile
- Understanding of SDLC
- Soft Skills

Software developers:

- Cloud Computing Skills (AWS, GCP, or Azure)
- Data Structure and Algorithms
- Git and Github
- Containers (Docker and Kubernetes)
- Text editors such as NotePad on Windows and VIM in Linux or advanced editors like Sublime and NotePad++, which provides IDE like functionalities.
- IDEs (VSCode or IntelliJIDEA): The modern IDES like Eclipse or Visual Studio Code is the most critical tool for any programmers. For C, C++, and C# programmer, the choice is clear, the Visual Studio and for Python developers, Jupiter Notebook
- Database and SQL
- Linux (UNIX)
- Object-Oriented Programming
- Computer Networks
- Scripting

Network architects:

- Ability to architect complex, multi-site hybrid networks, both WAN and LAN
- Expert level knowledge of Juniper, Arista or similar routing and switching platforms
- Experience with load balancers handling large volumes of traffic
- Expert level knowledge of IPv4 and IPv6, BGP, OSPF and Spanning Tree Protocol
- Expert level knowledge of network monitoring, and the tools needed to effectively monitor a network
- Knowledge of network security including IDS, DDoS, Firewalls, and other distributed attack schemes
- Ability to script in relevant languages.
- Strong experience in network automation,
- Data Protection Officer
- Statistical analysis:
- Programming:
- Machine learning
- Network analysis
- Analytical skills:
- Business intuition

Robotics Engineer:

- C++ development experience
- Experience with Robotics
- Basic proficiency in C#, Java, Python, or other Object Oriented Languages
- Ability to write tools and scripts to automate repetitive tasks
- Experience recording logs and information on software bugs
- Familiarity with networking (TCP/IP), or Serial Communications
- Windows and Linux experience, at the CLI level
- Able to work on industrial robots to smaller, limited end points like Raspberry Pis, NVidia Nanos etc.
- Working knowledge of ROS / Gazebo

(LinkedIn, 2020).

UK Cyber Security Sectoral Analysis 2022

The UK cyber security sector has been established as a cyber-power. During 2021, the sector's revenue has grown to more than £10 billion and it has added over 6,000 jobs. 2021 was also a record year for external investment into the sector with over £1 billion raised by firms across the UK. Further, there are also growing opportunities for UK firms to secure Critical National Infrastructure, both domestically and internationally in the coming years (GOV.UK, 2022).

According to survey findings, cyber security businesses reported that there were a lack of candidates within the labour market with the cyber security skills that they need. They stated that, 37% of all the vacancies posted since the start of 2019 were being hard-to-fill vacancies.

This suggests that the size of the cyber security skills shortage has not changed significantly from 2020, when this was 35% (DCMS, 2021).
This suggests, that there is a risk of further growth being significantly challenging within the cyber security sector, without the sufficient number of new talent.

The most common reason given for such positions being hard to fill was that applicants have lacked technical skills and knowledge. Additionally, applicants also lacking work experience, the right attitudes or motivation, and soft skills. Mentions of a lack of work experience have increased since 2020, from 8% to 35%.

Figure 4 shows the most common reasons offered by cyber sector businesses for having hard-to-fill vacancies (unprompted – multiple answers allowed):

Figure 4.
(DCMS, 2021).

Among cyber security firms, there was a lack of awareness of national initiatives to improve diversity within cyber security. Among the cyber sector firms that had heard of initiatives like CyberFirst and Cyber Discovery, there was a sense that these initiatives could be broader still in their recruitment. There were, however, mentions of other, often localised schemes, including Women in Cyber schemes, CodeClan and Black Codher, through which some cyber sector firms had recruited.

For example, the CyberFirst imitative helps to encourage and nurture new cyber talent. It highlights the potential of government, industry and academia working together to help both increase the number of potential cyber security staff, but to also best align their skills to the needs of industry and research (DCMS, 2021).

Support Initiatives
On top of the above mentioned initiatives, the UK government offers various start up schemes, loans, grants and schemes for any sector, not only the IT sector. The following article describes the important sources of government help available, what they do and how they can be accessed:
https://thepitch.uk/government-support-for-small-businesses/

FINLAND

The Information and Communication Technology (ICT) sector is Finland's most important export industry with operations making up more than 50% of Finnish exports (ITA, 2020). Over 300,000 Finns work in IT companies, while a total of around 700,000 people work in the technology sector directly or indirectly. In 2017, 6.8% of the workforce worked in the industry. This number was the highest in the EU, of which the average was 3.7%. A clear majority worked in the software businesses (TIF, 2020).

People working in the tech industry have seen an increased salary since 2018. There has also been an increase in developers hired, including front and backend developers and those with specialist skills such as Javascript.

Data suggests that there is a software developer shortage in Finland. Approximately 1,100 students graduate from Finnish universities with graduate degrees in the ICT field every year. Out of these, only about 300 specialise in software development, and about 1,000 developers retire every year. Thus, at least 95% of IT companies have at least planned to recruit outside of Finland (Espeo, 2022).

According to Helsinki Times, the different types of technology jobs available in Finland are as follows:

Full-stack developer.
A full-stack web developer can develop both client and server software. In addition to mastering HTML and CSS, the following skills are required:

- Program a browser (like using JavaScript, jQuery, Angular, or Vue).
- Program a server (like using PHP, ASP, Python, or Node).
- Program a database (like using SQL, SQLite, or MongoDB)

IT Project manager
IT project managers are responsible for planning, organising, allocating resources for, budgeting, and successfully executing organizations' specific IT goals. Such projects might include:

- Software and app development
- Hardware installations
- Network upgrades
- Cloud computing and virtualization rollouts
- Projects around business analytics and data management
- Miscellaneous IT services
- IT project managers may work with a variety of teams within the organization, including (but not limited to) those in charge of:
- Hardware (operating systems and platforms) and software
- Networking (firewalls and connectivity)
- Business data and analytics
- Service management (contracts and procurement)
- Help-desk support
- Information security (compliance and governance)

Software developer

Software developers are responsible for designing computer or mobile applications and developing such products is the primary focus of their work. This focus involves understanding user needs, developing software solutions, monitoring performance and modifying programs as needed. In such a complex role, these professionals inevitably need to have some precise technical know-how. Real-time job analysis software was used to examine more than 1 million software developer jobs posted over the past year. This data revealed the top technical skills employers are looking for:

- Java®
- SQL
- Software engineering
- JavaScript®
- Python®
- Microsoft® C#
- Linux
- Git
- Oracle
- DevOps

Game developer

A game developer is a professional who helps creating a video game from concept to actual product. While certificate, associates, bachelors, and even master's degree programs may be available in some of these different fields, a bachelor's degree is what is commonly required. At this level, aspiring UX and UI designers, and programmers usually receive hands-on training in the form of work placements. There may not be formal requirements beyond a bachelor's degree for game developers. Still, it may be beneficial for video game designers to gain as much experience in the field as possible. They may further develop their creativity and computer skills through self-study. Game designers may also add new projects and experiences to their professional portfolios to become more marketable. Aspiring game programmers may consider becoming certified in a specific programming language. These professionals should also engage in continuing education courses and participate in professional development opportunities to stay up to date with the current technologies.

Data scientist developer

Data scientists utilise their analytical, statistical, and programming skills to collect, analyse, and interpret large data sets. They then use this information to develop data-driven solutions to complicated business challenges. Data scientists commonly have a bachelor's degree in statistics, math, computer science, or economics. Data scientists have a wide range of technical competencies, including statistics and machine learning, coding languages, databases, and reporting technologies (Helsinki Times, 2020).

There is also a range of established roles that will experience increasing demand in the period up to 2022. These are Data Analysts and Scientists, Software and Applications Developers, and Ecommerce and Social Media Specialists. There is a wide selection of different roles working with technology but not officially a part of the industry that are also growing in demand which includes production, design,

finance, administration, communications, sales, marketing, and environmental responsibility (WEF, 2018).

Technology industry companies annually recruit almost 30 000 skilled workers. Around half of them have a university education, and half have vocational qualifications. Most frequently, technology companies hire technology and IT experts.

Five sub-sectors constitute the technology industry in Finland:

- Electronics and the Electro technical Industry
- Mechanical Engineering
- Metals Industry
- Consulting Engineering
- Information Technology (TIF, 2020).

The top ten companies leading in recruitment for IT and systems admin professionals over the period include Visma and Factory Harmonizer, Särmä Digital Oy, Kuori Oy, Sales Communications Finland Oy, Haahtela Group, Mavericks Out, Eficode, Rapal and Cuuma Communications (MeetFrank, 2019).

By 2022, no less than 54% of all employees will require significant re- and up skilling. Of these, about 35% are expected to require additional training of up to six months, 9% will require reskilling lasting six to 12 months, while 10% will require additional skills training of more than a year (WEF, 2018).

IT jobs in Finland are amongst the best paid jobs in the country. From MeetFrank data talent in these jobs earned an average of €4,000 over the first half of 2019, with some entry positions even starting at that amount. Talent that wishes to benefit from IT jobs in Finland would be advised to acquire necessary skills that will support them starting a little further up the ladder (MeetFrank, 2019).

Support Initiatives

Regional Capital Investment Strategy (RCIS) by the Finnish government is offering attractive tax breaks and other incentives to ICT-firms, along with other investor groups to locate to the city of Oulu. BusinessOulu is implementing the City of Oulu's industry policies and supports the development of tech firms and is seeing a rise in ICT-partnerships, capital funding projects and acquisition activity, from regional and foreign players (TechTarget, 2018).

There are many associate, bachelor and master degree programs in Finland in both Universities and vocational colleges. Finnish higher education institutions currently offer over 400 bachelor's and master's degree programmes taught in English. Doctoral study and research options are available, too. Most of the bachelor's degree programmes taught in English are offered by universities of applied sciences (UAS), whereas most of the master's programmes taught in English are offered by universities (Study in Finland, 2020).

Bachelors in Computer Science and IT provided by top tech schools focus on studying coding languages and programming theory for Information and Computer Systems. Undergraduate Computer Science programmes teach students software theory, design, development, and application.

Bachelor's degrees in Computer Science usually take 3 years to graduate in the EU, and 4 years in the U.S. Computer Science studies are usually offered as B.Sc. or B.S. (Bachelors of Science) degrees or B.Eng. (Bachelors of Engineering) degrees. Computer Science degree students can specialise in a lot of interdisciplinary fields, such as Artificial Intelligence, Computer Networks, Cyber Security, Web Technologies, Cloud Computing, UX Design, and more (Study Portals, 2020).

TURKEY

Turkey has the potential of becoming a technical talent hub. One of Turkey's top education centres offers free access to public universities with leading STEM programs, and produces close to 11,000 new IT graduates each year. 35% of IT graduates are female and the ratio of women working in the field outperforms the EU average by 4%. The pandemic has affected the IT industry in a positive way, thus investments in IT have increased and digitalisation is growing. As a result, there is an increased need for almost every expertise in the IT field. The most in demand IT roles include software developers, DevOps, cloud systems, cyber security, data, and automation.

More and more companies seek to optimise their business processes and IT infrastructure through virtualisation and enterprise automation, which has gained significant momentum during the COVID-19 pandemic as companies turned to RPA (robotic process automation) to make operations more efficient (CIO, 2021).

According to research carried out by McKinsey Global Institute (MGI), the adoption of digital technologies is the most important factor in future economic growth and it will account for about 60% of the potential productivity increase by 2030. Automation, AI, and digital technologies have the potential to boost Turkey's economy, therefore, it is critically important to understand the opportunities and challenges regarding the future of work and to prepare the Turkish workforce for the upcoming transformation. MGI's analysis shows that 21.1 million people in the Turkish workforce will need to improve their skills by leveraging technology while remaining employed in their current jobs (MGI, 2020). Figure 5 shows the breakdown of the number of people, who will need reskilling:

Figure 5.
McKinsey & Company, 2020

According to Total Jobs, the most in demand jobs require the following skills:

Cyber security specialist:

- Architectural and technical side of delivering ADAS solutions
- Possess a strong security background in cryptography, key management, firewall and software integrity
- Capable of conceptualising, defining, and implementing security systems and architectures
- CISSP, CISA, CISM, or similar certifications
- Project management tools such as Confluence, MIRO, Slack
- Possess a strong understanding of ISO26262

Software developer – Cloud:

- Strong background or professional experience with frontend application design utilising public cloud technologies (Microsoft Azure, Kubernetes, Docker, Apache Kafka)
- Experience with common frontend technologies (such as React, AngularJS, etc.)
- Strong coding skills in JavaScript and Python, solid and profound skills with clean coding, SW testing and version control (Git), ideally experience with C++
- Practical experiences and skills in the field of continuous integration and deployment (i.e. Azure DevOps, Jenkins, Azure Pipelines)

DevOps Engineer:

- Experience developing engineering applications for a large corporation,
- Current understanding of best practices regarding system security measures,
- Experience working together with teams from several departments to facilitate the orderly execution of a proposed project plan.
- Experience and knowledge of open-source software, frameworks and broader cutting-edge technologies around server-side development in Java; wide and deep understanding of Java ecosystem, monitoring and diagnosis; Containers, SpringBoot, Docker, Kubernetes, Jenkins. Experience in CI (CI as service)/CD.
- Strong experience in database systems with both relational and NoSQL stores
- Experience in Cloud deployments, Preferably in GCP.

Support Initiatives

Nations that nurture a digital- and innovation based culture have pioneered the global shift toward knowledge-based industries and have enjoyed extraordinary wealth (and job creation), while transforming the way people live and do business. This shift is made possible by substantial tech entrepreneurship activity within a supportive environment that includes both government and private-sector contributions. The Turkish government has introduced a number of initiatives designed to stimulate both angel and VC investment, tax exemptions have been the primary lever. However, to date, investments remain below desired levels. High-technology employment in Turkey represents a smaller proportion of total employment and, while in some countries tech giants fuel the tech ecosystem with ex-employees, the number and operational span of Turkey's resident tech companies make this crossover rare (OC&C, 2018).

ROMANIA

The IT industry in Romania represents one of the most prosperous economic sectors, registering in 2019 a turnover of almost 6 billion euros, representing approximately 5.5% of the Gross Domestic Product of the country. At the geographical level, Bucharest contributes with 63% of revenues, the North-West region with a share of 18%, the West region with 5%, the Central area with 6%, the North-East region with 5%, and the remaining 3 % being divided by the South, South-East and South-West regions.

The companies with foreign capital that operate in Romania represent 10% of the total number of companies in the industry, they generate 73% of the market revenues, while the Romanian companies generate approximately 27% of the total market. A problematic factor regarding the development of the IT industry in Romania is the fact that about 78% of the market is used as exports according to the Employers Association of the Software and Services Industry (ANIS), registering significant increases compared to 2017 (65%) and 2018 (72%) (ANIS, 2020).

This trend comes against the background of an undersized internal market, caused by the low degree of digitalisation of the administration, respectively the adoption of technology on a very small scale in Romanian companies, compared to the EU average. Romania ranks 26th out of the 28 EU member states in the Digital Economy and Society Index (DESI) for 2020. Regarding the evolution of the IT market in the last decade, the data published by the National Institute of Statistics (INS) in 2018, indicate a number of over 115,000 employees in the IT industry in Romania.

At the same time, the percentage evolution of the turnover, of the net profit, but also of the number of employees of the largest technology companies in Romania increased significantly in the period 2009-2019. Romania has the best results in the Connectivity dimension, due to the high use of very high speed broadband and the wide availability of very high capacity fixed networks, especially in urban areas. 49% of households in Romania subscribe to very high speed broadband services (at least 100 Mbps), making Romania the 5th largest in the EU.

However, the digitalisation of the economy has lagged behind, given that almost a fifth of Romanians have never used the Internet and less than a third have at least basic digital skills. Romania is well positioned in terms of ICT graduates, ranking fifth, with 5.6% of all graduates (EU average: 3.6%); however, in terms of digital public services and the use of internet services, Romania's performance is the lowest among EU member states. The context of the COVID-19 pandemic had a significant impact on the Romanian IT market both in terms of important societal indicators and in terms of the use of Internet services by citizens. Among the measures taken by the Ministry of Health is the creation of an application for the centralisation of medical data on the situation of coronavirus.

In recent years, the IT Industry has been the leading employer in Romania. Whether we are talking about software and hardware companies, applications developers or maintenance and support services, system engineers, programmers, either senior or junior are in great demand in Romania.

81% of employers declared having difficulties filling job vacancies before the Covid-19 pandemic. Skills were not evolving in line with the needs of expanding economic sectors.
The outcomes of the vocational education and training compared to the needs of the labour market are not in line. Although, steps have been taken to recognise non-formal education and training, yet

pressing challenges remain. Industry 4.0., combining communication networks, automation, robots, 3D printing, AI, control systems and automated cars, will significantly impact the economy, leading to an unprecedented level of automation and operational independence. Technology may replace some jobs, but can also continue to enable job growth. Therefore, the ICT sector in Romania is now confronted with important labour and skills shortages due to the incapacity of the education system to generate a skilled workforce (Iorganda, A. M. et al., 2020).

SKILLS GAP BETWEEN THE IT INDUSTRY NEEDS AND GRADUTAES' COMPETENCIES

NORTHERN IRELAND, UK

Some of the main IT graduate employers include the following global companies:

- Accenture
- Amazon
- Apple
- Capgemini
- Cisco
- Cognizant
- Facebook
- FDM
- Fujitsu
- Google
- IBM
- Infosys
- Intel
- Microsoft
- Rockstar Games
- Samsung
- Softcat
- Ubisoft.

Major telecommunications companies include:

- BT Group
- EE
- Sky UK
- TalkTalk
- Telefónica UK (O2)
- Three
- Virgin Media
- Vodafone

There are many smaller businesses and tech start-ups as the IT sector is fast-moving and dynamic. Small and medium-sized enterprises (SMEs) in the IT industry provide a range of specialist services and typically offer consultancy and technical roles.

IT professionals are also employed to work in many other job sectors, including:

- **Financial services** - recruiters such as Barclays, Citigroup, Deloitte, J.P. Morgan and Morgan Stanley are looking for IT graduates to work with the latest technologies. These include jobs with a focus on artificial intelligence (AI), virtual reality software development, robotics process automation, UX or analytics.
- **Manufacturing** - multinational engineering companies in the oil, pharmaceuticals, automotive and energy industries need IT specialists to work on the processes and technologies that underpin their operations e.g. MBDA, which is an aerospace and defence innovator, requires software engineers with numerous programming language skills.
- **Public sector** - local authorities, central government and the NHS recruit IT professionals to keep their systems running smoothly, deliver projects and analyse data efficiently so it can be used to make major decisions.
- **Retail** - major online and high street retailers such as Amazon, Arcadia, Tesco, TJX Europe and John Lewis also recruit technology graduates to develop new systems and apps, while rolling out technological solutions that satisfy their customers' needs (Prospects, 2021).

WHAT ARE THE IT SKILLS SHORTAGES?

According to Tech Nation:

- over 15bn USD investment raised by UK tech companies in 2020,
- 10% of all UK vacancies are now tech jobs
- The number of UK tech unicorns [1]are around 80, more than in any other country in Europe (Tech Nation, 2020).

However, in order to remain at the forefront of innovation and research and development (R&D), there is a need for the UK's growing digital skills gaps to be addressed. According to Microsoft research in partnership with Goldsmiths' University, 69% of leaders say their organisation is facing a digital skills gap. This is supported by LinkedIn's data, which found that of the ten areas facing the biggest skills gap in the UK, six require advanced digital capabilities (see Figure 6).

[1] Tech unicorn is privately held technology-based start-up company that has a valuation of over $1 billion.

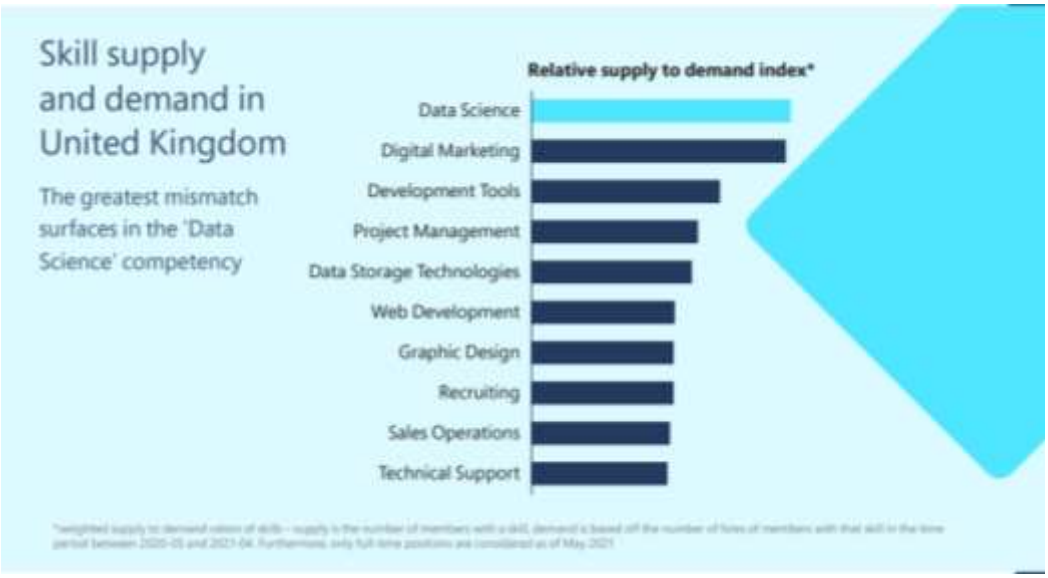


Figure 6

This research has also found that:

- Nearly 80% of employers believe graduates do not arrive fully equipped with the skills they need to be work ready
- 68% of students don't understand what skills are needed to start their career
- Just 28% of UK business leaders believe the education system offers adequate digital training (Microsoft, 2021).

Therefore it is evident, that UK's tech sector is growing at a faster rate than the rest of the economy, creating new jobs that require a range of skills and talent. However, the UK is still facing a major digital skills shortage. In order to effectively prepare our graduates in an ever-changing digital economy, we need to inspire and support them. The Microsoft research also suggests, that there's a lack of awareness of the career opportunities in IT (including current and future jobs) and how to get to them.

As one million people work in IT, the government has recently published a piece of research on the subject examining the demand for digital skills. In partnership with Burning Glass, the Department for Digital, Culture, Media and Sport (DCMS) produced a report on *No Longer Optional: Employer Demand for Digital Skills* (June 2019). It suggested that workers will need to constantly re-evaluate their skills to ensure they're prepared for changing future roles while specific digital skills reduce the risk posed by automation (Burning Glass Technologies, 2019).

According to the Chartered Institute of IT's (BCS) Insight 2021, 91% of organisations feel that they do not have enough resources for success in 2021. The report highlights various skills gap related to people with disabilities, people over 50, women in IT etc.

In the UK, 14% of the working age population are accounted for by people with disabilities and only 10% of them are employed in the IT sector:

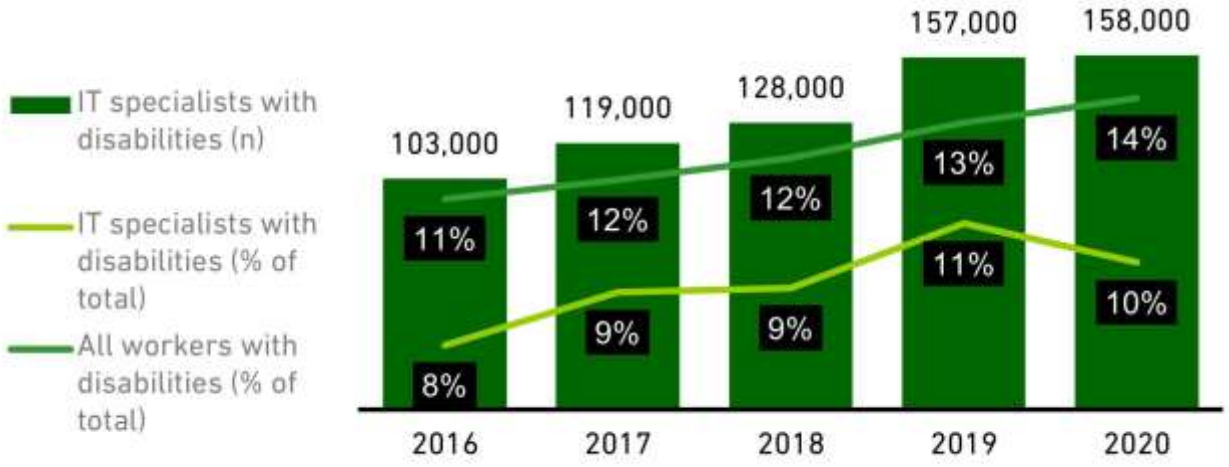


Figure 7. Source: Analysis of ONS Quarterly Labour Force Survey by BCS

Women accounted for 50% of the working age population in 2020 (those aged 16-64), 48% of those in work and 45% of the unemployed. Only 19% are employed in the IT sector (BCS insights 2021).

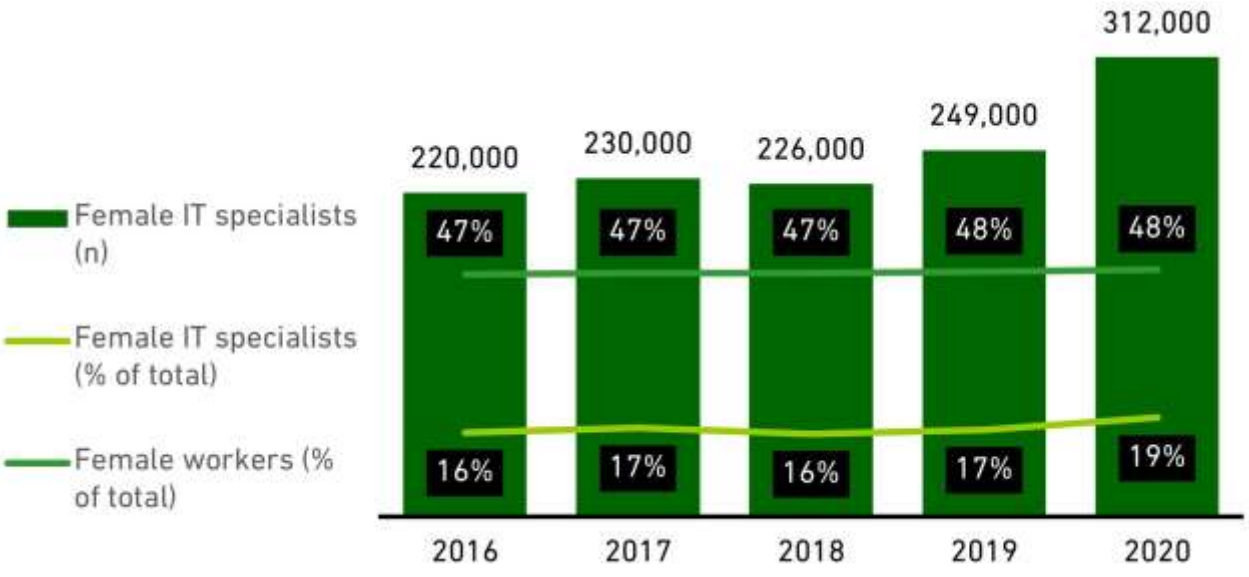


Figure 8. Source: Analysis of ONS Quarterly Labour Force Survey by BCS

The over-50 population is increasing – and it is evident that IT has a skills shortfall and an ageism problem. According to BCS: "Old systems represent a huge cost to strip out; have implications for a lot of expensive retraining; have huge underlying complexity and, even with the newer approach of integrating new and old; require expert knowledge.

Today some banks are still on mainframes; C is widely used; Fortran – which has a 2018 update replacing the 2015 flavour – is over 60 years old; as is COBOL. Even languages like Java are nearly 25 years old. There is potential drama in the fact that these and other legacy applications are still used in

air traffic control, nuclear power plants and the aerospace industry. Whilst these are real issues, there is a problem with this line of reasoning – it is inherently ageist. All this implies that older people are needed because of older systems. Legacy people for legacy systems is not a useful message. Official figures show that halving the employment gap between people aged 50 and state pension age and those in their 40s could see income tax and National Insurance receipts rise by 1% (just under £3 billion) and GDP up to 1% (£18 billion). It could also help to reduce the welfare bill, with £7 billion a year currently being spent on benefits for people aged 50 to state pension age who are out of work." (BCS insights 2019).

There were 362,000 IT specialists in the UK aged 50 and above during 2020 and at 22% (BSC, 2021).

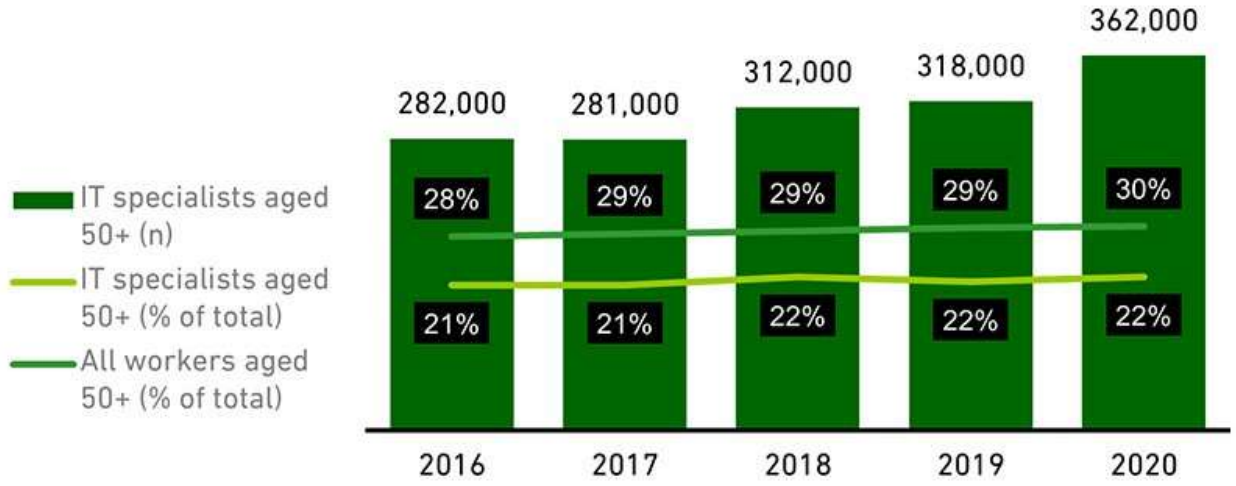


Figure 9. Source: Analysis of ONS Quarterly Labour Force Survey by BCS

The following list of skills gaps were identified by IT leaders:

- data science,
- cloud,
- big data,
- machine learning,
- agile,
- python and
- cyber security issues
- blockchain ('everybody in blockchain seems to be focused on Fintech and the workforce is focusing on that.').

IT leaders also highlighted business and personally oriented skill gaps including:

- Understanding regulatory compliance and the impacts on the organisation
- General requirements of GDPR, including data security by design.
- The ability to understand how to translate regulatory requirements and apply them pragmatically to internal systems.
- Basic understanding of engineering processes and the transformation of ideas into reality.

RESPONDING TO THE SKILLS GAP

The responses of IT leaders reflected a lack of confidence in resources available and the top 3 responses are related to up skilling:

01. Up-skilling / on-the-job training (74%).
02. Career development planning (45%).
03. Mentoring (36%).
04. General recruitment (36%).
05. Professional certifications (31%).
06. Headhunting (18%).
07. Suitable apprentices (17%).
08. Relevant professional body membership (11%) (BSC, 2019).

ARTIFICIAL INTELLIGENCE (AI): WHAT JOBS WILL BE AFFECTED IN FIVE YEARS TIME?

There will be various augmentation roles available in the future. However, IT leaders suggest that there will be no job losses.
Here is a selection of roles that IT leaders considered likely to be affected within five years:

- Greater automation on support in marketing, market intelligence, analysing customers' behaviour through the internet; and in finance, analysis functions.
- Increasing automated vehicle control, automated traffic flow management, customs processing and smuggling detection, network traffic flow optimisation.
- Automotive, elements of passenger transport, elements of highway traffic control
- Teachers could possibly use automation more in terms of assessment - and then patterns might be presented in terms of individual pupil progress. There might be improvements in development of programming languages (PL) or pedagogies used in the teaching of computer science which will be because of AI/ Machine Learning (ML) - for example using eye tracking and then ML to compare PL or pedagogical approaches. There could be data crunching and data analysis type opportunities e.g. comparing GCSE results with other local data.

WHAT SHOULD THE GOVERNMENT DO?

The responses of IT leaders included several suggestions including:

- Grants for development of applications for social good
- Infrastructure e.g. cancel HS2 spend the money on gigabit fibre throughout the UK. Tax relief on research and development; mandate AI in the civil service
- Legal and policy related e.g. develop a culture throughout society that values expertise and of software engineering being a 'profession' with professional standards and training.
- Education:
    I. AI education should be taught at an introductory level from primary and secondary school.
    II. Government needs to invest in maths, data and computer science skills.

III. In the popular press AI loosely means machine learning statistical techniques - curve fitting and classification. But there are many other techniques that are more robust, traceable, and explainable (BSC, 2019).

WHAT ARE THE IT INDUSTRY TRENDS?

The technologies that organisations prioritised for 2021 were:

- Cloud (61%),
- Cyber security (61%),
- Automation (47%) (BSC, 2021).

While the priorities for 2020 were 'operational efficiencies' (56%), 'continuous innovation' (53%) and; 'business transformation and organisational change' (43%).

Manipulation of data is a very important skill, especially for a data scientist role. Therefore students with mathematical and/or programming aptitude and with excellent analytical and problem-solving skills should consider opting for relevant degrees such as computer science, data science, statistics, mathematics and engineering. Additionally, there will be more information released about roles in blockchain, a system of delivering information in a fully automated and safe manner.

The key findings for Artificial Intelligence are as follows:

- 54% of organisations polled currently use AI or machine learning in their business.
- Of the remainder, 32% plan to use it in the near future.
- 48% of AI users cited that they use it for 'automation of mundane or repetitive tasks'
- 66% stated that they will use AI in the future

WHAT SKILLS ARE MOST DIFFICULT TO RECRUIT FOR?

IT leaders stated that most tools and technologies are quite young and are continuously evolving, therefore the experience is an oxymoron and so developer skills are lacking. In general, the answers to this question fell into four broad categories:

1. 'IT SKILLS'

   The following IT skills were mentioned by most of the IT leaders: Data scientists; Machine language engineering; Pragmatic/realistic metamodel technicians; and Quantitative analysts.

2. 'UNDERPINNING PRINCIPLES'

   Most of the respondents considered personal qualities that important, namely critical thinking and creative thinking.

3. 'BUSINESS SKILLS'

   To be successful, employees need more than technical and learned skills. An entrepreneurial spirit, a community-oriented mindset, and a tendency toward

innovation greatly benefit those seeking jobs. Business skills include a wide range of skills such as Communication, Finance, Management, Business soft skills etc.

4. 'ETHICS'
   IT leaders expressed great concerns in regards to finding people who understand bias, those who can consider the wider benefits/societal implications of AI activity. Therefore, graduates should have an in-depth understanding of issues surrounding big data, its proper use and ethical dimension (BSC, 2019).

According to the 2021 review, some of the harder skills listed included:

- Red teaming skills;
- In-depth penetration testing,
- Edge device protection and
- Security postmortem deep forensics.

Related deeper skills, or experience-related items, included finding 'people who are real engineers and think solutions through properly,' as described by one responder (BSC, 2021).

HOW IT ORGANISATIONS CURRENTLY FILLING SKILLS GAPS?

IT organisations are currently filling skills gaps with external partnerships and up skilling. They use a flexible partnership model with external and internal teams, and where resources lack a certain skill, training is used to develop it.

Filling gaps with partnerships moves the skills need from being predominantly technology-based to the business and management environment. Thus, some of the leaders commented that over-reliance on IT vendors to manage key systems can cause a dilution of knowledge in the organisation's decision-making and ability to execute.

In terms of addressing the capability gaps, the survey carried out among IT leaders had the following outcome:

- Up skilling /on the job training 74%
- Career development planning 45%
- Mentoring 36%
- General recruitment 36%
- Professional qualifications 31%
- Headhunting 18%
- Finding suitable apprentices 17%
- Relevant professional body membership 11% (BSC, 2019).

ADDITIONAL RESOURCE NEEDS

The IT leaders' responses are as follows regarding additional resource needs for IT organisations:

1. Enhanced IT capability and skills in existing workforce (62%).
2. Additional IT staff that are suitably qualified (45%).
3. Increased budget (42%).
4. Enhanced IT capability in leadership team (30%) (BSC, 2019).

Are there sector skills councils within your country advising the government on the skills content of your national curriculum?

Sector Skills Councils (SSCs)

SSCs are employer-led bodies licensed by the UK Government to develop occupational standards and skills solutions for their industry sectors. The UK Commission for Employment and Skills (UKCES) offers advice on UK skills, employment issues and labour market intelligence. Employers are involved in designing and delivering vocational qualifications and learning programmes, such as Apprenticeships.

The main objectives of SSCs are to:

- to reduce skills gaps and shortages;
- to improve productivity, business and public service performance;
- to increase opportunities to boost the skills and productivity of everyone in the sector's workforce; and
- to improve learning supply through National Occupational Standards, apprenticeships, and further and higher education

There are 13 SSCs and 5 Sector Skills Bodies (SSBs), covering private, public and voluntary employment, and 90% of UK workforce occupations. The Sector Skills Councils and Bodies are supported by the Federation for Industry Sector Skills & Standards (FISSS) and funded through various means, including competitive government funding, contributions from member organisations and income from the services they provide, for example, consultancy services.

The following image depicts the approach to policy development within the UK:

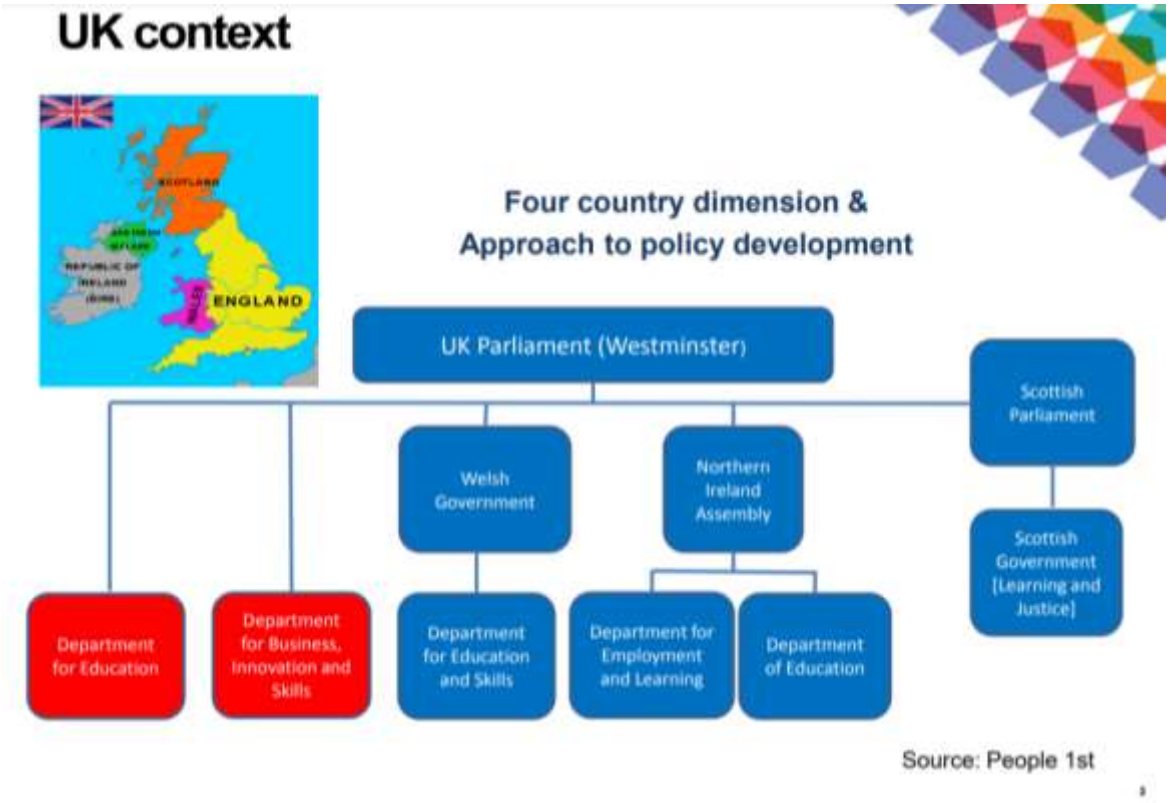


Figure 10. *British Council: UK Sector Skills Councils & World Class Skills 2015*

Sector Skills Councils take responsibility for:

- Influencing the demand for and supply of training
- Raising employer engagement and investment in training
- Increasing work based learning
- Reforming and approving qualifications for employers
- Approving vocational qualifications for funding
- Contributing to the development of National Occupational Standards
- Forecasting future skills required within the sector
- Establishing the content of qualifications

Impact and Results of SSCs:

- 550,000 businesses worked with SSCs
- £52m additional invested in skills
- Improving delivery of training
- Reducing unemployment among young people, women and ethnic groups in training
- Providing high quality careers advice
- Saving employers money

The National Occupational Standards (NOS) describe what an individual needs to do, know, and understand in order to carry out a particular job or function. Therefore employers and industry are integral to the development and use of occupational standards.

NOS also form the basis of all vocational qualifications as they:

- Describe good practice in a particular area of work
- Set out a statement of job competence
- Provide managers with a tool for workforce management and quality control
- Offer a framework for training and development

The following image illustrates the process of qualification development in the UK:

Figure 11. *British Council: UK Sector Skills Councils & World Class Skills 2015*

Sector Skills Councils help employers make better decisions by carrying research including:

- Recruitment trends
- Labour force changes
- Productivity calculations
- Employment relationships
- Training needs
- Trends

SSCs develop work-based learning in terms of apprenticeships. Apprenticeships are programmes of learning that include competence in the workplace; knowledge and; transferable development for work.
SSCs also develop National Skills Academies (NSAs), which are led and supported by employers. NSAs are designed to facilitate the delivery of training to existing employees and new entrants, depending on the priorities of employers in their sector. While they will continue to promote established awards, such as Apprenticeships and Advanced Apprenticeships, they may also be involved in the development of new awards to meet the needs identified by employers, if gaps in provision exist. Their delivery arrangements are meant to be designed to fit the needs of employers within their sector and therefore vary significantly across the different NSAs.

SSCs also influence curriculum development based on:

- Experiential Learning
- Work based Learning
- Virtual Learning
- Entrepreneurial Learning
- Technology based Learning

SSCs in the UK have enjoyed more public funding than similar models elsewhere in the world, however, they now rely on the employer match funding model. If other countries wish to establish similar models, it is recommended to consider the governance, leadership, funding and operation of sector based organisations. In the UK, the vast majority of SSCs are formally independent of the state, they are employer-led. However, they are regulated by a state-constituted-body (the UK Commission for Employment and Skills) which is directly accountable to Ministers (British Council, 2015).

Does your school carry out a skills needs analysis in relation to industry requirements within the curriculum?

Maintained schools in the UK are legally required to follow the statutory national curriculum which sets out in programmes of study, on the basis of key stages, subject content for those subjects that should be taught to all pupils. In England, all schools must publish their school curriculum by subject and academic year online. In Northern Ireland some schools do publish their curriculum, but not all. Therefore, the awarding bodies would have the national curriculum listed on their website:

- CCEA in Northern Ireland
- SQA in Scotland,
- Qualifications Wales in Wales
- AQA, OCR and Pearson in England

All schools should make provision for personal, social, health and economic education (PSHE), drawing on good practice. Schools are also free to include other subjects or topics of their choice in planning and designing their own programme of education. Figure 1 shows the structure of the national curriculum in England, in terms of which subjects are compulsory at each key stage:

Figure 1 – Structure of the national curriculum

	Key stage 1	Key stage 2	Key stage 3	Key stage 4
Age	5 – 7	7 – 11	11 – 14	14 – 16
Year groups	1 – 2	3 – 6	7 – 9	10 – 11
Core subjects				
English	✓	✓	✓	✓
Mathematics	✓	✓	✓	✓
Science	✓	✓	✓	✓
Foundation subjects				
Art and design	✓	✓	✓	
Citizenship			✓	✓
Computing	✓	✓	✓	✓
Design and technology	✓	✓	✓	
Languages[4]		✓	✓	
Geography	✓	✓	✓	
History	✓	✓	✓	
Music	✓	✓	✓	
Physical education	✓	✓	✓	✓

Figure 12. *Department for Education: The national Curriculum in England*

The Northern Ireland Curriculum was introduced in 2007 and covers all 12 years of compulsory education. Education in Northern Ireland is similar to the structure set up in England, with a few key differences. Even though GCSE, AS and A2 levels exist in Northern Ireland, in England and Wales, they are slightly different from that offered in Northern Ireland (DFE, 2013).
Therefore schools do not carry out skills needs analysis in relation to industry requirements.

AISR was developed in response to fill the skills gap in Science, Technology, Engineering and Mathematics (STEM). AISR is a private Academy, who focuses on curriculum development within the STEM subjects and addresses teachers' skills deficit within the UK. We at AISR, also focus on research projects, which analyse skills deficits across the UK and Europe, and based on the findings, we incorporate any skills deficit within our curriculum and advise students on what skills they need for future careers as part of our STEM strategy for 21st curriculum and careers.

FINLAND

There is a widening skills gap in Finland. The effects of demographic trends, the post-recession slowdown in hiring and more has resulted in a growing shortage of talent in critical sectors considered the country's traditional areas of strength. The situation is made worse by the fact that despite an increasing amount of unemployed individuals, organisations are having trouble finding the right skills and specialisations to meet their business needs. As a result of new digital technologies, the nature of work is evolving, business models are becoming more innovative and customer expectations are growing. This leads to the challenge of hiring employees with relevant and diverse skills and experience, which will be even more pronounced in the future.

As Finland evolves into a more digitally enabled knowledge economy, the education, skills and business capabilities required of its workforce are undergoing a radical change. Employees of tomorrow must be more creative, collaborative, entrepreneurial, and digitally savvy than ever before. Building a pipeline of talent that meets these criteria will ensure Finnish organisations have the prerequisites to remain globally competitive.

As Finland transitions further to a digitally-enabled knowledge economy, the nature of work is evolving from standardised, repetitive activities to more complex, problem-solving ones. As a result, organisations are increasingly looking for employees that have not just one or two key functional skills, but a diverse portfolio of skills that help them operate more seamlessly and efficiently. Accenture's research shows a variance between the skills possessed by students and the mission-critical future needs of organisations.

Executives highlighted the challenges of finding and attracting candidates with specialised skills. The top functional areas where a shortage of relevant skills is most prevalent include:

- Information technology (IT),
- Digital (social media, mobility, analytics and cloud),
- Sales,
- Engineering, and
- Research and development (R&D).

The following image shows the % executives' ranking of the top five functional areas in which they are experiencing shortage of skills:

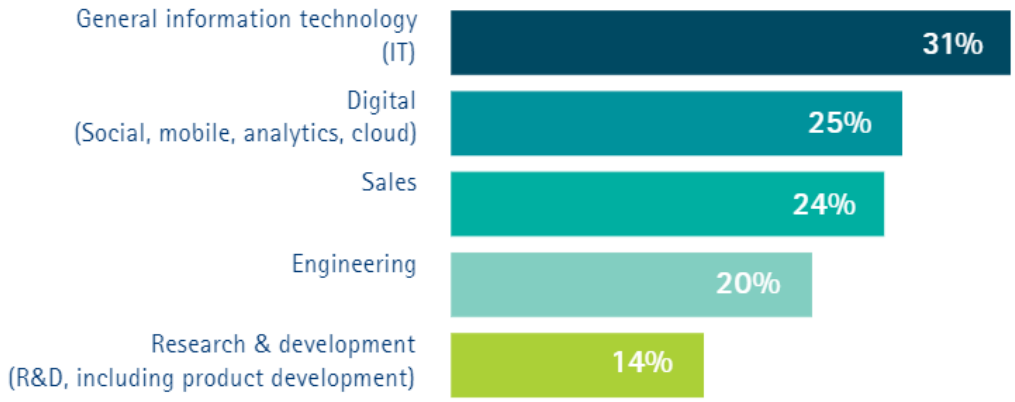


Figure 13. *Accenture: Finland Skills Gap Survey*

Finland has traditional strengths in engineering—and recent redundancies have made engineering skills more readily available. But these are not necessarily the kind of engineers that organisations need at the moment.

When asked about the most important skills to find a job for those just finishing school, executives listed mathematics, foreign languages (primarily English), Finnish language, physics and chemistry, and psychology as their top five. The high ranking for foreign languages underscores the importance Finnish organisations give to skills that enable them to operate on a global scale. This appears to resonate with students, who ranked foreign languages as the top skill requirement. History and social studies figured among the students' top five, as did the Swedish language—perhaps reflecting Finland's strong business ties with its westerly neighbour. Physics and chemistry, and psychology were assigned lower priority.

It is evident, that digitalisation is significantly transforming operating models and ways of working. Finnish organisations across multiple sectors reported that digital technologies were already impacting their business. But 43% of top managers cited the lack of digital skills as their greatest challenge. Today, employees with an ability to leverage mobility, social media, cloud, analytics and other emerging technologies and solutions are critical for Finnish organisations to remain competitive.

Executives ranked high school students poorly across the entire spectrum of skills (Figure 14.). Only 2% of executives felt students had any leadership skills, and only 5% thought students were equipped with entrepreneurial and professional skills. Although 81% of executives felt students are well-quipped with digital skills, industry skills were rated 5%. Furthermore, the survey highlighted wide gaps between the executives' perception of students' skill levels and those of the students themselves. The largest gap was noted in problem solving (66% of students perceived their abilities as strong versus 17% of executives.

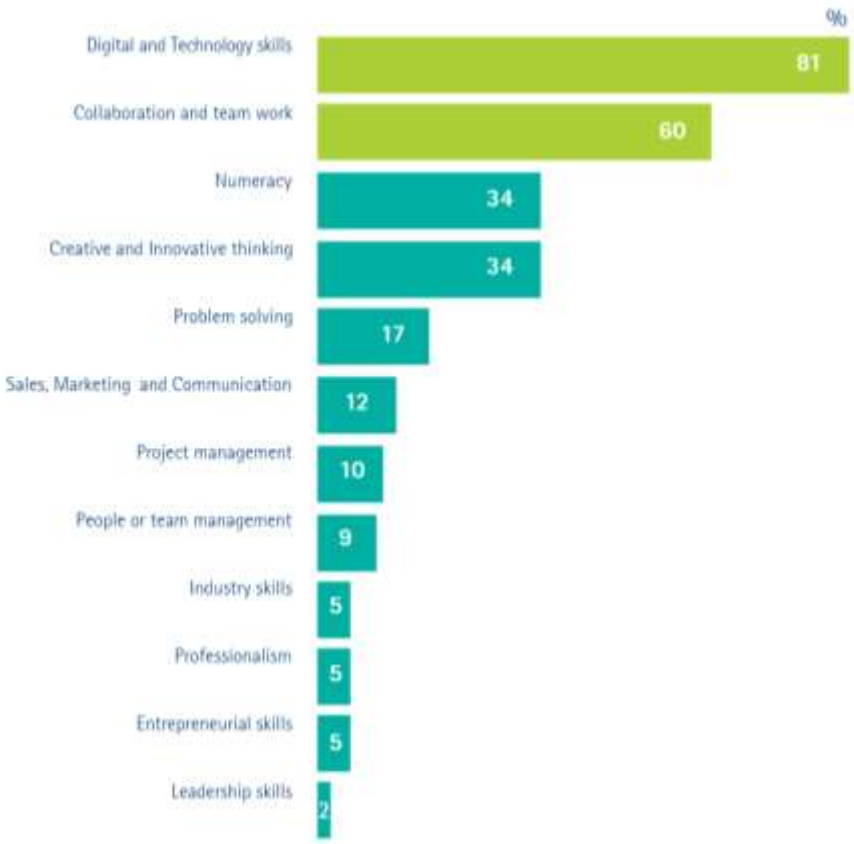


Figure 14. *Accenture: Finland Skills Gap Survey*

Clearly, many organisations still do not have a complete understanding of the challenges and opportunities presented by digital technologies. Just as importantly, they have not yet put in place strategic initiatives aimed at hiring and retaining digital skills. That must change quickly if Finnish companies are to effectively leverage digital to streamline productivity, improve efficiency and use analytics insights to move closer to their customers (Accenture, 2014).

It's important to note, that the phrase "digital skills" in Accenture's survey refers to accessing the Internet daily with devices such as smartphones, personal computers, laptops and tablet.

According to reports published by the Ministry of Economic Affairs (TEM) regarding recruitment problems, in 2019, Finnish employers experienced difficulties in recruiting software developers. This finding was confirmed by Manpower, who performs analysis of employment needs in Finland. Based on their findings, Finland is most in need in IT personnel, including cyber security experts, network administrators and technical support (Finnwards, 2021).

In Finland, skills anticipation activities are well-established and linked to policymaking. Over recent years, socioeconomic factors such as the gradually decreasing number of people in the labour force, and the ageing population increased the need for better matching between the skills supply and demand. As a result, significant investment in skills anticipation has been undertaken in order to steer the education system, both vocational education and training (VET) and higher education (HE) – to meet the needs of the labour market.

The Finnish National Agency of Education (Opetushallitus, EDUFI, under the Ministry of Education and Culture (Opetus ja kulttuuriministerio), plays a key role in anticipation activities and is supported in this role by the Skills Anticipation Forum (Osaamisen ennakointifoorumi), established in early 2017. The Forum replaced and took over all the tasks of the former Education Committee System of the Ministry of Education. Under an ongoing reform of the VET system, quantitative forecasting of educational needs will be improved.

In general, there is a high degree of stakeholder involvement in skills anticipation activities. Major trade unions, employers, regional councils, and representatives of educational institutions are involved in anticipation exercises. The responsibility of education providers for anticipating and responding to the labour market changes has increased, as operational targeting and steering powers have been devolved to universities, polytechnics, and VET providers. Providers are required to play an active role in addressing the national/regional labour market skills needs (Cedefop, 2017).

The discussions at the summer 2019 edition of the public debate forum SuomiAreena focused on innovation and the competences needed by the workforce of the future. Speakers highlighted future challenges related to competence and education in the context of the labour market, the competitiveness of the Finnish economy, and the demands of changing working environments and new skills. Many panellists saw the development of the lifelong learning model as a key factor with regard to the need to match the demand for labour with available skills in a flexible manner, and create personal learning paths for each individual learner.

A lack of suitably skilled workers, the substantial challenge of digital competence, the challenge of innovation, said Technology Industries of Finland CEO Jaakko Hirvola, listing the main obstacles to growth reported by businesses.

Technology Industries of Finland's member companies will need to recruit 53,000 new employees over the next four years, he explained, of whom 60% are university-educated and the other 40% hold qualifications from vocational institutions. There is an immediate need for 11,400 professionals in the ICT sector alone.

On the other hand, the need for those whose highest qualification is a secondary school diploma is decreasing as artificial intelligence and automation take over many routine tasks. Competence requirements are evolving and becoming more demanding. In light of such trajectories, Hirvola stresses the importance of investing in education at all levels.

Perhaps most important is the ability to understand the basic principles of coding and apply them to the tasks at hand. The required percentage of experts focused on deep coding know-how is in fact rather small, estimated Finnish National Agency for Education Director General Olli-Pekka Heinonen.

In the context of future changes, workers' personal resilience and capacity for tolerating uncertainty will gain more importance. It is therefore essential for individuals to anticipate how their existing competencies should be developed to match the needs of the future (CSC, 2019).

TURKEY

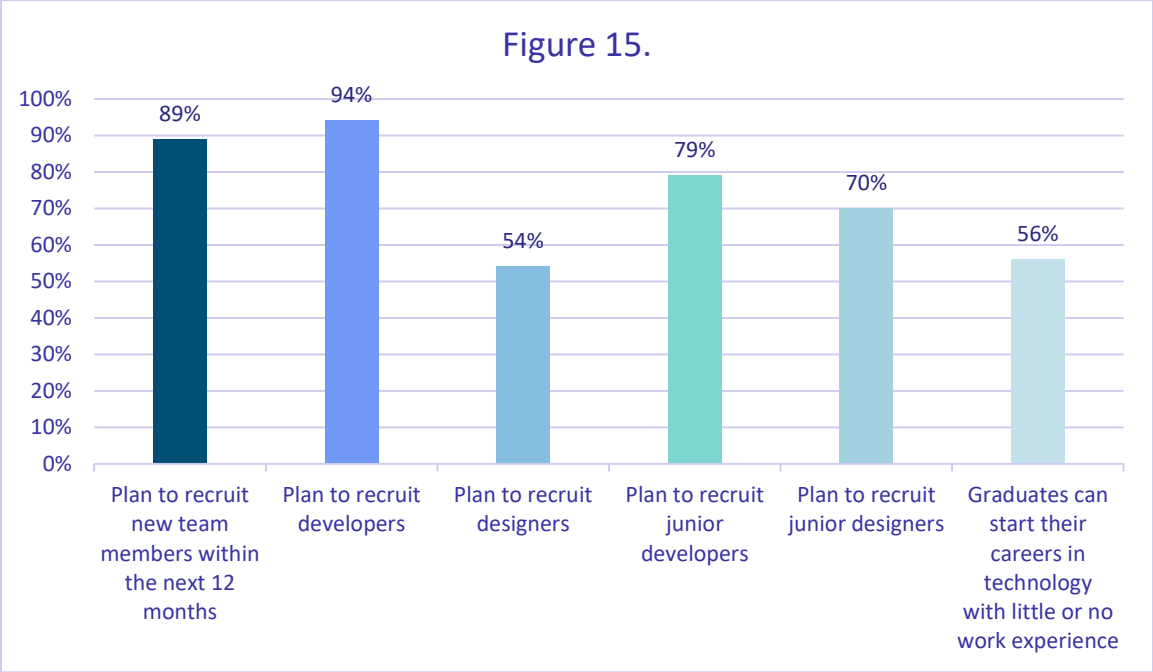
What skills and knowledge graduates lack, that the IT industry requires?

Although the Turkish economy has faced hardships over the past decade, the technology sector has continued to grow and created new educational and job opportunities. In 2019 alone, there were nearly 3500 open positions for software developers.

A recent study undertaken by McKinsey anticipates that within the next decade, digital technologies have the potential to create 1.3 million new jobs in the technology sector. In addition, 1.8 million jobs that currently do not exist may be created and many of these will be in technology-related sectors. To meet the talent transformation needs of the economy and match employer demand, investment in market-driven up skilling initiatives - targeting both technical skills and core employability skills - will be critical, particularly for youth embarking on careers in the digital economy.

However, to date, limited information is available on the needs of employers, especially among privately-owned companies, in Turkey's technology sector. The up skilling initiatives mentioned above lack the data to guarantee the success of their programming, and youth do not have the context to adequately thrive in these careers. To better understand private sector demand for talent, Re:Coded and Impact Hub Istanbul surveyed 54 organisations utilising technology in their operations. The analysis focuses on junior developer and designer roles; as formal technical education and experience are not pre-requisites for success, these roles serve as key entry points for youth interested in starting a career in the digital economy. The data affirms that these employers' main challenges in recruiting new, junior talent relates to candidates' inadequate technical expertise, employability, or awareness of the industry.

The survey found the following upcoming recruitment plans (Figure 15):



The main technical skills that employers are looking for while recruiting for open positions are shown in Figure 16:

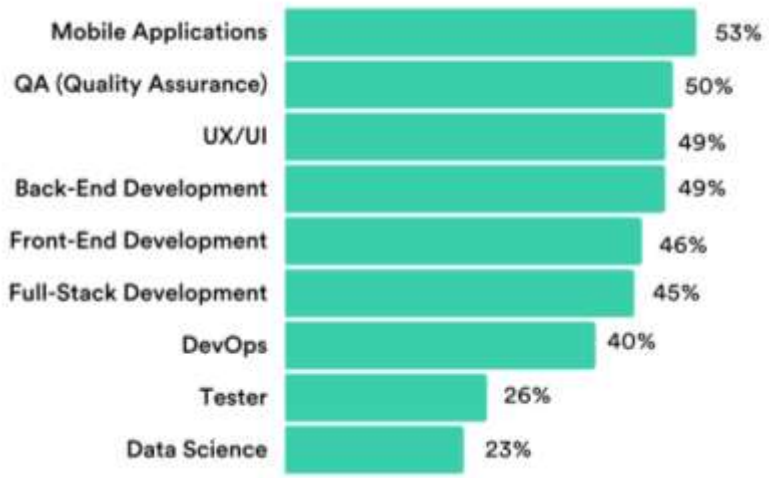


Figure 16. *Opportunities to Bridge the Skills & Talent Gaps in the Turkish Technology Sector*

Employers reported that their main challenges (Figure 17) in recruitment processes are:

- Time spent on interviews
- An inability to find the right person for open positions
- Applicants are lacking both the technical and English-language skills required for open positions
- Many applicants were not aware of changing sector dynamics, and did not demonstrate a clear commitment to their own professional development and continued learning.

Figure 17. *Opportunities to Bridge the Skills & Talent Gaps in the Turkish Technology Sector*

Despite the promising market indications, the main key driver of youth and refugee unemployment in Turkey is a substantial skills mismatch. Young people do not have access to the skills needed to succeed in today's jobs, let alone tomorrow's. According to the 2020 Information and Communications Technology (ICT) Sector Labour Market Report by ISKUR (the Turkish Employment Agency), employers struggle the most when recruiting for competent Software Engineers, Software Developers, and Computer Engineers. Some of the top reasons employers are struggling to find employees in the ICT sector are shown in Figure 18.

Figure 18. *Opportunities to Bridge the Skills & Talent Gaps in the Turkish Technology Sector*

Employers expect junior developers and designers to keep up-to-date with the latest technologies, thus besides technical proficiency, it is encouraged to engage in professional development activities in order to improve their English language skills, to leverage the skill set demanded of a position, and to adapt themselves to a real work environment. Figure 19. shows the skills that Junior Developers and Designers most commonly lack (Re:Coded et al., 2021):

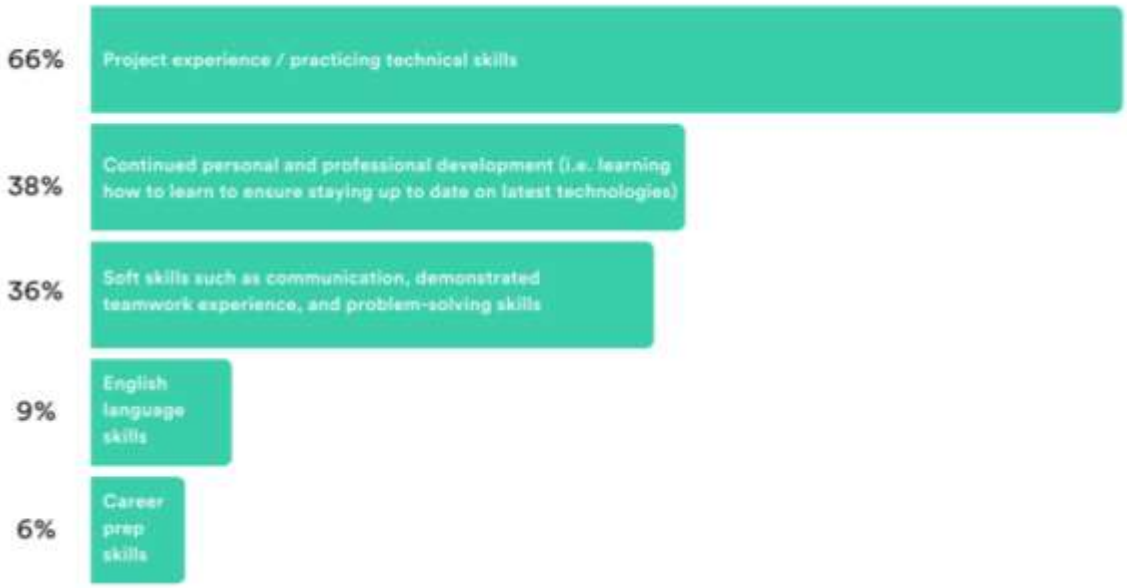


Figure 18. *Opportunities to Bridge the Skills & Talent Gaps in the Turkish Technology Sector*

Are there sector skills councils within your country advising the government on the skills content of your national curriculum?

The main authority to design industry and technology policies in Turkey is the Ministry of Industry and Technology (MoIT). MoIT is responsible to develop effective strategies and incentives for navigating both technology-led transformation and enhancing employability and skills to meet labour market needs.

Turkey's technological and digital development is supported by the "Turkey's 2023 Industry and Technology Strategy" and "National Technology Initiative". This transformation also requires the public sector, businesses, social parties and non-governmental organisations to work closer and produce common policies and strategies.

A number of initiatives are already in motion:

- The "Open Source Platform" is a public-private-academic initiative to improve the software developer ecosystem and to increase the number of qualified software developers
- MoIT has established two coding schools with Ecole 42, a new generation free coding school with project-based, peer-to-peer and gamified learning system. These two schools have a capacity of 2,000 students, and the duration of their study is about three years, resulting in a potential employability rate of 100%. The private sector contributes to curriculum development, projects and mentoring.
- "DENEYAP Technology Workshops" provides basic technology education to students from grade 4 to grade 9 since 2017. DENEYAP provides trainings for three years in the fields of design, coding, robotics, electronic programming, internet of things, nanotechnology, aviation and

space. These workshops have been established in 30 provinces, and 5,600 students have started or completed their training. The target is to reach a total of 100 workshops in 81 provinces in order to provide training to more than 50,000 students within five years.

A coalition of government and business leaders will work together to scale and accelerate many of these initiatives through the *Turkey Closing the Skills Gap Accelerator*, which is coordinated by the Istanbul Development Agency in collaboration with the World Economic Forum. This initiative allowed Turkey to join a group of 10 countries that are implementing this model as part of the *Reskilling Revolution.*

The *Closing the Skills Gap Country Accelerators* are national public-private collaboration platforms to help governments and businesses prepare their country for the future of work through improving skilling and education ecosystems. The model is designed to implement targeted initiatives across four key objectives:

1. Lifelong learning and up skilling
2. Proactive redeployment and re-employment
3. Innovative skills funding models; and
4. Skills anticipation and job market insight (Varank and Zahidi, 2021).

Some of the organisations directly supporting the software industry and the corporate collaboration of institutions include the Ministry of National Education, the Ministry of Industry and Technology, and the Ministry of Youth and Sports. Some of the non-governmental organisations, who provide advice to the government regarding skills and the content of the national curriculum include Imece, Kodluyoruz Akademy, Esas Sosyal, Habitat Derneği etc.

Does your school carry out a skills needs analysis in relation to industry requirements within the curriculum?

Our school does not conduct a skill needs analysis regarding industry requirements within the curriculum.

ROMANIA

Skills gap between IT industry needs and graduates competencies

Romania's expenditure on education remains among the lowest in the EU. The latest available data shows that, in 2018, general government expenditure on education had increased by 6.4%, which is equivalent to 3.2% of GDP. However, this level of spending is significantly below the EU average of 4.6% and one of the lowest in the EU. Expenditure on education remained broadly stable compared to 2010, recording real growth of only 1%. Under-investment is particularly felt in pre-university education and funding mechanisms to support equity remain weak. Although the relationship between spending and educational outcomes is not linear, Romania's low spending on essential public services, most notably on education, means that socio-economic background has a pivotal impact on human capital outcomes.

According to EUROSTAT, in 2019, only 25.8% of Romanians aged 30-34 had a university degree, significantly below the EU average of 40.3% and the lowest in the EU. Although the rate has increased significantly compared to 2009 (16.8%), it still remains below Romania's national Europe 2020 target of 26.7%. In 2018, 28.1% of students graduated in science, technology, engineering or mathematics (STEM), of which 5.8% in ICT. Although these proportions are among the highest in the EU, the actual number of professionals ready to enter the labour market is low. Furthermore, graduates' skills often do not meet the expectations of employers.

Romania has one of the lowest labour force participation rates in the EU and its working-age population has been declining steadily since 2008, while labour and skills shortages have been increasing. Therefore, there is a need to capitalise better on existing human resources and invest in the skills of the current and future workforce. However, the education and training system is struggling to provide the skills the country needs due to challenges linked to quality, equity and labour market relevance. The digital skills of the general population and among young people are lower than the EU average. Overall, less than a third of Romanians aged 16-74 have at least basic digital skills, compared to 58% on average in the EU. The availability of tertiary educated professionals is restricted by the limited number of graduates and by emigration – almost 40% of Romania's higher education graduates aged 24-64 are estimated to have emigrated.

There are significant skills mismatches, with a high proportion of people with tertiary education either over-educated for their occupations or employed in a sector that does not match their field of education. There is no skills forecasting system to feed into the planning of VET and higher education programmes, although one is expected to be developed as a pre-condition for using European Structural and Investment Funds (2021-2027). Despite the high need for training to keep up with trends in the economy and to improve the resilience of the workforce, participation in adult learning programmes is very low (European Commission, 2020).

Fifteen years ago, the Romanian IT industry had just over 10,000 employees, whilst in 2019, a turnover of almost 6 billion euros was registered, which is approximately 5.5% of the country's GDP. The biggest challenge is the capacity of the Romanian state to manage the explosion of this sector as the education system is outdated and fails to meet the growing demand of skilled IT specialists. Although Romania experiences an annual need of approximately 15,400 IT specialists while universities provide only 9,500 graduates in this field, a high potential for market development can be predicted due to the fact that

98% of IT specialists speak at least one foreign language, Romania ranks 6th in Europe regarding the number of IT specialists, and in recent years, Romania has been the source of some of the best robotics teams globally in competitions such as Infomatrix and First Tech Challenge, as well as in the case of the Balkan, European and international IT Olympics (Dinu, 2020).

The major problem stems from the lack of skilled teachers, who can train future programmmers. Starting with the 2017-2018 school year, the Ministry of Education has introduced a computer class in all Romanian schools starting with the fifth grade. However, it was not explained how schools would find teachers who are trained and skilled to be able to teach these computer classes, especially in rural areas (Voinea and Muntean, 2018).

There is a significant mismatch between what the market requires and what universities are delivering. Currently, only about 20% of the market needs are met and the provision of ICT training at firm levels remains low. In 2018, only 5% of the Romanian employers provided training opportunities to their employees, compared to 23% in the EU.

The lack of adequate soft skills is another cause of skilled workforce deficit. This issue arises from the fact that soft skills are not taught in school, nor in vocational education or other training systems. Soft skills that are in high demand include:

- Interpersonal
- Communication (collaboration and team work)
- Problem solving
- Attention to details,
- Planning and organisation

According to the 2016 Talentspotting Survey from Romanian technology recruiter Brainspotting, the country's most sought-after professionals were:

- Software developers (55%)
- Testers (9%) and
- Developers of mobile applications, iOS/Android (4%).

The survey showed the highest demand in programming skills is for Java, PHP, Net/C# and C/C++ (Polak, 2016).

There are numerous international companies present in Romania due to the fact, that Romania outsources its software development services. According to the services of some of the best IT companies in Romania, such as Neuroy, Synergo Goup and Lateral Inc., the most sought after programming and IT skills include:

- Java
- PHP
- Net/C#
- Scala

- Javascript
- iOS
- Andrid
- Hybrid
- Frameworks
- HTML/CSS
- Git and GitHub
- Backend languages
- Web architecture
- HTTP and REST
- Database storage
- Basic design skills
- NPM (Burak, 2021).

ASSESSMENT OF LEARNING AND TEACHING TOOLS AND METHODS

UK

Teaching methods and learning materials are not officially set, but are decided by teachers and schools. Therefore, each individual teacher is responsible for planning lessons that:

- Meet statutory requirements
- Setting appropriate learning objectives/outcomes
- Planning lessons that enable all pupils to meet learning objectives

Although most teaching at Stage 2 & 3 is organised and delivered within subject boundaries, all teachers have a responsibility for developing the cross-curricular skills of communication, using mathematics, and using ICT of the Northern Irish Curriculum. There are no suggested textbooks for pupils, hence all teaching and learning materials are selected by schools.

Textbooks are produced by commercial publishers and do not require government approval. However, schools will generally only choose to use textbooks which pay attention to the requirements of the Northern Irish Curriculum.

All schools have a range of ICT tools available for use by teachers and pupils, which may include PCs, laptops, tablets or iPads, interactive whiteboards and other handheld devices such as digital cameras, video cameras and even educational robots.

AISR carried out a research during the year of 2020, where only Science, Technology, Engineering and Mathematic (STEM) teachers were surveyed across Northern Ireland. The survey was sent out to all of the 192 post-primary schools in NI and its purpose was to collect information about challenges of teaching, current teaching methods, digital skills, resources available, CPD opportunities and best practices in STEM education.

Based on the responses, it was found that flipped classroom and game-based learning methodologies have shown to be less popular methods of teaching. 52% of respondents do not use Flipped Classroom methodology, 54% do not use Game based learning, and 42% do not use Peer Teaching at all. The responses regarding the use of problem based learning for 25% of the lesson was slightly higher (58% of respondents) as opposed to inquiry based learning (46% of respondents). However, inquiry based

teaching is more demanding for the students as they have to decipher the problem from a case study and then solve the problem that they have found by analysing the said study. This is a multi-faceted approach and should be used for about 75% of the lesson as opposed to 25% which most of the participants stated (46% of respondents out of the 62% who use Inquiry based learning). The reasons could be that teachers may not fully appreciate the difference between the various teaching methods.

Respondents stated the most popular tools they use, which include Kahoot! GeoGebra, Google Classroom, YouTube videos and Padlet.

AISR is using interactive whiteboards, laptops, iPads, educational robots, various applications and interactive software to make the learning experience more engaging, motivating and fun. We are exploring new ways of using modern technology and modern teaching methods to improve lifelong learning. We achieve this by developing educational games, mobile applications, augmented reality (AR) applications; and coding for robotics.

AISR developed its own:

- VR chemistry lab, where students carry out step by step practicals in an immersive environment
- We bring our educational posters to life with AR videos.
- GCSE level mobile game, which combines various STEM subjects and concepts in order for students to learn in a fun way

AISR is currently developing the following mobile applications:

- Speak Like a Native English Language app to improve grammar and pronunciation of ESL learners (English as a Second Language)
- Augmented reality STEM Careers Advice

We are also developing a Minecraft-like game, which focuses on the causes and consequences of obesity and promotes healthy and nutritious choices.

Additionally, AISR is also developing:

- other software solutions for educational institutions, teachers and students, which will aid in the digital assessment and lesson delivery process
- Neuro Psychology and Hypnotherapy courses and training modules for both teacher training and the health and well-being sector.

FINLAND

Finland launched a special information society strategy in the mid-1990s. Since 1995 Finland has been working towards an integrated ICT education system with the introduction of the 'Special Information Society Strategy', devised by the Ministry of Education, 1995 and the Ministry of Finance, 1996. This strategy included the use of information and communications technology (ICT) in teaching and learning. The national development has been outlined in the document; Education, Training and Research in the Information Society: a national strategy (Ministry of Education, 1995, Hannele Niemi).

The principles of strategic actions can be summarised as:

- From instant training towards continuous learning, all levels of an educational system must develop their learning environments towards networking and flexibility, to provide individual learning opportunities using relevant ICT applications as their standard working methods.
- Information society skills for all – all primary and secondary schools must provide both genders with ICT skills. Adults should have opportunities to gain the basic skills of ICT and to develop them continuously.
- Professional skills in ICT – Finland must be in the front line of vocational competence to develop services and products in information management. This requires high-quality basic and further education.
- Teachers have a central role. They must have high-quality content knowledge and pedagogical skills to supervise learners in independent study. Teachers must be able to use different media in teaching and to develop relevant learning materials for these environments. Pre-service and in-service teacher education must be developed along the lines of these requirements.
- Knowledge products and services must be developed. High-quality national knowledge storage and resources must be available in education, training and research. Finnish multimedia entrepreneurship will be supported.
- Research into the information society. Higher education and research must be on the international cutting edge of research. This requires a high-quality computing infrastructure, e.g. workstations' capacities and high-speed connections. Learning through media and the interaction of human beings with machines are fundamental areas of pedagogical research.
- Information networks of education and research. The national ICT infrastructure is combined with global open networks, such as the Internet. Schools and learning institutions are also integral parts of local communities and their networks. The whole educational system and libraries will be provided with the necessary infrastructure for access to information networks. The expertise for effective use of these facilities is secured.
- Supportive conditions: legal aspects, copyright issues, standardisation, publicity and intimate protection, the security of information networks and commercial conditions are clarified (Niemi, 2015).

The Ministry of Education (1999) has updated the ICT strategy in Information Strategy for Education and Research 2000-2004. This is a Continuation of earlier governmental efforts to steer national growth towards an information society through learning and education. The main concept is a 'learning citizenship society'. The updated strategy consists of ten national projects to ensure development in 2000-04. The projects are:

1. Information society skills for all
2. OPE.fi ('TEACHER.fi', a free translation)
3. Education and training of professionals in knowledge production and digital communication
4. Virtual University
5. Virtual Polytechnics
6. Virtual School Project
7. Research into learning environments
8. Digital learning materials
9. Infrastructures of an information society
10. Cultural content production.

The OPE.fi project sets the aim that, during the period 2000-04, all teachers will have at least basic ICT skills and to ensure that half of all personnel in educational institutions will have high-level skills. The OPE.fi project has three different levels, which facilitates strategic progress towards teachers' ICT competence. The project outlines both pre-service and in-service teacher education (Ministry of Education, 1999).

Level Skills/Competencies

1. Every teacher can use computers and other ICT facilities and has knowledge of the principles to use them in teaching and learning. These skills are related to word processing, email, the World Wide Web and educational technology in teaching and learning.
2. At least half of the teachers, in addition to basic skills, have more advanced ICT competences, such as:
    - Implementing email, the Web and ICT-based platforms for group work;
    - Managing toolkits for developing teaching and knowledge of the main principles of producing and using digital material in their own teaching area and appropriate skills and competences for pedagogical applications of ICT;
    - Following up the development of technological tools and programmes
3. 10% of the teachers should have special competences in ICT, such as
    - Content-specific or profession-specific applications for example picture management, multimedia, distance education applications, simulations;
    - High standards in levels of pedagogical applications and skills, to support colleagues as ICT users, to work as ICT trainers and developers of schools and learning communities and as partners of expert networks
    - Special skills in computer programming;
    - Producing digital material;
    - ICT management and administration in schools;
    - Anticipating ICT innovations in teaching and conducting research into them (Niemi, 2015).

ICT is not a separate component in a teacher's work. It must be integrated as a natural element in teaching. ICT should also be a connecting factor, creating a culture of collaboration and sharing in schools and teacher education. Teachers' pre-service and in-service education also has a special position in the updated national plan.

Teacher competence is a core issue in developing the information society. It is not only a question of ICT skills but a much deeper and larger cultural issue in schools. The boundaries between school, home and working life are diminishing. This requires new methods in teaching in which collaboration and sharing, providing students with learning skills, and learning and working in net-based environments are essential qualities. Changing learning environments opens paths for lifelong learning, and the acceleration of knowledge production, in particular, requires combining pedagogical expertise with collaborative methods in teaching. According to updated strategies all pre-service and in-service teacher education should allow for:

- Learning and studying in different environments
- Continuous development and evaluation of working communities
- Sharing and adding expertise in communities
- Inquiring, managing and assessing knowledge
- Knowledge of different cultures and communication skills
- Using multimedia and different methods in studying
- In-depth content knowledge
- An innovative approach
- Opportunities for different new media tools and environments (Ministry of Education, 1999).

Digitalisation has been said to be the biggest upheaval Finnish schools have faced in decades. Knowledge and understanding of ICT tools is a core skill of the new basic education curriculum introduced to schools in 2016. The curriculum places ICT skills as one of the seven transversal competences that apply to all subject areas of the curriculum. ICT is embedded to the curriculum as a cross-curricular set of skills. This allows teachers to make use of a rich variety of ICT tools in teaching math, languages, science, biology, arts or any other of the 21 subjects offered in the Finnish curriculum. ICT skills are not the only transversal competence integrated to subjects in Finnish education. These skills have been incorporated into the learning objectives of all subjects of the curriculum.

The full list of transversal competences show how the new curriculum puts a strong focus on developing soft skills that students will need in order to succeed in the future world of work:

- Thinking and Learning to Learn
- Cultural Competence, Interaction, and Self-Expression
- Taking Care of Oneself and Managing Daily Life
- Multiliteracy
- Information and Communication Technology (ICT) Competence
- Working Life Competence and Entrepreneurship
- Participation, Involvement, and Building a Sustainable Future

While digitalisation speeds up the process of finding and processing information and solving problems, it does not in itself solve the problems of teaching and learning. First and foremost, if ICT tools are meant to be used in a meaningful way in learning, pedagogical change is needed. In addition to technical ICT skills, schools need to guide children towards rich information management and responsible behaviour in digital environments. This requires schools to adopt new pedagogical approaches and up skilling of teachers (Järvinen, 2019).

One particular aim of the curricula reform (2014) was to develop the learning environments: Games and other virtual environments should also be recognised more often as learning environments. Technology plays an increasingly significant role in everyday school routines, allowing pupils to be more easily involved in the development and selection of their own learning environments. Technology is used as one of the several learning elements at each educational stage, starting from early education. The use of technology equipment is pursued step-by-step, as long as its use is learning-enhancing, pedagogically useful and justified. Smart devices are usually used as a part of physical learning or other activities, such as:

- Exploring and photographing nature
- Children making videos of their own role playing
- Motivating training methods for mathematics and reading skills
- During basic education: The use of equipment becomes more versatile as the pupils and their skills develop.

Technology is a fantastic way to enrich learning, which pupils find highly motivating. When facing learning challenges, technology provides excellent training opportunities and helpful aids that truly help in individual learning (GEPF, 2017).

Finland endeavours to use blended learning in its classrooms. The term is defined as a combination of face-to-face and online learning. Interactive learning technologies, such as Web 2.0 applications, are used to support communities of inquiry by helping students actively engage in deep and meaningful learning experiences.

Social bookmarking applications are used to share personal collections of web-based resources to complete group projects. Blogs facilitate student self-reflection and peer review of course assignments. Students use wikis to collaboratively summarise course discussions, refine research papers or even co-create online books. Social networking applications, such as Facebook and Myspace, are used to extend the boundaries of the classroom to create online communities and discussions/debates that include past students, potential employers and subject matter experts.

Audio, graphic and video files can now be created and shared through social media applications such as Podomatic, Flikr and YouTube. These files and other data sources can then be recombined to create new meaning and interpretations by using mash up applications such as Intel’s Mash Maker and MIT’s Piggy Bank. Synchronous technologies such as Skype and Elluminate Live! allow students to communicate and collaborate outside of the classroom. Moreover, virtual world applications such as Second Life provide opportunities for rich synchronous interaction in 3-D immersive worlds to support collaborative and creative project-based work. (Joutsenvirta and Myyry, 2010).

In 2016 the education ministry announced plans to put an extra 50 million euros towards helping teachers learn to use electronic devices in their work. But, according to Saarinen those efforts and investments do not appear to have paid off." The more that digital tools were used in lessons, the worse learning outcomes were. This was found in all areas of the Pisa measurements," she said, noting that it was not a question of students being unable to use the devices. Instead, she said students can easily be distracted by the devices themselves-like laptops or tablets - and often start using them for

something besides schoolwork. Saarinen said the results surprised her, but only to a certain degree." There have been similar findings from research in other countries. And many parents have said the same thing," she said (YLE, 2018).

TURKEY

What IT equipment (educational technologies: software and hardware) students have access to (e.g. iPad, Laptop, PC, smart board educational apps, VR glasses etc.)?

All classrooms in our school are equipped with smart boards and computers. Our teachers and students use programs that support the visual, auditory and tactile learning system. Our students and teachers also use different devices such as iPad, laptop, PC, smart board education applications, VR glasses and mobile phones in online education. Student progress tracking programs include K12 and Zoom. Arduino and Phyton, which are robotic coding programs, are among the programs used.

The use of educational technologies across the curriculum e.g. do they use iPads in a history class?

Educational technology equipment is used in all lessons. Especially smart boards, computers, tablets and mobile phones are the most important ones.

Which delivery methodologies do your teachers use within the classroom e.g. flipped classroom, problem based projects etc.?

Our teachers use traditional teaching methods and this is reinforced with homework exercises. We also use flipped classroom methodology, where students are introduced to content at home and practice working through it at school.

How do you assess learning? e.g. exams (oral or written), tests, assignments, practical or paper based assessments

Our school uses written exams, which are held periodically to measure students' understanding. These exams are prepared by the teachers. In addition, classroom performance and homework are also included in the students' grade. Some homework may require students to record their activity such as a cooking task. Multiple-choice high school entrance and university entrance exams are held centrally in our school. According to the results, students can progress to a suitable high school and/or university.

Are there any standardisation sessions to measure if the course outcomes are equally met across each class?

Our teachers make decisions after a standardisation meeting. Accordingly, they adjust the marks or agree that the standard that is being taught is adequate or satisfactory.

Is there a government body to carry out school inspections in order to measure the teaching and learning within the schools?

Inspectors are appointed by the government and they carry out whole school inspections on a yearly basis. There are also inspectors who evaluate teaching and learning within the school. They have separate meetings with the principal, the school management team and with the teachers to give them feedback on the outcomes of the inspection.

ROMANIA

Assessment of learning and teaching tools for online learning

Online teaching is not just a change of physical environment - from the classroom to your own home – as students lack direct interaction with the teacher and friends, and there are no breaks in which to play, talk or relax with other students. For this reason, we need to offer them a different kind of stimulation during the courses. We already know that didactic (as a form of teaching) and word-for-word information (as a form of assessment) are not among the most effective and attractive methods used in the classroom. In the online environment, they are even less useful.

Below are some of the examples of digital tools we use in order to make teaching more dynamic and interactive, and that can turn knowledge assessment into a fun activity.

Applications for questionnaires / opinion polls
We use these applications to find out what students think about a particular topic, when we want to test their level of knowledge, what concepts they associate with a particular word, or to what extent they agree with a statement on a scale of 0 to 10 e.g. Mentimeter and PollEverywhere.,

Knowledge assessment applications
Using digital tools can turn knowledge testing into a fun and interactive activity, reducing the anxiety that many students feel when they hear the word "test". These applications are especially useful for recapitulation or game based learning e.g. Kahoot!.
Educaplay, Quizizz, or LearningApps can be used both in and out of class (for example, as a homework assignment), as they can be accessed at any time via a link provided by the teacher. Quizlet allows the creation of flashcards, where students can self-evaluate and decide what information needs further study.

Applications for creative thinking / imagination exercises
It is crucial to allow students to think critically, to express their opinions or feelings in a safe environment and to form relationships. For this reason, we use two digital tools, Padlet and Checkin.
Padlet gives students the opportunity to work in a team and gather ideas in real time, eliminating some problems that usually occur in the physical environment (inhibition or fear of being judged, the need to wait for our turn to speak). Being an application for creative thinking, it can be used in different ways, the purpose depending only on the creativity of the teacher.

Checkin is a tool that raises questions that can be used to relax the atmosphere or to help students get to know each other better.

Applications for organising / presenting information
To present information on a much more interactive and engaging level, we use online whiteboards such as Classroom screen, which also allows students to work in groups and present their opinions/ideas in real time. As an alternative to PowerPoint presentations, we use Prezi. The MindMup tool is used to create mind maps (to illustrate how different concepts are related), and the Textfixer platform is used to generate random lists e.g. when we want to divide students into teams.

Recommendations for reform within the English and IT curricula

NORTHERN IRELAND, UK

Due to the fact that the English curricula was analysed from the "English as a Second Language (ESL)" point of view, the Northern Irish English curriculum was not analysed.

As mentioned in the previous section, AISR carried out a research during the year of 2020, where only STEM teachers were surveyed across Northern Ireland in order to collect information about challenges of teaching, current teaching methods, digital skills, resources available, CPD opportunities and best practices in STEM education.

Based on the results of the 50 respondents, it was found that there are no refresher STEM training conducted on a regular basis, and that professional development is not compulsory. As described earlier, there is no legal minimum requirement for the length of time to be spent on CPD and schools can avail of a maximum of 10 INSET days. However, these are usually spent with SEN and ICT as opposed to subject specific professional development i.e. how to implement python lessons or how to implement robotic lessons into the Science and Technology area.

The Northern Irish statutory requirements for using ICT (UICT) focus on the process of learning using the 5E's (Explore, Express, Exchange, Evaluate and Exhibit), which is very similar to the 5E Inquiry-Based Instructional Model. The latter is based on cognitive psychology, constructivist theory to learning, and best practices in STEM instruction. The 5E learning cycle leads students through five phases: Engage, Explore, Explain, Elaborate, and Evaluate; it brings coherence to different teaching strategies, and provides connections among educational activities (BSCS 2019). Therefore, the 5E's of the statutory requirement are appropriate as compared to traditional teaching models, the 5E learning cycle results in greater benefits concerning students' ability for technical and scientific inquiry.

However, coding and programming are not directly referenced in the revised statutory Curriculum. ICT or UICT is incorporated as a cross-curricular skill, which can be beneficial, however, Computational thinking and Coding is only included in the UICT Desirable Features, which is not compulsory. Thus, there is flexibility for schools to teach coding if they wish. There is little evidence that schools opt for this in practice, as it has been suggested that coding is rarely taught in primary and post-primary schools.

According to the 'programme of curriculum monitoring in 2018/19' carried out by CCEA, teachers reported, that pupils' experience of the curriculum may depend on levels of teacher confidence or familiarity with areas such as UICT or digital skills. Teachers reported that digital skills are underdeveloped at Key Stage 3 and that some of the current practice in teaching ICT is dated, narrow and does not account for the wide variety of careers that can be accessed through ICT/digital skills. Respondents appreciated the move towards teaching computational thinking and coding and some felt that there is a case for more opportunity for the development and embedding of digital skills provision, particularly at Key Stage 3 and across the curriculum. Teachers reported that they needed access to professional learning opportunities in order to keep up to date with technological developments and that access to equipment and resources such as devices and reliable Wi-Fi.

These findings were underpinned by AISR's survey, where respondents were asked to rank the obstacles that prevent them from implementing effective STEM teaching. They ranked 'Pressure to prepare students for exams' as the number one obstacle, followed by 'Budget constraints in accessing adequate content/material for teaching'. 'Administrative constraints in accessing adequate content/material for teaching was ranked as the third biggest obstacle, followed by 'Insufficient number of computers' as the 4th biggest obstacle, while 'Insufficient bandwidth' came on the 5th place.

Only 6% of respondents reported that STEM refresher training are conducted on a regular basis. Respondents expressed that they would like to participate in UICT CPD activities, 30% stated that they would like to participate in 'ICT and programming' related CPD, followed by 'engaging and innovative teaching methods'.

It is crucial to prepare young people for the rapidly changing requirements by the modern STEM industry, therefore we must design learning environments that provide all students with unique and engaging opportunities to master the skills using the technologies STEM professionals use. However, powerful learning experiences also require effective teachers who are trained on the appropriate use of tools and teaching methodologies and possess up-to-date knowledge and skills regarding industry required programming languages and tools.

Although there are free coding, python and ICT resources, lesson plans and slides available on the Teach Computing website and also on CEA Online Training, we must remember that a number of teachers who studied computing or computer science as the main subject specialism of their teaching qualification, represented 0.9% of teachers registered with GTCNI in 2014 (NIA, 2015). As the number of registered teachers in 2018 was only 0.9% higher than in 2014, we can assume that the number of registered computing and computer science specialist teachers would not be higher than 1.7%.

Therefore, the following are recommended:

- Provide funding opportunities for qualifying organisations to develop:
  - High quality coding/programming online teaching resources, which can be made available for teachers for free
  - STEM hubs in rural and disadvantaged areas, where professional learning events and other STEM related events can be held to support collaboration and empower STEM teachers.

- Provide funding opportunities for the development of Science Centres within schools and/or STEM training organisations, especially in rural and disadvantaged areas, in order to promote equal access to high quality science education to all.
- Encourage schools to develop an innovative ethos, in order to be willing to give developmental time to their teachers in order for them to be able to investigate the full portfolio of free resources that are available. Traditionally, it has been up to the goodwill of teachers to investigate which free resources are available, but the time taken for them to do so was predominantly outside of their contractual hours.
- Enable schools to allow their teachers to access professional development workshops for their teachers, as it is a vital importance to ensure that they are working with updated knowledge and skills. The absence of this can have a detrimental effect on student learning within the classroom.
- Implement STEM careers advice lessons into the curriculum from as early as 7 years of age. As a valid and reliable STEM careers advice is crucial to make young people aware of the wide range of up-to-date careers available to them. This can influence their interest in STEM subjects during primary and post primary school. Additionally, this can further influence their decisions when they choose their GCSE or A level subjects.
- Encourage schools, STEM Ambassadors and STEM teachers to develop links with local STEM businesses, so that industry visits can be arranged allowing students to visit the facilities and learn more about particular STEM jobs.
- Provide STEM funding opportunities for qualifying organisations to be able to implement STEM projects and cross-disciplinary lessons to inspire young people, to build confidence, skills and knowledge in STEM subjects.

AISR is Northern Ireland's first independent STEM school, fully UK accredited and ISO 9001:2015 compliant. AISR was developed in response to fill the skills gap in Science, Technology, Engineering and Mathematics (STEM). AISR offers internationally accredited undergraduate and postgraduate programmes to the highest standards in Business, Science, Mathematics, Information Technology, Arts, Social Sciences, Engineering, Education, Para Medical and Medical studies. AISR is fully recognised by the government of India as we are the permanent constituent polytechnic college of the Manipur International University (MIU), the University of Excellence in India. Therefore, MIU accredits AISR's internationally offered Diplomas, Degrees, Masters and PhD programmes.

The curricula of these internationally offered undergraduate and postgraduate courses are developed and updated by AISR in line with the latest industry needs regarding the most sought after skills. AISR's Quality Regulatory body, the International Curriculum and Assessment Network (ICAN), ensures that the designed qualifications fit the needs of the relevant sector. Then MIU accredits such courses. Therefore it is part of AISR's core belief to develop qualifications that meet the needs of employers and learners.

Additionally, the content of all AISR's teacher training courses are developed by AISR and customised in order to ensure that the content is suitable for the individual needs of the attendees.

FINLAND

Introduction

Learnmera Oy is a highly successful corporate language training institute situated in Helsinki, Finland. Veronica Gelfgren, the founder of Learnmera, has worked in the industry for over 20 years as an instructor and principal in various institutions. Learnmera's expertise originates from the development of tailored language training designed around the specific needs and objectives of their clients. Learnmera's experience with such tailor-made adult education has led to the early adoption of e-learning and creating language learning materials over a wide range of topics and business areas in their languages of instruction; English, Finnish, Swedish, French, Russian and Portuguese.

Learnmera has participated in many EU projects regarding immigration and language teaching, therefore also has expertise in creating material and online resources targeted for adult education, migrants and refugees. Accordingly, Learnmera also maintains leading-edge skills relating to ICT, web portals, websites and mobile applications.

Tailor-made corporate language training courses

Courses are in-house and typically consist of 10-week terms involving weekly or bi-weekly lessons of 90-120 minutes. These terms are most often continued over a year or two, offering a continuous evaluation of progress for the student. However, since 2002 Learnmera began open contracts with companies, so there has been no need to decide on the length of the course which is on-going. Intensive courses spanning a few weeks can include full-day or half-day lessons which offer the benefit of immersion for the student and can support the rapid acquisition of language specifics in a short period. The courses are designed to meet client needs by:

- Incorporating the company's own materials such as brochures, websites, documents etc.
- Teaching specific vocabulary needed for work
- Game activities and exercises made specifically for the client
- Role-playing exercises incorporating real work-life experiences such as presentations and customer meetings.

The first lesson is a trial lesson, given free of charge and set on general topics the learner’s previously expressed interest in. The trial lesson offers an insight into the level and motivation of the students, thereby giving an opportunity to reassess levels if necessary. Following the lesson course structure and contents can then be discussed with the learners and, taking into consideration the company requirements, the learners themselves can direct the course plan to include individual topics of interest and necessary language components such as grammar, speech, writing and listening to satisfy all of their needs. With this information, the instructor can compile a course plan, including all of the necessary study material.

When there is a larger group of learners from the same company, Learnmera organises free testing for the participants with teachers of that language. They conduct a 20-30 minuses oral test with pre-created questions, while listening to the vocabulary, grammar, pronunciation, and listening/discussion skills in the foreign language. Written tests are rarely used as it is not a focus on the offered courses.

Preparation of material for each course

The teachers use various tools to develop creative and engaging lesson materials and activities for the courses:

1. Online tools such as The language Menu (www.thelanguagemenu.com) to create topic-specific worksheets, flashcards and games
2. Articles from online sources such as the Guardian and local language-specific newspapers to develop reading skills and promote discussion
3. Short videos and audio-visual content used for listening comprehension exercises and discussion starters
4. Area-specific games created for vocabulary and grammar exercises
5. Hands-on activities such as team building activities and activities which develop the ability to give and receive instructions while under pressure

Learnmera rarely uses textbooks unless they are specifically requested. In the experience of Learnmera, the practice of using books in the classroom slows the acquisition of specific language activities as it is stilted, slow and out-dated. Learnmera prefers to use more creative and flexible means to teach a language that involves a greater diversity with spontaneous and practical two way and group engagement.

Tools, resources and examples of teaching methods

Some examples of tools and methods used in the Learnmera classroom are:

1 Resources for online tools for material creation can be found in this LiveBinder created by Learnmera http://www.livebinders.com/edit/index/1310662#anchor
2 Vocabulary: Choose an article online, paste to a word document and remove specific vocabulary and insert a line. Add the removed words in a box for the learner to fill the gaps. Students read the article aloud while filling in the gaps. The content of the article is then used to prompt a discussion.
3 Grammar: Choose an article online and have the learner circle specific grammar words like verbs, prepositions, adjectives, adverbs etc. Ask the learner to explain the terms, give an opposite or use the words in different contexts.
4 Use an advertisement, discuss how they are trying to sell the item, and if you would buy it or not.
5 Use a recorded news segment, write down questions related to the news segment for the learner to answer.
6 Create your own games with online tools according to the topic you are teaching. 27 online tools to create worksheets can be found here: https://www.thelanguagemenu.com/
7 Use quizzes, board games like Trivial Pursuits and other games that can improve vocabulary
8 Use images of items or people (or ready-made flashcards) and have students describe what it is, who they are, what they do etc
9 How to use flashcards in many different ways can be found here: https://www.teachingideas.co.uk/sites/default/files/funwithflashcards.pdf

10 Online and mobile apps that can be used are Socrative teacher and Socrative student. Kahoot is a competition based tool that lets the group play against each other, answering questions that can be designed to support course content.
11 Describing your surroundings, feelings or activities managed throughout the day
12 Emptying your handbag and describing the items, what they look like, feel like and for what they are used. Ask questions, and have the learners answer.
13 Taking your learners out of the classroom to a cafe, restaurant, for a walk, to a museum, shopping, for errands etc. is an excellent way of keeping up the conversation about where you are, what you are doing, what you see, and picking up more localised vocabulary like menu items in a cafe or restaurant dialogues, the taste of the food and drinks, all the different items in the shop, practising adjectives by going to a museum describing what you see, the vocabulary needed in the post office, bank etc.

Non-formal Learning methodology

Learnmera uses a non-formal method of teaching. The students' motivation is typically voluntary. This voluntary nature plays an important role, as learning becomes more meaningful for students. Teaching inside the non-formal education system is as well organised as it is spontaneous and engaging. The teacher designs group specific activities that use learning objectives associated with curriculum but regularly stray to include more freestyle activities to make practical the learning experience. The activities take place out of the institutions of the educational environments; the learning setting is in the work location.

The students perceive the teacher as a friend or language guide and as a partner together in the learning process. Teaching methods rely on participation techniques and lectures are almost non-existent. Students are not tested but their achievements and progress are recognised and celebrated. Teachers are constantly assessing the learner's language skills orally when determining the individuals and group levels. Non-formal education leads to not sequential qualification.

There is a report that students get at the end of the term which measures their progress in different areas of language. Learning by doing is most important, everything that students learn is based on activity and what they do. Methods do not rely on learning theory. The activities are designed according to the students' specific needs, students are actively involved in identifying their own needs and finding solutions to progress beyond their challenges.

Learners represent a valuable resource, they are encouraged to assess, practice and reflect on their learning. Students are partners with the teacher in the learning process. Non-formal education relies on active methods of cooperation and on group-dynamic processes. All the activities enhance participatory learning. There is a focus on communicative activities, the learning process is a communicative and cooperative activity where students learn from each other and with each other. The non-formal educational system is open to students' suggestions, students are active co-designers of their own development and the learning process. The student is in the centre of the learning process, the methods and the objectives are adapted to the students' needs and interests

ROMANIA

Reform within the English curriculum

The English curriculum in the Romanian educational system as it is now is organised, based on students' competencies and skills, would be quite efficient if teachers were more concerned with developing skills in students than with going through and finishing textbooks and their content. It seems that most of the teaching is more theoretical as opposed to being practical, thus not focusing on the students' needs and skills. Moreover, the curriculum as it is now, if approached wisely, could also help students in passing recognised English exams. Thus, more concentration on students' needs and skills and focus on English exams would be of benefit in relation to reform within the English curriculum.

Reform within the IT curriculum

As a result of the changes in the field of informatics and the technology of information and communication, the Romanian Ministry of Education and Research (MEC) adopted a new framework plan for middle school which was implemented nationwide starting with the 2017-2018 school year (Please see detailed description in the "Analysis of IT Curricula" section). The new school curriculum for middle school encourages students to use technology responsibly and creatively and to address the need to continue digital literacy efforts and to reconsider this concept from the perspective of new socio-professional requirements. These are achieved through a relevant curriculum, which aims to build a set of digital skills that each graduate can use during schooling and working life.

TURKEY

A comprehensive and sustainable in-service training system should be developed for English teachers. This system should aim to increase competences in contemporary English language teaching methodologies and results. Particular focus should be on:

- Teaching English as a communication tool;
- Emphasis on how the content of textbooks can be “personalised” to instil interest and motivation in students of different ages and skill groups.
- Training should be included in some form of continuing professional development framework and linked to an incentive scheme for teachers, including accreditation of training courses.

In order to ensure eligibility, the content of this training course must be developed by well-trained and experienced professionals. Training can be given by staff consisting of teacher trainers. In order to detect improvements in teaching standards, the impact of education on actual classroom practices should be thoroughly reviewed and evaluated.

The curriculum should be reviewed and relevant learning materials developed, including textbooks. The new curriculum developed should include

- Additional content-based and functional objectives that will allow teachers to provide students with a variety of original and student-focused opportunities and reasons to communicate;
- Encourage flexibility to show teachers how to match the differing skills of students.

The revised curriculum and learning materials mentioned above should:

- Demonstrate realistic progression from grade 2 to grade 12;
- It should be given in a structure where the number of weekly course hours increase
- Allow the addition of modules that provide useful options for students with different needs / abilities, with special emphasis on vocational / technical high schools;
- Should be developed with the support and participation of classroom teachers

The findings show that the technology applied in pilot schools does not provide the expected developments in the observed classes. In addition, it is predicted that not providing sufficient information to teachers /students in advance regarding the use of smart boards / tablets may cause disconnection of students and interrupt the success of technology use. Learning has been advanced regarding technology due to the investment made by the Ministry, however, there is a need for the following:

- Formal approval of all technology-related training and the issuance of official certificates stating learned skills and competencies;
- The development of a platform for new tablets that will allow students (teachers) to create (observed) 'learning communities'.
- Online synchronous classrooms with security measures built in e.g. passwords etc.

This platform should include:

- Apps to create e-leaflets that can be used for continuous classroom assessments and national assessments in grades 8 and 12;
- A safe space for a collaborative and virtual environment, where resources can be shared by all users (students, teachers and schools);

At this point, the activities in thecode.org system, which are also included in the curriculum proposal, should be determined and used. Translation of the English lesson plans on this site should be provided for each activity. The following features should be enabled:

- Enrolling students in the system,
- Enabling students to re-do the same activities at school or at home by logging into the system
- Membership information, so teachers can follow students' activities and progress through the system.

In addition, teachers should be informed about the various applications regarding coding such as Scratch. We believe, that it would be useful to establish standardisation or at least a framework in this regard. Finally, we think, that it would be beneficial to include robotic application systems and examples in the curriculum, which are very popular e.g. Arduino, Micro:bit etc.; along with software such as Scratch, Arduino, mBlock; Tinkercad etc. in order to equip the teachers with knowledge for innovation.

RECOMMENDATIONS

Additional to the recommendations described in the previous section regarding IT and English curricula reform, we would also recommend the implementation of the following:

Based on research and on our findings, it is evident, that the UK, Finland, Romania and Turkey are afflicted with a digital and STEM skills gap, which has been growing steadily and impacting business operations and economies since the early 2000s. Moving forward we must begin to see closer collaboration between our educational institutions and industry, allowing businesses to nurture, offer opportunity and educate pupils from age 7. This collaboration encourages more innovation and generating as yet untapped excitement for IT and other STEM subjects in future generations.
This could be achieved by:

- Implementing STEM and CLIL related careers advice lessons into the curriculum from as early as 7 years of age. A valid and reliable careers advice is crucial to make young people aware of the wide range of up-to-date careers available to them, which can influence their interest in STEM and language subjects and also their decisions of further study and career path.
- Encourage schools, STEM Ambassadors and teachers to develop links with local STEM businesses, so that industry visits can be arranged allowing students to visit the facilities and learn more about particular STEM jobs.
- Provide STEM funding opportunities for qualifying organisations to be able to implement STEM projects and cross-disciplinary lessons to inspire young people, to build confidence, skills and knowledge in STEM subjects.

It is clear from the findings that teachers in partner countries would benefit greatly from CPD and teacher training workshops on ICT and programming, educational technology, and on the appropriate use of teaching methodologies and strategies within the classroom. It should be noted that these innovative strategies need to be planned out and need to be appropriately used or their effectiveness will be diminished. There needs to be a culture of innovation within the schools, in order for teachers to adopt these innovative technologies such as game based learning and the use of robotics and other similar types of innovative technologies.

Teacher CPD should include:

- Inquiry based/problem based teaching methodology
- Foundations of computer science and robotics and how these practices can be applied across all STEM subjects.
- Digital skills including online lesson delivery, e-assessment, engaging students during online lessons and innovative STEM lesson delivery.
- STEM careers - available STEM jobs at an international level; how to develop links with STEM businesses
- The effective use of the wide range of educational technology e.g. smart boards, robots, simulations, collaborative software etc.

- How to deliver lessons which are both engaging and interesting to the students. This requires teachers to possess a high degree of knowledge of STEM and regular teacher training.
- Content and Language Integrated Learning (CLIL) CPD in order to increases students' motivation to learn foreign languages, to promote the learning of a more extensive and varied vocabulary. CLIL also puts a language into a vocational context, which is useful for work based learning and employability skills.

Provide funding opportunities for qualifying organisations to develop:

- High quality STEM online teaching resources, which can be made available for teachers for free
- Videos in relation to STEM careers
- STEM hubs in rural and disadvantaged areas, where professional learning events and other STEM related events can be held to support collaboration and empower STEM teachers
- Powerful digital tools including STEM simulations, dynamic representations of STEM systems and digital assessments. This will enable schools to implement new, research based approaches, to leverage technology in order to improve STEM education.
- Science Centres within schools or STEM training organisations, especially in rural and disadvantaged areas, in order to promote equal access to high quality science education to all.

Involve young people's families with information sessions, recorded webinars, online resources regarding up-to-date STEM career opportunities, pay scales and subject choices. This can also influence young people's choices regarding further education.

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