



ATS2020
Assessment of Transversal Skills



Research Report on Transversal Skills Frameworks

ATS2020 - Assessment of Transversal Skills 2020

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Research Report on Transversal Skills Frameworks

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Contents

1. Introduction.....	1
1.1. Purpose and Aims of this Deliverable.....	3
1.2. Structure of this Document	3
2. Skills and Competences	3
2.1. What Do Skills and Competences Refer to	3
2.2. What Do Transversal Skills Refer to.....	4
3. Frameworks	5
3.1. enGauge 21st Century Skills: Digital Literacies for a Digital Age	9
3.2. The Definition and Selection of Competencies: Theoretical and Conceptual Foundations (DeSeCo).....	10
3.3. The Key Competences for Lifelong Learning – A European Framework	12
3.4. P21's Framework for 21st Century Learning (P21)	14
3.5. ISTE Standards for Students	16
3.6. UNESCO ICT Competency Standards for Teachers (ICT-CST).....	18
3.7. Innovative Teaching and Learning Research Project (ITL) and 21st Century Learning Design (21CLD)	19
3.8. Assessment and Teaching of 21st Century Skills (ATC21S)	21
3.9. NAEP Technology and Engineering Literacy (TEL) Assessment	22
3.10. DIGCOMP: A Framework for Developing and Understanding Digital Competence in Europe.....	25
3.11. Key Skills of Junior Cycle - Framework for Junior Cycle.....	26
3.12. Summary.....	28
11. Development and Assessment of Transversal Skills	29
12. Conclusions	29
References.....	31

1. Introduction

The rapid technological growth and digital transformation of our societies, have brought new affordances and at the same new challenges in people's lives. While there are many opportunities arising from the use of digital technologies, there is a big risk to have unprepared citizens for the future. In order to realise the potential of digital technologies, education systems have to support young people to develop the knowledge, skills and values they need to live and work in such an environment.

In 2006, eight competences were defined as key competences for lifelong learning for European citizens (EU, 2006)¹: 1) Communication in the mother tongue; 2) Communication in foreign languages; 3) Mathematical competence and basic competences in science and technology; 4) Digital competence; 5) Learning to learn; 6) Social and civic competences; 7) Sense of initiative and entrepreneurship; and 8) Cultural awareness and expression. The key competences are all considered equally important, in the framework, because each of them can contribute to a successful life in a knowledge society. Many of the competences overlap and interlock: aspects essential to one domain will support competence in another. Competence in the fundamental basic skills of language, literacy, numeracy and in information and communication technologies (ICT) is an essential foundation for learning; and learning to learn supports all learning activities. At the same time, critical thinking, creativity, initiative, problem solving, risk assessment, decision taking, and constructive management of feelings play a role in all eight key competences (EU, 2006).

In the most recent Communication on *Rethinking Education: Investing in skills for better socio-economic outcomes* (EU, 2012) education and skills are considered as a core strategic asset for growth. Investment in education and training for skills development is considered essential to boost growth and competitiveness with skills determining Europe's capacity to trigger innovation and growth and to increase productivity. As modern, knowledge-based economies require people with higher and more relevant skills, efforts need to be concentrated on developing transversal skills for the 21st century, such as ability to think critically, take initiative, problem solve and work collaboratively. According to Suto (2013), whereas the possession of detailed facts and figures was once a passport to a professional job or a university place, there is now much more emphasis on interpersonal skills and on what people can do with the knowledge they can access.

Education faces a new challenge: to provide the populace with the skills needed in a digital society. Educational systems must adjust, emphasizing information and technological skills, rather than production-based ones (Griffin et al. 2012). The transition from manual tasks to more abstract ones, the automation of routine tasks using technological tools such as artificial intelligence, lead to the transformation of our role in the accomplishment of various facets of our lives, personal, social and professional. The access for example to services, require today sufficient digital skills, as more and more services are provided as e-services. In Figure 1, we can see this transition in the job world, with job tasks moving away from manual and routine tasks towards more abstract tasks.

¹ In 2016 the *New Skills Agenda for Europe-Working together to strengthen human capital, employability and competitiveness* was published (COM(2016) 381 final) to replace the 2006 adopted Recommendation on Key Competences for Lifelong Learning.

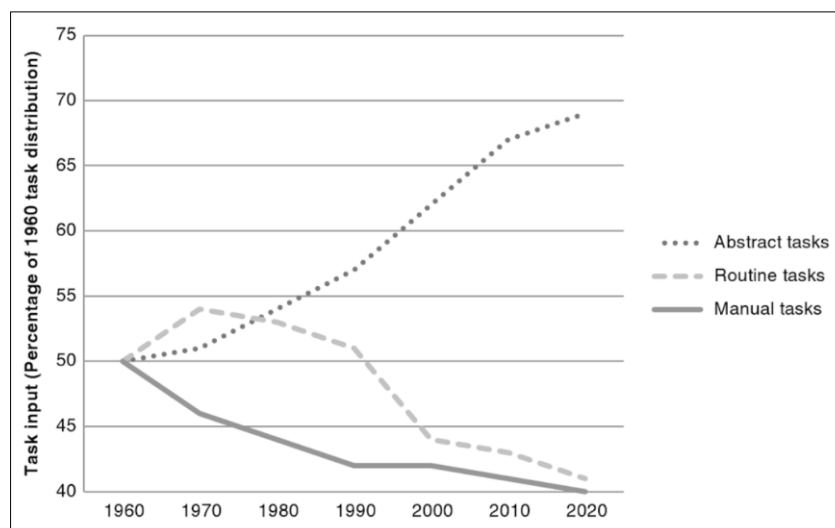


Figure 1 : Trends in job tasks (Griffin et al. 2012, adapted from Autor et al. 2003)

Digital competences are essential to increase among the general population at all stages of life, as digitally skilled workforce and digitally competent consumers will be a driving force for the achievement of a strong digital economy and a precondition for Europeans' participation in the digital world of e-commerce, services, communication and other forms of interaction, according to the Digital Single Market Strategy for Europe (EU, 2015). The Commission will address digital skills and expertise as a key component of its future initiatives on skills and training and will support the countries' efforts in addressing the lack of essential digital skills by playing its role in enhancing the recognition of digital skills and qualifications and increasing the level of ICT professionalism in Europe.

The digital society and economy is leading to the need for more skilled ICT professionals in all sectors of the economy, as well as digitally skilled employees for nearly all jobs where ICT complements existing tasks. Moreover, it changes the way we learn by fostering online communities, by enabling personalised learning experiences, by supporting the development of soft skills such as problem solving, collaboration and creativity, and by making learning fun. Finally, it is leading to the need for every citizen to have at least basic digital skills in order to live, work, learn and participate in the modern society (EU2014a).

Technology offers unprecedented opportunities to improve quality, access and equity in education and training. It is a key lever for more effective learning and to reducing barriers to education, in particular social barriers. Individuals can learn anywhere, at any time, following flexible and individualised pathways (EU, 2012). Education needs to ensure that measures are taken to introduce transversal skills (such as entrepreneurial initiative, digital skills and foreign languages) across all curricula from early stages of education up to higher education, using innovative and student-centred pedagogical approaches, and to design assessment tools through which levels of competence can be effectively assessed and evaluated.

Formal education and training should equip everyone with a broad range of skills which opens doors to personal fulfilment and development, social inclusion, active citizenship and employment. These include literacy, numeracy, science and foreign languages, as well as transversal skills and key competences such as digital competences, entrepreneurship, critical thinking, problem solving or learning to learn. Early acquisition of these skills is the foundation for the development of higher, more complex skills which are needed to drive creativity and innovation (EU, 2016).

Where some Member States have taken steps to incorporate them in curricula, this has not always been done consistently. The full potential for improving education through ICT in Europe remains yet to be

discovered and this is why the European Commission is developing policy and supporting research to make learners fit for 21st century life and work (EU, 2014a). To promote a shared understanding of the various competences, a number of reference frameworks are being developed. A list of such frameworks, extended but not exhaustive, was selected for this study. Based on this review, the ATS2020 transversal skills framework is expected to be developed for the needs of the ATS2020 learning and assessment model experimentation.

1.1. Purpose and Aims of this Deliverable

The purpose of this deliverable is to provide a theoretical and research background regarding the transversal skills needed for the 21st century citizens and to explore various frameworks that have been developed for better understanding these skills, their development and their assessment. It discusses the value and need of these skills for the digital era, as well as ways that they are approached in education. References are also given to teaching and learning approaches for their development and assessment.

The deliverable aims to support the ATS2020 partnership to develop the ATS2020 transversal skills framework for the ATS2020 learning and assessment model.

1.2. Structure of this Document

This paper is structured as follows:

1. *Introduction*: This part provides an orientation of the deliverable's content, with trends in reference to transversal skills.
2. *Skills and competences*: This part discusses the concepts of skills and competences, as well as the different terms used that are considered to represent the concept of transversal skills.
3. *Transversal skills frameworks*: This part provides a compact literature review regarding the main elements of theoretical models and frameworks related to transversal skills.
4. *Development and assessment of transversal skills*: this part introduces a discussion to approaches on the development and assessment of transversal skills.
4. *Conclusions*: This part summarizes the main elements of the previous parts and gives recommendations regarding the design of the ATS2020 transversal skills framework so as to be effective in supporting the learning designs, activities and scaffolding tools to be developed and used for the successful implementation of the ATS2020 learning and assessment model by teachers and students. This part provides a summary of the whole paper.
5. *References*: A list of references of the literature that was used in order to write this deliverable.

2. Skills and Competences

2.1. What Do Skills and Competences Refer to

The terms *skills* and the term *competences* are found in literature to be used inconsistently and interchangeably. This is expected as different systems, researchers, practitioners, policy makers follow various structuring models to constitute the elements of learning processes. For example, the use of the one term or the other, also depends on the level of analysis of an area of skills or competences in a defined taxonomy or framework.

ESCO classification² indicates that while sometimes used as synonyms, the terms *skill* and *competence* can be distinguished according to their scope. The term *skill* refers typically to the use of methods or instruments in a particular setting and in relation to defined tasks. The term *competence* is broader and refers typically to the ability of a person - facing new situations and unforeseen challenges - to use and apply knowledge and skills in an independent and self-directed way.

In the document of key competences for lifelong learning (EU, 2006), *competences* are defined as a combination of *knowledge*, *skills* and *attitudes* appropriate to the context, with key competences to be those which all individuals need for personal fulfilment and development, active citizenship, social inclusion and employment.

In the European Qualifications Framework (EQF) (EU, 2008, EU, 2011) knowledge, skills and competence are approached as learning outcomes to be qualified:

Knowledge means the outcome of the assimilation of information through learning. Knowledge is the body of facts, principles, theories and practices that is related to a field of work or study. In the context of the EQF, knowledge is described as theoretical and/or factual.

Skills refer to the ability to apply knowledge and use know-how to complete tasks and solve problems. They can be described as cognitive (involving the use of logical, intuitive and creative thinking) or practical (involving manual dexterity and the use of methods, materials, tools and instruments).

Competence means the proven ability to use knowledge, skills and personal, social and/or methodological abilities, in work or study situations and in professional and personal development. In the context of EQF competence is described in terms of responsibility and autonomy, meaning the ability of the learner to apply knowledge and skills autonomously and with responsibility.

An interesting approach for understanding competences and skills, is the revised Bloom's taxonomy for the 21st century learners (Anderson et al., 2001). The revised taxonomy revisits the six categories of the Bloom's *Cognitive process* -remember, understand, apply, analyse, evaluate, create- under the *Knowledge dimension* -factual, conceptual, procedural, metacognitive. This new model, enables us to tackle the learning process and outcomes, within the transversal skills development and assessment.

Concluding this short review on skills and competences, we will adapt the term *competence* as a broader concept including knowledge, skills and attitudes that enable the student for his/her personal, social and professional development. The level of analysis of *competences* and *skills* will be undertaken in D1.3: ATS2020 Learning and Assessment Model, where a conceptual framework will be discussed for the ATS2020 transversal skills.

2.2. What Do Transversal Skills Refer to

The word *transversal* has its roots to Latin, meaning '*running or lying across*'. Transversal skills, even if developed in a specific context, are regarded as skills that are transferable to different disciplines, situations and context. It seems from the literature review that there is no common definition on "transversal skills"; rather, there are discussions on underlying characteristics of transversal skills. What makes the situation more confusing is the use of a variety of terms for transversal skills, in an effort to define this broad spectrum of skills within the context that these skills are approached, as well as the effort to identify which skill sets are important in each context. Common terms used include Transversal skills, 21st century skills, Digital skills, Key skills, Key competences, Transferable skills, Horizontal skills, Soft skills, Life skills, and so on. Transversal skills for the 21st century are directly associated with their development and deployment in the digital

² <https://ec.europa.eu/esco/home>

context, as digital technologies are part of everyday life. For the purpose of this document, we will use different terms interchangeably, as these are given in the original reference.

According to Suto (2013), it is expected that there is no single widely-accepted definition of '21st Century skills', given the diversity of agendas held by different educationalists, policy makers, employers, teaching unions, and higher education institutions. For example, in an educational context emphasis is given on the learning process and expected outcomes. The DG EAC ET2020 Working Group on Transversal Skills (2014b) defines transversal skills as skills which "refer to a broad set of key skills that are known to be critically important to success in school, further education and the world of work. They include the ability to think critically, take initiative, use digital tools, solve problems and work collaboratively; skills which are relevant for individuals as citizens and in employment in today's varied and unpredictable career paths"³. In a more job-oriented context "Transversal skills and competences refer to as relevant to a broad range of occupations and sectors. They are often referred to as core skills, basic skills or soft skills, the cornerstone for the personal development of a person. Transversal skills and competences are the building blocks for the development of the "hard" skills and competences required to succeed on the labour market"⁴.

Transversal skills usually refer to skills that are described as *soft skills* as opposed to *hard skills*. *Hard skills* are skills that have as underlying characteristics the following: they are teachable, quantifiable, and include specific knowledge, while they are usually job related. *Soft skills* are skills that have as underlying characteristics the following: they are hard to teach and measure (quantify), they are related to a person's competence and refer to personality and social interactions. Examples include good communication, collaboration, critical thinking, problem solving and son on.

In the ATS2020 context transversal skills are approached as a broad set of key skills developed through different disciplines and are critically important for success in school, further education, work and personal and social life and focusses (as described in the next sections of this document) on transversal skills for *autonomous learning, collaboration and communication, information literacy, and creativity and innovation* in a *digital context*.

Different initiatives, refer to such skills under different terminology and different clustering of skills. In this broad spectrum of (re)defining necessary skills needed for the 21st century, a number of frameworks are being developed internationally elaborating on the same core body of skills. ATS2020 project reviewed a wide range of such frameworks so as to examine whether a framework can be used, adapted or build on existing frameworks for the *ATS2020 Transversal Skills Framework*.

3. Frameworks

A number of frameworks have been developed independently around the world on transversal skills. For the purposes of the ATS2020 project, we conducted in-depth desk research and literature review to identify the most grounded frameworks, relevant to the ATS2020 learning and assessment model and its goals. We highlighted a number of frameworks, so as to identify the most pertinent key skills that are critical to meeting the needs of students in the 21st century, relevant to the ATS2020 goals and aims and not isolated from the educational context of the ATS2020 partner countries. This list was not exhaustive, as new work and research is continuously being developed in this area, and through the three-year life span of the project it is expected to be updated for the needs of the ATS2020 framework. The frameworks studied are listed in Table 1 (in a chronological order), with a brief description. The 11 frameworks are analysed further in this section using information published by each one.

³ <http://www.seecel.hr/et-2020-working-group-on-transversal-skills>

⁴ <https://ec.europa.eu/esco/home>

Table 1: List of Frameworks on “transversal skills” reviewed for the ATS2020 project

Framework	Description
enGauge 21st Century Skills: Digital Literacies for a Digital Age	<p>The enGauge 21st Century Skills were developed by the North Central Regional Educational Laboratory (NCREL) and the Metiri group with the purpose of fostering 21st century competences in students, teachers, and administrators.</p> <p>The following skill clusters, when considered within the context of rigorous academic standards, are intended to provide the public, business and industry, and educators with a common understanding of—and language for discussing—what is needed by students, citizens, and workers in the Digital Age: <i>Digital-Age Literacy; Inventive Thinking; Effective Communication; High Productivity</i>.</p> <p>Further exploiting the enGauge framework, NCREL with Metiri Group developed a new Web-based framework which identifies Six <i>Essential Conditions</i>—systemwide factors critical to effective uses of technology for student learning.</p> <p>(NCREL and Metiri, 2002)</p>
The Definition and Selection of Competencies: Theoretical and Conceptual Foundations (DeSeCo)	<p>In late 1997, the OECD initiated the DeSeCo Project with the aim of providing a sound conceptual framework to inform the identification of key competencies and strengthen international surveys measuring the competence level of young people and adults. This project was carried out under the leadership of the Swiss Federal Statistical Office in collaboration with the U.S. Department of Education, National Center for Education Statistics, and with support from Statistics Canada.</p> <p>DeSeCo Project’s conceptual framework for key competencies classifies such competencies in three broad categories: <i>Using Tools Interactively; Interacting in Heterogeneous Group; Acting Autonomously</i>. These categories, each with a specific focus, are interrelated, and collectively form a basis for identifying and mapping key competencies. The need for individuals to think and act reflectively is central to this framework of competencies. <i>Reflectiveness</i> involves not just the ability to apply routinely a formula or method for confronting a situation, but also the ability to deal with change, learn from experience and think and act with a critical stance.</p> <p>(DeSeCo 2003)</p>
The Key Competences for Lifelong Learning – A European Framework (Note: A revised version was published in 2018)	<p>The Key Competences for Lifelong Learning European Reference Framework is an outcome of the joint work of the European Commission and the Member States within the Education and Training 2010 Work Programme. The Reference Framework sets out eight key competences: <i>Communication in the mother tongue; Communication in foreign languages; Mathematical competence and basic competences in science and technology; Digital competence; Learning to learn; Social and civic competences; Sense of initiative and entrepreneurship; Cultural awareness and expression</i>.</p> <p>Many of the competences overlap and interlock: aspects essential to one domain will support competence in another. Competence in the fundamental basic skills of language, literacy, numeracy and in information and communication technologies (ICT) is an essential foundation for learning and learning to learn supports all learning activities. There are a number of themes that are applied throughout the Reference Framework: critical thinking, creativity, initiative, problem-solving, risk assessment, decision-taking, and constructive management of feelings play a role in all eight key competences.</p> <p>Each of the key competences has a short definition given before it is analysed in <i>Essential knowledge, Skills and Attitudes</i> related to this competence.</p> <p>(European Union 2006).</p>
P21's Framework for 21st Century Learning (P21)	<p>The Partnership for 21st Century Skills (P21) developed in the US with the goal of positioning 21st century competences at the centre of K12 education under a vision for student success in the new global economy. P21 is a national organization formed in 2001 with the sponsorship of the US government and several organizations from the private sector.</p> <p>The elements described as “21st century student outcomes” are the skills, knowledge and expertise students should master to succeed in work and life in the 21st century. These include: <i>Core Subjects and 21st Century Themes; Learning and innovation skills; Information, Media and Technology Skills; Life and Career Skills</i>.</p> <p>The Partnership has identified five <i>critical support systems</i> to ensure student mastery of 21st century skills: 21st Century Standards; Assessments of 21st Century Skills; 21st Century Curriculum and Instruction; 21st Century Professional Development; 21st Century Learning Environments.</p>

	<i>(Partnership for 21st Century Skills, 2007)</i>
ISTE standards for students (ISTE Standards-S)	<p>The ISTE Standards for Students (ISTE Standards-S) were developed by the International Society for Technology in Education (ISTE). First published in 1998 (formerly NETS-S), they were the result of almost three years of development engaging a broad range of stakeholders. The standards defined what students needed to know and be able to do with technology. The second edition of the ISTE Standards-S focuses more on the skills and expertise and less on the technology tools themselves.</p> <p>The technology standards for students are divided into six broad categories. A brief standard statement follows each category. The four performance indicators (a-d) for each standard provide specific outcomes to be measured: <i>Creativity and Innovation; Communication and Collaboration; Research and Information Fluency; Critical Thinking, Problem Solving and Decision Making; Digital Citizenship; Technology Operations and Concepts.</i></p> <p>Teachers, technology coaches, other administrators and technology directors must work in concert to support the ISTE Standards-S. Thus, ISTE Standards-T, ISTE Standards-C, and ISTE Standards-C were also published to support the ISTE Standards-S.</p> <p><i>(ISTE, 2007)</i></p>
UNESCO ICT competency standards for teachers (ICT-CST)	<p>UNESCO ICT Competency Standards for Teachers (ICT-CST) is a UNESCO initiative that aims at identifying a common set of qualifications needed for the integration of ICT in teaching and learning. The framework was specifically designed to improve teachers' practice by providing guidelines for teacher education and training with a focus on ICT competences and on emergent views in pedagogy, curriculum, and school organisation. By crossing three approaches on human capacity development (<i>technology literacy, knowledge deepening, and knowledge creation</i>) with six components of the educational system (<i>policy and vision, curriculum and assessment, pedagogy, ICT, organisation and administration, and teacher professional development</i>) a Competency Standards for Teachers Matrix is created. Each of the cells of the matrix constitutes a module in the framework. Within each of these modules, there are specific curricular goals and teacher skills. A description of detailed teacher competencies, objectives, and methods for each module is provided.</p> <p>The second phase of the ICT-CST project involves the establishment of a UNESCO mechanism to endorse training programs for compliance with the UNESCO standards.</p> <p><i>(UNESCO 2008)</i></p>
Innovative Teaching and Learning Research Project (ITL) and 21st Century Learning Design (21CLD)	<p>Innovative Teaching and Learning (ITL) research on using the 21st Century Skill Rubrics along with the most effective models of professional development is an initiative sponsored by Microsoft Partners in Learning in collaboration with SRI International, namely the 21st Century Learning Design program (21CLD).</p> <p>The <i>21st Century Skill Rubrics</i> focus on the degree to which learning activities provide opportunities for students to develop 21st century skills and the degree to which student work exhibits these skills. Two types of rubrics were developed. Rubrics for coding learning activities describe the 21st century learning opportunities offered by each learning activity, while rubrics for coding student work describe the 21st century skills that students exhibit in the work they do. Learning activities are coded on five dimensions: <i>collaboration, knowledge building, problem-solving and innovation, use of ICT for learning, and self-regulation</i>. Student work is coded on four similar dimensions: <i>knowledge building, problem-solving and innovation, use of ICT for learning, and skilled communication</i>.</p> <p>Each dimension is accompanied by detailed definitions and a 4-point rubric to describe the varying depth with which the skill is called for (in learning activities) or exhibited (in student work). For each dimension, definitions and rubrics are intended to distinguish clearly between learning activities that begin to provide basic opportunities for students to learn related skills and those that are structured so that students exercise the skill deeply.</p> <p><i>(SRI International and Microsoft Partners in Learning, 2010)</i></p>
Assessment and Teaching of 21st Century Skills (ATC21S) and the KSAVE model	<p>The ATC21S project define twenty first century skills as any skills that are essential for navigating the twenty-first century. Three major technology companies, Cisco, Intel and Microsoft, sponsored the ATC21S project, in joining forces with six national governments, an academic partnership with the University of Melbourne, and an advisory panel. The multi-year project was launched in 2009 and aimed to define the skills required in operational terms, taking also into consideration teaching and learning needs from classroom practice.</p>

	<p>ATC21S provides a list of twenty first century skills based on an analysis of twelve relevant frameworks. To structure the analysis of twenty first century skills frameworks, an overall conceptual diagramme was created, defining ten skills grouped into four categories: <i>Ways of thinking; Ways of working; Tools for working; Living in the world</i>. The KSAVE model was developed, where three categories were designed in order to approach each skill from different approaches: Knowledge, Skills, and Attitudes, Values, and Ethics.</p> <p>(ATC21S, 2012)</p>
<p>NAEP Technology and Engineering Literacy (TEL) Assessment</p>	<p>The Technology and Engineering Literacy Framework (TEL) was developed by WestEd for the 2014 National Assessment of Educational Progress (NAEP) at request of the National Assessment Governing Board of the US. The goal of this framework is to establish what students should know about and be able to do with technology. It includes three content areas (<i>Technology and Society, Design and Systems, Information and Communication Technology</i>) and three practices (<i>Understanding Technological Principles, Developing Solutions and Achieving Goals, Communicating and Collaborating</i>).</p> <p>Preliminary achievement level definitions (<i>Basic, Proficient, and Advanced</i>) have been developed for each of the three areas to be reported separately in the assessment and they will be used to guide item development and initial stages of standard setting for the 2014 NAEP Technology and Engineering Literacy Assessment.</p> <p>As crucial to the assessment as the <i>practices</i> are the “<i>contexts</i>” -the situations and types of problems in which assessment tasks and items will be set. The <i>practices</i> expected of students are general, cross-cutting reasoning processes that students must use in order to show that they understand and can use their technological knowledge and skills. The <i>contexts</i> in which technology and engineering literacy tasks and items appear will include typical issues, problems, and goals that students might encounter in school or practical situations. Together, the <i>assessment targets, practices, and contexts</i> provide a structure for the generation of tasks and items.</p> <p>(NAEP, 2014).</p>
<p>DIGCOMP: A Framework for Developing and Understanding Digital Competence in Europe (2013).</p> <p>(Note: “DigComp 2.0: The Digital Competence Framework for Citizens” and the “DigComp 2.1: The Digital Competence Framework for Citizens” were published in 2016 and 2017 respectively)</p>	<p>“DIGCOMP: A Framework for Developing and Understanding Digital Competence in Europe” was published in 2013 by the European Commission Joint Research Centre (JRC). It presents a detailed framework for the development of digital competence of all citizens. It consists of detailed descriptions of all competences that are necessary to be proficient in digital environments and describes them in terms of knowledge, skills, and attitudes. Three proficiency levels are suggested for each competence. The report also provides a self-assessment grid for mapping digital competence levels.</p> <p>As described in the DIGCOMP report (2013), the shell of the DIGCOMP framework is structured in five dimensions: <i>competence areas</i> that have been identified; <i>competences</i> that are pertinent to each area; <i>proficiency levels</i> that are foreseen for each competence; <i>examples of the knowledge, skills and attitudes</i> applicable to each competence; examples on the applicability of the competence to different <i>purposes</i>.</p> <p>The DIGCOMP areas of digital competence are: <i>Information; Communication; Content-creation; Safety; Problem-solving</i>.</p> <p>(JRC, 2013)</p>
<p>Key Skills of Junior Cycle - Framework for Junior Cycle</p>	<p>The Key Skills of Junior Cycle Framework was developed by the Department of Education and Skills in Ireland for the needs of the Junior Cycle curriculum. Eight key skills are described in the Framework for Junior Cycle: <i>Quality; Wellbeing; Creativity and Innovation; Choice and flexibility; Engagement and participation; Inclusive education; Continuity and development; Learning to learn</i>.</p> <p>The eight key skills required for successful learning by students across the curriculum and for learning beyond school are analysed in 46 elements. The key skills are named and explained in language that students can access and understand so as to help them take greater responsibility for their learning. The key skills will be embedded in the learning outcomes of every junior cycle subject and short course.</p> <p>(Department of Education and Skills, 2015)</p>

3.1. enGauge 21st Century Skills: Digital Literacies for a Digital Age

Title: enGauge 21st Century Skills: Digital Literacies for a Digital Age

Organisation(s): North Central Regional Educational Laboratory (NCREL) and the Metiri group

Period of work/Date published: started in 2000 and funded until 2005, framework published in 2002

Terms used (in reference to transversal skills): 21st Century Skills

Terms used in reference to the conceptual framework: skill clusters, representative skill sets, skills

References: www.metiri.com, www.ncrel.org/engauge

Brief description of the project:

The enGauge 21st Century Skills were developed through a process that included literature reviews, research on emerging characteristics of the Net-Generation, a review of current reports on workforce trends from business and industry, analysis of nationally recognised skill sets, input from educators, data from educator surveys, and reactions from constituent groups. In addition, data was gathered from educators at state-level conference sessions in 10 states, surveys, and focus groups in Chicago and Washington, D.C. Initial drafts of the enGauge 21st Century Skills were reviewed by experts in the field prior to inclusion in the enGauge list.

Brief description of the framework/model:

According to Lemke (2002), the following skill clusters, when considered within the context of rigorous academic standards, are intended to provide the public, business and industry, and educators with a common understanding of—and language for discussing—what is needed by students, citizens, and workers in the Digital Age: *Digital-Age Literacy; Inventive Thinking; Effective Communication; High Productivity* (Figure 2).

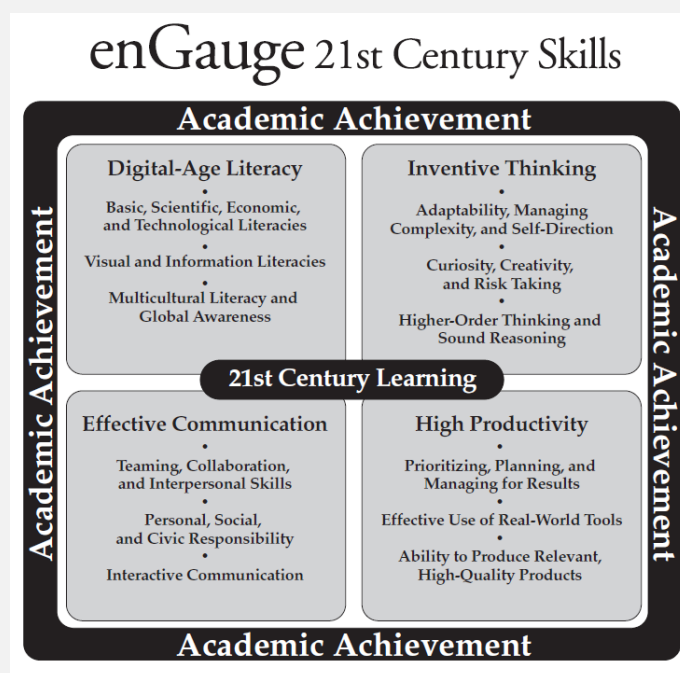


Figure 2 : enGauge 21st Century Skills (www.ncrel.org/engauge)

Each skill cluster is further broken down into representative skill sets, which offer guidance on recognising student performance in developing the enGauge 21st Century Skills.

Further exploiting the enGauge framework, NCREL with Metiri Group developed a new Web-based framework which identifies Six Essential Conditions—systemwide factors critical to effective uses of technology for student learning.

3.2. The Definition and Selection of Competencies: Theoretical and Conceptual Foundations (DeSeCo)

Title: The Definition and Selection of Competencies: Theoretical and Conceptual Foundations (DeSeCo)

Organisation(s): OECD, led by the Swiss Federal Statistical Office in collaboration with the U.S. Department of Education, National Center for Education Statistics, and with support from Statistics Canada

Period of work/Date published: initiated in 1997, first publication in 2001, final report in 2003

Terms used (in reference to transversal skills): Key competences

Terms used in reference to the conceptual framework: competences, categories, conceptual linkages between key competencies, critical dimensions

References: www.oecd.org/edu/statistics/deseco, www.deseco.admin.ch

Brief description of the project:

In late 1997, the OECD initiated the DeSeCo Project with the aim of providing a sound conceptual framework to inform the identification of key competencies and strengthen international surveys measuring the competence level of young people and adults. This project, carried out under the leadership of the Swiss Federal Statistical Office in collaboration with the U.S. Department of Education, National Center for Education Statistics, and with support from Statistics Canada, brought together experts in a wide range of disciplines to work with stakeholders and policy analysts to produce a policy-relevant framework. Individual OECD countries were able to contribute their own views to inform the process. The project acknowledged diversity in values and priorities across countries and cultures, yet also identified universal challenges of the global economy and culture, as well as common values that inform the selection of the most important competencies.

As described in the Second DeSeCo Symposium (Rychen, Salganik and McLaughlin, 2003), DeSeCo aimed to develop, through an interdisciplinary, collaborative, and forward-looking approach, a frame of reference for assessments and indicators of competencies that would have resonance with the information needs of policy-makers. It is a vital contribution to advancing our understanding of what it means to be a competent individual and of how investments in key competencies can benefit both individuals and societies. Based on theoretical and conceptual approaches to competence and informed by political and practical considerations, the DeSeCo Project succeeded in developing a conceptual frame of reference for key competencies. DeSeCo framework will serve as a guide to the OECD for the planning and implementation of a coherent, long-term strategy for assessments and indicators of key competencies among young people and adults. The DeSeCo framework could also find much wider application in the development of education and training programs for all stages of lifelong learning.

Brief description of the framework/model:

The DeSeCo Project's conceptual framework for key competencies classifies such competencies in three broad categories (Figure 3). First, individuals need to be able to use a wide range of tools for interacting effectively with the environment: both physical ones such as information technology and socio-cultural ones such as the use of language. They need to understand such tools well enough to adapt them for their own purposes – to use tools interactively. Second, in an increasingly interdependent world, individuals need to be able to engage with others, and since they will encounter people from a range of backgrounds, it is important that they are able to interact in heterogeneous groups. Third, individuals need to be able to take responsibility for managing their own lives, situate their lives in the broader social context and act autonomously. These categories, each with a specific focus, are interrelated, and collectively form a basis for identifying and mapping key competencies. The need for individuals to think and act reflectively is central to

this framework of competencies. Reflectiveness involves not just the ability to apply routinely a formula or method for confronting a situation, but also the ability to deal with change, learn from experience and think and act with a critical stance.

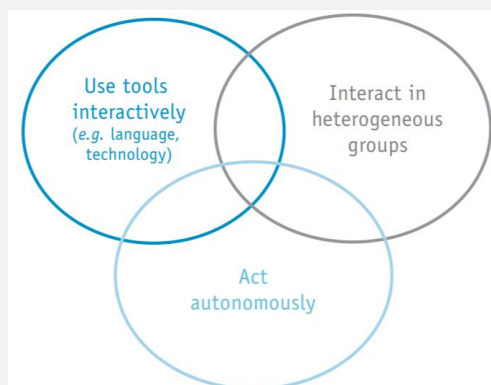


Figure 3: DeSeCo three broad categories for key competencies (www.iste.org)

Each category was analysed under the questions “why” and “what competencies”:

- Competency Category 1: Using Tools Interactively

Why:

- The need to keep up to date with technologies
- The need to adapt tools to own purposes
- The need to conduct active dialogue with the world

What competencies:

- Use language, symbols and texts interactively
- Use knowledge and information interactively
- Use technology interactively

- Competency Category 2: Interacting in Heterogeneous Groups

Why:

- The need to deal with diversity in pluralistic societies
- The importance of empathy
- The importance of social capital

What competencies

- Relate well to others
- Co-operate, work in teams
- Manage and resolve conflicts

- Competency Category 3: Acting Autonomously

Why

- The need to realise one’s identity and set goals, in complex world
- The need to exercise rights and take responsibility
- The need to understand one’s environment and its functioning

What competencies

- Act within the big picture
- Form and conduct life plans and personal projects
- Defend and assert rights, interests, limits and needs

It is worth noting that an underlying feature of DeSeCo is that key competencies involve a mobilisation of cognitive and practical skills, creative abilities and other psychosocial resources such as attitudes, motivation

and values. Despite the fact that competencies comprise more than just taught knowledge, the DeSeCo Project suggests that a competency can itself be learned within a favourable learning environment. At the centre of the framework of key competencies is the ability of individuals to think for themselves as an expression of moral and intellectual maturity, and to take responsibility for their learning and for their actions.

3.3. The Key Competences for Lifelong Learning – A European Framework

Title: The Key Competences for Lifelong Learning – A European Framework

Organisation(s): European Union

Period of work/Date published: As an Annex of a Recommendation of the European Parliament and of the Council of 18 December 2006 on key competences for lifelong learning that was published in the Official Journal of the European Union on 30 December 2006/L394. (*Note: A revised version was published in 2016*)

Terms used (in reference to transversal skills): Key competences for Lifelong Learning

Terms used in reference to the conceptual framework: competence, knowledge, skills, attitudes

References: http://eur-lex.europa.eu/LexUriServ/site/en/oj/2006/l_394/l_39420061230en00100018.pdf

Brief description of the project:

The European reference framework is an outcome of the joint work of the European Commission and the Member States within the Education and Training 2010 Work Programme. This framework aims on one hand at identifying and defining the key competences that are necessary in the knowledge society; on the other hand, it aims at providing a European-level reference for supporting Member States' efforts towards ensuring the development of these key competences across all age groups. The Reference Framework sets out eight key competences:

- Communication in the mother tongue
- Communication in foreign languages
- Mathematical competence and basic competences in science and technology
- Digital competence
- Learning to learn
- Social and civic competences
- Sense of initiative and entrepreneurship
- Cultural awareness and expression.

Many of the competences overlap and interlock: aspects essential to one domain will support competence in another. Competence in the fundamental basic skills of language, literacy, numeracy and in information and communication technologies (ICT) is an essential foundation for learning and learning to learn supports all learning activities. There are a number of themes that are applied throughout the Reference Framework: critical thinking, creativity, initiative, problem-solving, risk assessment, decision-taking, and constructive management of feelings play a role in all eight key competences (EU, 2006).

Brief description of the framework/model:

Each one of the key competences has a short definition given before it is analysed in *Essential knowledge, Skills and Attitudes* related to this competence. The eight key competences are presented with their definition:

1. Communication in the mother tongue.

Definition: Communication in the mother tongue is the ability to express and interpret concepts, thoughts, feelings, facts and opinions in both oral and written form (listening, speaking, reading and writing), and to

interact linguistically in an appropriate and creative way in a full range of societal and cultural contexts; in education and training, work, home and leisure.

2. Communication in foreign languages.

Definition: Communication in foreign languages broadly shares the main skill dimensions of communication in the mother tongue: it is based on the ability to understand, express and interpret concepts, thoughts, feelings, facts and opinions in both oral and written form (listening, speaking, reading and writing) in an appropriate range of societal and cultural contexts (in education and training, work, home and leisure) according to one's wants or needs. Communication in foreign languages also calls for skills such as mediation and intercultural understanding. An individual's level of proficiency will vary between the four dimensions (listening, speaking, reading and writing) and between the different languages, and according to that individual's social and cultural background, environment, needs and/or interests.

3. Mathematical competence and basic competences in science and technology.

Definition:

A. Mathematical competence is the ability to develop and apply mathematical thinking in order to solve a range of problems in everyday situations. Building on a sound mastery of numeracy, the emphasis is on process and activity, as well as knowledge. Mathematical competence involves, to different degrees, the ability and willingness to use mathematical modes of thought (logical and spatial thinking) and presentation (formulas, models, constructs, graphs, charts).

B. Competence in science refers to the ability and willingness to use the body of knowledge and methodology employed to explain the natural world, in order to identify questions and to draw evidence-based conclusions. Competence in technology is viewed as the application of that knowledge and methodology in response to perceived human wants or needs. Competence in science and technology involves an understanding of the changes caused by human activity and responsibility as an individual citizen.

4. Digital competence

Definition: Digital competence involves the confident and critical use of Information Society Technology (IST) for work, leisure and communication. It is underpinned by basic skills in ICT: the use of computers to retrieve, assess, store, produce, present and exchange information, and to communicate and participate in collaborative networks via the Internet.

5. Learning to learn

Definition: 'Learning to learn' is the ability to pursue and persist in learning, to organise one's own learning, including through effective management of time and information, both individually and in groups. This competence includes awareness of one's learning process and needs, identifying available opportunities, and the ability to overcome obstacles in order to learn successfully. This competence means gaining, processing and assimilating new knowledge and skills as well as seeking and making use of guidance. Learning to learn engages learners to build on prior learning and life experiences in order to use and apply knowledge and skills in a variety of contexts: at home, at work, in education and training. Motivation and confidence are crucial to an individual's competence.

6. Social and civic competences

Definition: These include personal, interpersonal and intercultural competence and cover all forms of behaviour that equip individuals to participate in an effective and constructive way in social and working life, and particularly in increasingly diverse societies, and to resolve conflict where necessary. Civic competence equips individuals to fully participate in civic life, based on knowledge of social and political concepts and structures and a commitment to active and democratic participation.

7. Sense of initiative and entrepreneurship

Definition: Sense of initiative and entrepreneurship refers to an individual's ability to turn ideas into action. It includes creativity, innovation and risk-taking, as well as the ability to plan and manage projects in order

to achieve objectives. This supports individuals, not only in their everyday lives at home and in society, but also in the workplace in being aware of the context of their work and being able to seize opportunities, and is a foundation for more specific skills and knowledge needed by those establishing or contributing to social or commercial activity. This should include awareness of ethical values and promote good governance.

8. Cultural awareness and expression

Definition: Appreciation of the importance of the creative expression of ideas, experiences and emotions in a range of media, including music, performing arts, literature, and the visual arts.

3.4. P21's Framework for 21st Century Learning (P21)

Title: P21's Framework for 21st Century Learning (P21)

Organisation(s): The Partnership for 21st Century Skills

Period of work/Date published: started in 2002 and still on, framework published 2007

Terms used (in reference to transversal skills): 21st century skills

Terms used in reference to the conceptual framework: skills, knowledge, expertise, student outcomes, support systems

References: www.21stcenturyskills.org, www.p21.org/Framework

Brief description of the project:

The Partnership for 21st Century Skills (P21) developed in the US with the goal of positioning 21st century competences at the centre of K12 education under a vision for student success in the new global economy. P21 is a national organization formed in 2001 with the sponsorship of the US government and several organizations from the private sector. P21's Framework for 21st Century Learning was developed with input from teachers, education experts, and business leaders to define and illustrate the skills and knowledge students need to succeed in work, life and citizenship, as well as the support systems necessary for 21st century learning outcomes.

Brief description of the framework/model:

P21 partnership has developed a unified, collective vision for learning known as the Framework for 21st Century Learning, to help practitioners integrate skills into the teaching of core academic subjects. According to P21 (2007), this Framework describes the skills, knowledge and expertise students must master to succeed in work and life; it is a blend of content knowledge, specific skills, expertise and literacies. Every 21st century skills implementation requires the development of core academic subject knowledge and understanding among all students. Those who can think critically and communicate effectively must build on a base of core academic subject knowledge. Within the context of core knowledge instruction, students must also learn the essential skills for success in today's world, such as critical thinking, problem solving, communication and collaboration. When a school or district builds on this foundation, combining the entire Framework with the necessary support systems—standards, assessments, curriculum and instruction, professional development and learning environments—students are more engaged in the learning process and graduate better prepared to thrive in today's global economy.

The elements described as “21st century student outcomes” (represented by the rainbow in Figure 4) are the skills, knowledge and expertise students should master to succeed in work and life in the 21st century. These include:

- *Core Subjects and 21st Century Themes*

Mastery of core subjects and 21st century themes is essential to student success. Core subjects include English, reading or language arts, world languages, arts, mathematics, economics, science, geography, history, government and civics. In addition, schools must promote an understanding of academic content at much

higher levels by weaving 21st century interdisciplinary themes into core subjects (Global Awareness; Financial, Economic, Business and Entrepreneurial Literacy; Civic Literacy; Health Literacy; Environmental Literacy).

- *Learning and innovation skills (4Cs)*

These are the skills that separate students who are prepared for increasingly complex life and work environments in today's world and those who are not. They include: **Creativity and Innovation; Critical Thinking and Problem Solving; Communication and Collaboration.**

- *Information, Media and Technology Skills*

In today's technology and media-driven environment, marked by access to an abundance of information, rapid changes in technology tools and the ability to collaborate and make individual contributions on an unprecedented scale, effective citizens and workers must be able to exhibit a range of functional and critical thinking skills, such as: Information Literacy; Media Literacy; ICT (Information, Communications and Technology) Literacy.

- *Life and Career Skills*

Today's life and work environments require far more than thinking skills and content knowledge. The ability to navigate the complex life and work environments in the globally competitive information age requires students to pay rigorous attention to developing adequate life and career skills, such as: Flexibility and Adaptability; Initiative and Self-Direction; Social and Cross-Cultural Skills; Productivity and Accountability; Leadership and Responsibility.

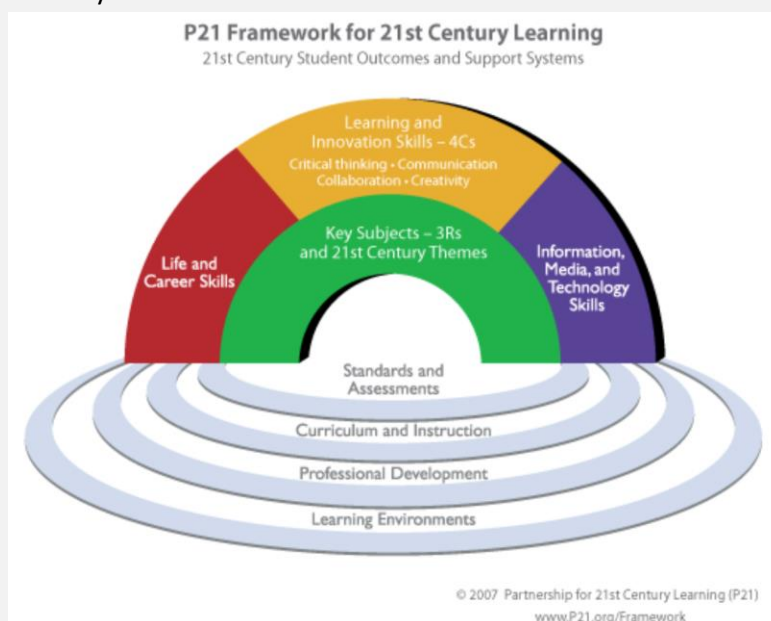


Figure 4: P21 for 21st Century Learning - 21st Century Student Outcomes and Support Systems
(www.p21.org/Framework)

Developing a comprehensive framework for 21st century learning requires more than identifying specific skills, content knowledge, expertise and literacies. An innovative support system must be created to help students master the multi-dimensional abilities that will be required of them. The Partnership has identified five critical support systems to ensure student mastery of 21st century skills:

- 21st Century Standards
- Assessments of 21st Century Skills
- 21st Century Curriculum and Instruction
- 21st Century Professional Development
- 21st Century Learning Environments

The P21 partnership published the *Assessment: A 21st Century Skills Implementation Guide*, in order to ensure that P21 support systems are aligned to produce 21st century outcomes for today's students.

3.5. ISTE Standards for Students

Title: ISTE standards for students

Organisation(s): International Society for Technology in Education (ISTE)

Period of work/Date published: ISTE standards for students (formerly NETS-S) was first published in 1998 and a second edition was published in 2007 as ISTE Standards-S

Terms used (in reference to transversal skills): technology standards for students

Terms used in reference to the conceptual framework: standards, categories, standard statement, performance indicators

References: www.iste.org/standards, ISTE (2007). "ISTE Standards for Students (Second Edition). USA: ISTE."

Brief description of the project:

The ISTE standards for students (ISTE Standards-S) were developed by the International Society for Technology in Education (ISTE). First published in 1998 (formerly NETS-S), they were the result of almost three years of development engaging a broad range of stakeholders. The standards defined what students needed to know and be able to do with technology. The second edition of the ISTE Standards-S focuses more on the skills and expertise and less on the technology tools themselves.

Brief description of the framework/model:

According to ISTE (2007), ISTE Standards-S identify several higher-order skills and digital citizenship as critical if we are to truly provide students the opportunity to learn effectively for a lifetime and live productively in our emerging global society and increasingly digital world. The ISTE Standards-S reflect the knowledge and skills that students need for work, life and citizenship in a digital age, global economy. The ISTE Standards-S are lofty learning goals, describing how students must leverage appropriate technologies to create, communicate, collaborate and innovate.

The technology standards for students are divided into six broad categories (Figure 5).



Figure 5: ISTE Standards for Students (www.iste.org)

A brief standard statement follows each category. The four performance indicators (a-d) for each standard provide specific outcomes to be measured:

- Creativity and Innovation

Students demonstrate creative thinking, construct knowledge, and develop innovative products and processes using technology.

- Apply existing knowledge to generate new ideas, products, or processes
- Create original works as a means of personal or group expression

- c. Use models and simulations to explore complex systems and issues
- d. Identify trends and forecast possibilities

- Communication and Collaboration

Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others.

- a. Interact, collaborate, and publish with peers, experts, or others employing a variety of digital environments and media
- b. Communicate information and ideas effectively to multiple audiences using a variety of media and formats
- c. Develop cultural understanding and global awareness by engaging with learners of other cultures
- d. Contribute to project teams to produce original works or solve problems

- Research and Information Fluency

Students apply digital tools to gather, evaluate, and use information.

- a. Plan strategies to guide inquiry
- b. Locate, organize, analyze, evaluate, synthesize, and ethically use information from a variety of sources and media
- c. Evaluate and select information sources and digital tools based on the appropriateness to specific tasks
- d. Process data and report results

- Critical Thinking, Problem Solving and Decision Making

Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.

- a. Identify and define authentic problems and significant questions for investigation
- b. Plan and manage activities to develop a solution or complete a project
- c. Collect and analyze data to identify solutions and/or make informed decisions
- d. Use multiple processes and diverse perspectives to explore alternative solutions

- Digital Citizenship

Students understand human, cultural, and societal issues related to technology and practice legal and ethical behavior.

- a. Advocate and practice safe, legal, and responsible use of information and technology
- b. Exhibit a positive attitude toward using technology that supports collaboration, learning, and productivity
- c. Demonstrate personal responsibility for lifelong learning
- d. Exhibit leadership for digital citizenship

- Technology Operations and Concepts

Students demonstrate a sound understanding of technology concepts, systems, and operations.

- a. Understand and use technology systems
- b. Select and use applications effectively and productively
- c. Troubleshoot systems and applications
- d. Transfer current knowledge to learning of new technologies

Through the ISTE standards Refresh Project, the student profiles and scenarios were introduced (ISTE, 2007). A general set of profiles describing ICT literate students at key developmental points in their precollege education (Grades PK-2, Grades 3-5, Grades 6-8 and Grades 9-12) were developed. The profiles highlight a few important types of learning activities students might engage in as the ISTE Standards-S are implemented. Furthermore, scenarios that accompany the profiles describe authentic activities that reflect not only the ISTE Standards-S but also relevant curriculum standards, underscoring the belief that technology use should not occur in isolation but as an integral part of learning across all skills and subject areas.

To ISTE, ISTE Standards are not a top-down construct. Teachers, technology coaches, other administrators and technology directors must work in concert to support the ISTE Standards-S. Student learning is at the centre of all educational efforts. Thus, ISTE Standards-T, ISTE Standards-C, and ISTE Standards-C were also published to support the ISTE Standards-S.

3.6. UNESCO ICT Competency Standards for Teachers (ICT-CST)

Title: UNESCO ICT Competency Standards for Teachers (ICT-CST)

Organisation(s): UNESCO

Period of work/Date published: 2008

Terms used (in reference to transversal skills): ICT Competency Standards (for teachers)

Terms used in reference to the conceptual framework: education system components, human capacity development approaches

References: www.unesco.org/en/competency-standards-teachers, “UNESCO (2008a). ICT COMPETENCY STANDARDS FOR TEACHERS: Policy Framework. United Kingdom: UNESCO.”, “UNESCO (2008b). ICT COMPETENCY STANDARDS FOR TEACHERS: Competency Standards Modules. United Kingdom: UNESCO.”

Brief description of the project:

UNESCO ICT competency standards for teachers (ICT-CST) is a UNESCO initiative that aims at identifying a common set of qualifications needed for the integration of ICT in teaching and learning. The framework was specifically designed to improve teachers’ practice by providing guidelines for teacher education and training with a focus on ICT competences and on emergent views in pedagogy, curriculum, and school organisation. By crossing three approaches on human capacity development (technology literacy, knowledge deepening, and knowledge creation) with six components of the educational system (policy and vision, curriculum and assessment, pedagogy, ICT, organisation and administration, and teacher professional development) a curriculum framework is created for the UNESCO ICT Competency Standards for Teachers (ICT-CST) project (UNESCO 2008a, 2008b). The second phase of the ICT-CST project involves the establishment of a UNESCO mechanism to endorse training programs for compliance with the UNESCO standards.

Brief description of the framework/model:

The three approaches on human capacity development (Figure 6) are employed along the six components of the educational system (Figure 7) to develop the ICT-CST.

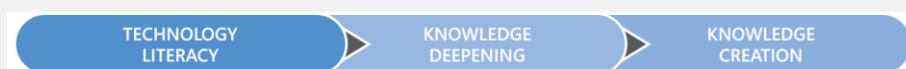


Figure 6: UNESCO three approaches on human capacity development (UNESCO, 2008)

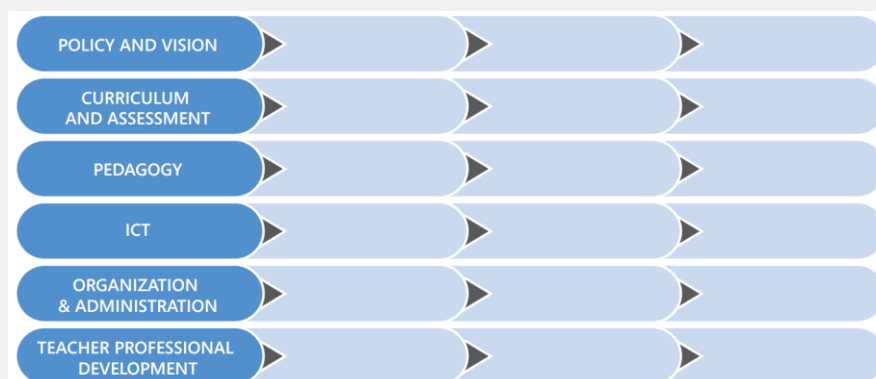


Figure 7: UNESCO six components of the educational system (UNESCO, 2008)

Together they provide a developmental trajectory by which education reform supports increasingly sophisticated ways of developing a country's economy and society: from technology uptake, to a high performance workforce, to a knowledge economy and information society (UNESCO, 2008a, 2008b):

- Increase the technological uptake of students, citizens, and the workforce by incorporating technology skills in the curriculum (Technology Literacy approach).
- Increase the ability of students, citizens, and the workforce to use knowledge to add value to society and the economy by applying it to solve complex, real-world problems (Knowledge Deepening approach).
- Increase the ability of students, citizens, and the workforce to innovate, produce new knowledge, and benefit from this new knowledge (Knowledge Creation approach).

The UNESCO ICT Competency Standards for Teachers Matrix (Figure 8) presents this interrelation of the three approaches and the six components. Each of the cells of the matrix constitutes a module in the framework. Within each of these modules, there are specific curricular goals and teacher skills. A description of detailed teacher competencies, objectives, and methods for each module is provided.

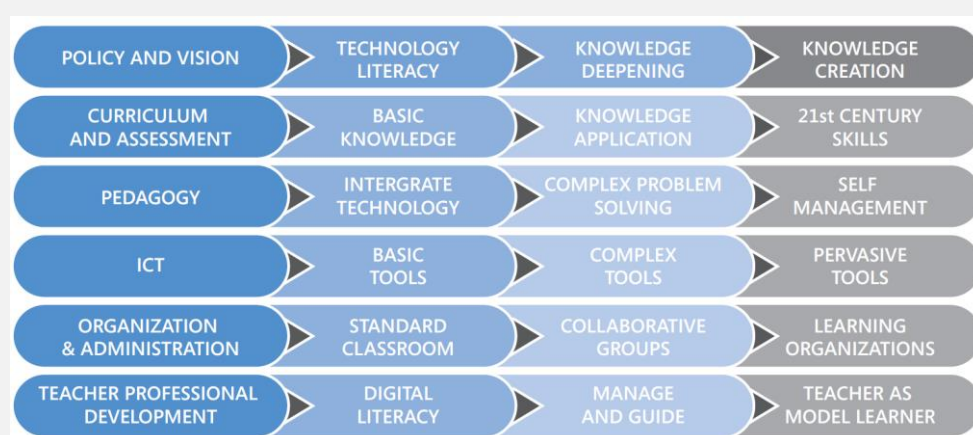


Figure 8: UNESCO ICT Competency Standards for Teachers Matrix (UNESCO, 2008)

3.7. Innovative Teaching and Learning Research Project (ITL) and 21st Century Learning Design (21CLD)

Title: Innovative Teaching and Learning Research Project (ITL) and 21st Century Learning Design (21CLD)

Organisation(s): Microsoft Partners in Learning, SRI International

Period of work/Date published: 2010

Terms used (in reference to transversal skills): 21st century skills

Terms used in reference to the conceptual framework: dimensions, activities, skills, definitions, rubrics

References: www.itlresearch.com, "Shear, L., Novais, G., Means, B., Gallagher, L. & Langworthy, M. (2010a). ITL Research Design. Menlo Park, CA: SRI International.", "Shear, L., Novais, G., & Moorthy, S. (2010b). Innovative Teaching and Learning Research: Executive Summary of Pilot Year Findings. Seattle: Microsoft Partners in Learning."

Brief description of the project:

Innovative Teaching and Learning (ITL) research on using the 21st Century Skill Rubrics along with the most effective models of professional development is an initiative sponsored by Microsoft Partners in Learning in collaboration with SRI International, namely the 21st Century Learning Design program (21CLD). Educators globally are working to design new models of learning that better prepare learners for life and work in the

21st Century. The purpose of the 21st Century Learning Design rubrics is to help educators identify and understand the opportunities that learning activities give students to build 21st century skills.

The 21st Century Skill Rubrics focus on the degree to which learning activities provide opportunities for students to develop 21st century skills and the degree to which student work exhibits these skills. Building on prior programs of research, these rubrics were initially developed for the evaluation of Microsoft's Innovative Schools Programme, an international programme for school reform, as a way to characterise 21st century teaching and learning consistently across subject areas and national contexts. In school reform programs that often seek to increase use of ICT by teachers and students, these dimensions offer a way to contextualise ICT use within the broader goal of a coherent program of student-centered instruction. The rubrics have been further developed through the Innovative Teaching and Learning (ITL) Research, which investigates the factors that support innovative teaching practices and the learning outcomes that result across a wide range of country contexts.

Brief description of the framework/model:

Two types of rubrics were developed. Rubrics for coding learning activities describe the 21st century learning opportunities offered by each learning activity, while rubrics for coding student work describe the 21st century skills that students exhibit in the work they do. These rubrics deconstruct the broad concepts of "21st century learning opportunities" and "21st century skills" into component dimensions that direct attention to specific attributes of learning activities and student work. Learning activities are coded on five dimensions: collaboration, knowledge building, problem-solving and innovation, use of ICT for learning, and self-regulation. Student work is coded on four similar dimensions: knowledge building, problem-solving and innovation, use of ICT for learning, and skilled communication. Each dimension is accompanied by detailed definitions and a 4-point rubric to describe the varying depth with which the skill is called for (in learning activities) or exhibited (in student work) (SRI, 2010).

For each dimension, definitions and rubrics are intended to distinguish clearly between learning activities that begin to provide basic opportunities for students to learn related skills and those that are structured so that students exercise the skill deeply.

The dimensions of 21st Century Teaching and Learning are described as follows:

- *Collaboration*: Students work together in groups, share responsibility for the work they do together, and produce a joint work product that requires them to negotiate and make substantive decisions together
- *Knowledge Building*: Students move beyond the reproduction of information to construct knowledge that is new to them. At higher levels, the knowledge they build is integrated across traditional academic disciplines.
- *Problem-Solving and Innovation*: Students solve problems for which there is no previously learned solution, make choices in their approach, and implement their solutions in the real world.
- *Use of ICT for Learning*: Students use ICT to construct knowledge, and their use of ICT provides new learning opportunities, enabling them to learn something that they could not have learned without it.
- *Self-Regulation*: Students plan and monitor their work and make revisions based on feedback or self-assessment.
- *Skilled Communication*: Students present their ideas in ways that are clear and compelling, and present sufficient relevant evidence on a topic or theme.

For each dimension, the teacher is guided to determine how strongly the student work demonstrates the related skill. Each dimension has the same structure:

- An overview introduces key concepts for that dimension.
- "Big ideas" define important attributes of the student work for each dimension.
- A rubric uses the big ideas to help the teacher assign a number from 1 to 4, according to how strongly the student work demonstrates the given skill.
- A flowchart shows how to choose the best number in each case.

3.8. Assessment and Teaching of 21st Century Skills (ATC21S)

Title: Assessment and Teaching of 21st Century Skills (ATC21S) and the KSAVE model

Organisation(s): Cisco, Intel and Microsoft, in joining forces with six national governments, an academic partnership with the University of Melbourne, and an advisory panel

Period of work/Date published: launched in 2009, published in 2012

Terms used (in reference to transversal skills): Twenty first century skills

Terms used in reference to the conceptual framework: categories, skills, KSAVE model

References: www.atc21s.org, "Griffin, P., Care, E. & McGaw, B. (2012). The Changing Role of Education and Schools. In P. Griffin, E. Care, & B. McGaw (Eds), Assessment and Teaching of 21st Century Skills. London: Springer."

Brief description of the project:

The ATC21S project define twenty first century skills as any skills that are essential for navigating the twenty-first century. These skills do not need to be new, but rather skills that are needed in the twenty first century, with essential new skills to emerge (Griffin et al., 2012). The project derived from the need, especially in developed economies, of major employers for skills demand jobs and deficiencies in these skills in new recruits in their workforces. Three major technology companies, Cisco, Intel and Microsoft, sponsored the ATC21S project, in joining forces with six national governments (Australia, Finland, Portugal, Singapore, England and USA), an academic partnership with the University of Melbourne, and an advisory panel (with representatives from OECD, IEA, UNESCO, the World Bank, the Inter-American Development Bank, the National Academy of Sciences and the International Test Commission). The multi-year project was launched in 2009 and aimed to define the skills required in operational terms, taking also into consideration teaching and learning needs from classroom practice.

Brief description of the framework/model:

According to Binkley et al. (2102) ATC21S provides a list of twenty first century skills based on an analysis of twelve relevant frameworks. To structure the analysis of twenty first century skills frameworks, an overall conceptual diagramme was created, defining ten skills grouped into four categories (Figure 9):

Ways of thinking

1. Creativity and innovation
2. Critical thinking, problem solving, decision making
3. Learning to learn, Metacognition

Ways of working

4. Communication
5. Collaboration (teamwork)

Tools for working

6. Information literacy
7. ICT literacy

Living in the world

8. Citizenship – local and global
9. Life and career
10. Personal and social responsibility – including cultural awareness and competences

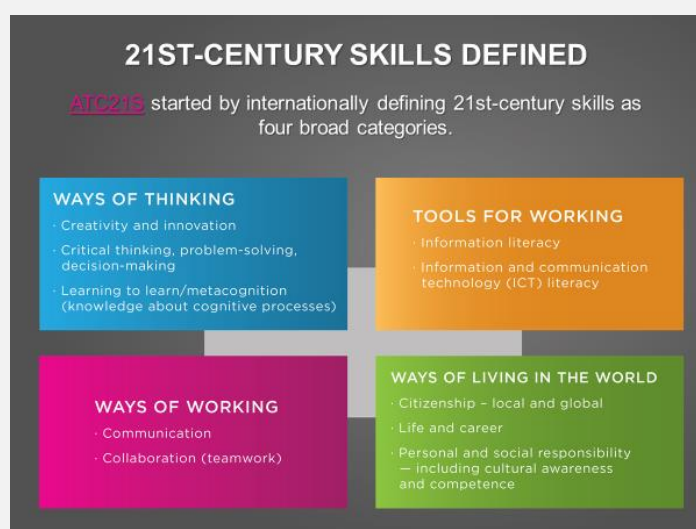


Figure 9: The four broad categories defined for the ATC21S ten 21st-century skills (www.atc21s.org)

The KSAVE model was developed, where three categories were designed in order to approach each skill from different approaches: **Knowledge**, **Skills**, and **Attitudes, Values, and Ethics**.

The *Knowledge* category includes all references to specific knowledge or understanding requirements for each of the ten skills.

The *Skills* category includes the abilities, skills, and processes that curriculum frameworks are designed to develop in students and which are a focus for learning.

Attitudes, Values, and Ethics category refers to the behaviors and aptitudes that students exhibit in relation to each of the ten skills.

3.9. NAEP Technology and Engineering Literacy (TEL) Assessment

Title: NAEP Technology and Engineering Literacy (TEL) Assessment

Organisation(s): The National Assessment of Educational Progress (NAEP)

Period of work/Date published: 2014

Terms used (in reference to transversal skills): Technology and engineering literacy

Terms used in reference to the conceptual framework: areas, sub-areas, assessment objectives, practices and contexts, achievement level definitions

References: www.nationsreportcard.gov/tel_2014, “National Assessment Governing Board (2014). Technology and Engineering Literacy Framework for the 2014 NATIONAL ASSESSMENT OF EDUCATIONAL PROGRESS - 2014 Abridged. United States: National Assessment Governing Board.”

Brief description of the project:

The Technology and Engineering Literacy Framework (TEL) was developed by WestEd for the 2014 National Assessment of Educational Progress (NAEP) at request of the National Assessment Governing Board of the US. The goal of this framework is to establish what students should know about and be able to do with technology. Students needed to demonstrate the wide range of knowledge and skills detailed in the three TEL assessment areas and they were asked to perform a variety of problem-solving tasks based on interactive scenarios reflecting realistic solutions. It included three content areas (Technology and Society, Design and Systems, Information and Communication Technology) and three practices (Understanding Technological Principles, Developing Solutions and Achieving Goals, Communicating and Collaborating) (Figure 10).

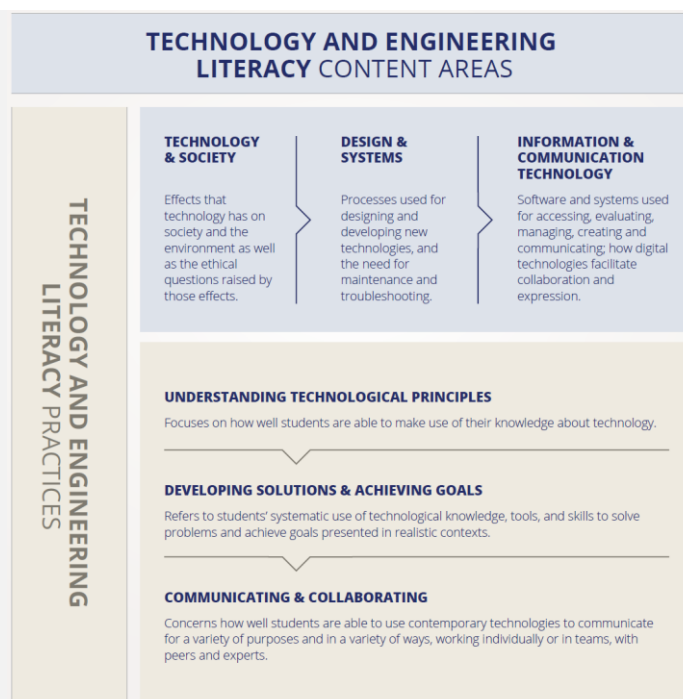


Figure 10: The Technology and Engineering Literacy assessment evaluation of students' knowledge in three content areas and across three practices. (www.nationsreportcard.gov/tel_2014)

Brief description of the framework/model:

The assessment objectives are organized into three major interconnected areas: (1) Technology and Society; (2) Design and Systems; and (3) Information and Communication Technology (NAGB, 2014). Each broad category is further broken down into discrete areas (sub-areas) to be assessed. The interconnected relationship among these three major assessment areas can be illustrated as a threesided pyramid in which each side supports the other two (Figure 11).

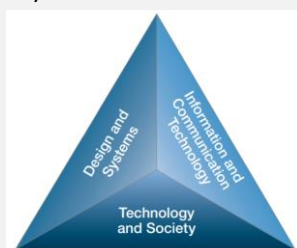


Figure 11: The Three Areas of Technology and Engineering Literacy (www.nationsreportcard.gov/tel_2014)

The *Technology and Society* area deals with the effects that technology has on society and on the natural world and with the sorts of ethical questions that arise from those effects. The four sub-areas in which students are assessed include:

- A. Interaction of Technology and Humans
- B. Effects of Technology on the Natural World
- C. Effects of Technology on the World of Information and Knowledge
- D. Ethics, Equity, and Responsibility

Design and Systems area covers the nature of technology, the engineering design process by which technologies are developed, and basic principles of dealing with everyday technologies, including maintenance and troubleshooting. The four sub-areas in which students are assessed include:

- A. Nature of Technology
- B. Engineering Design
- C. Systems Thinking
- D. Maintenance and Troubleshooting

Information and Communication Technology area includes computers and software learning tools, networking systems and protocols, hand-held digital devices, and other technologies for accessing, creating, and communicating information and for facilitating creative expression. The five sub-areas in which students are assessed include:

- A. Construction and Exchange of Ideas and Solutions
- B. Information Research
- C. Investigation of Problems
- D. Acknowledgement of Ideas and Information
- E. Selection and Use of Digital Tools

Although these elements are central to the design of the NAEP Technology and Engineering Literacy Assessment, they are not sufficient to describe the kinds of reasoning to be expected from students, the context or subject matter that will be used to construct test items, or the overall shape of the entire assessment. The assessment targets and the sub-areas within each describing what students should be able to do foreshadow the cross-cutting practices—ways of thinking and reasoning—for which the TEL is designed.

In all three areas of technology and engineering literacy, students are expected to be able to apply particular ways of thinking and reasoning when approaching a problem. These types of thinking and reasoning are referred to as "practices." The framework specifies three kinds of practices that students are expected to demonstrate when responding to test questions: (1) Understanding Technological Principles; (2) Developing Solutions and Achieving Goals; and (3) Communicating and Collaborating (Figure 12).

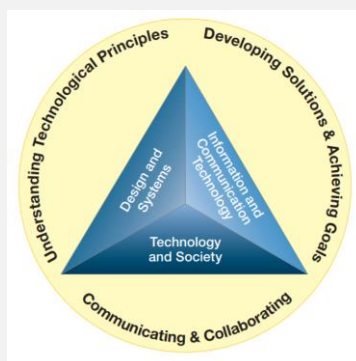


Figure 12: "Practices" for Technology and Engineering Literacy (www.nationsreportcard.gov/tel_2014)

Understanding Technological Principles focuses on students' knowledge and understanding of technology and their capability to think and reason with that knowledge. *Developing Solutions and Achieving Goals* refers to students' systematic application of technological knowledge, tools, and skills to address problems and achieve goals presented in societal, design, curriculum, and realistic contexts. *Communicating and Collaborating* centers on students' capabilities to use contemporary technologies to communicate for a variety of purposes and in a variety of ways, working individually or in teams.

As crucial to the assessment as the *practices* are the "contexts"—the situations and types of problems in which assessment tasks and items will be set. The *practices* expected of students are general, cross-cutting reasoning processes that students must use in order to show that they understand and can use their technological knowledge and skills. The *contexts* in which technology and engineering literacy tasks and items appear will include typical issues, problems, and goals that students might encounter in school or practical situations. Together, the assessment targets, practices, and contexts provide a structure for the generation of tasks and items (Figure 13).

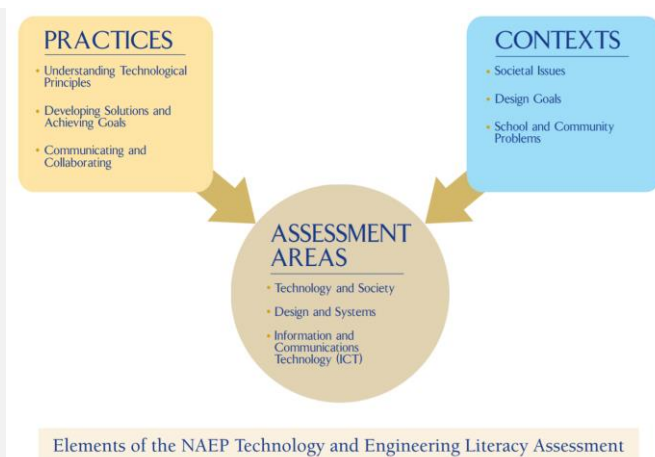


Figure 13: Practices and Contexts for Technology and Engineering Literacy (www.nationsreportcard.gov/tel_2014)

Preliminary achievement level definitions (*Basic*, *Proficient*, and *Advanced*) have been developed for each of the three areas to be reported separately in the assessment and they will be used to guide item development and initial stages of standard setting for the 2014 NAEP Technology and Engineering Literacy Assessment.

Technology and Engineering Literacy marks the next generation of assessments for NAEP as it is completely digitally based and includes interactive scenario-based tasks.

3.10. DIGCOMP: A Framework for Developing and Understanding Digital Competence in Europe

Title: DIGCOMP: A Framework for Developing and Understanding Digital Competence in Europe

Organisation(s): European Commission, Joint Research Centre, Institute for Prospective Technological Studies

Period of work/Date published: 2013 (Note: “DigComp 2.0: The Digital Competence Framework for Citizens. Update Phase 1: The Conceptual Reference Model” and “DigComp 2.1: The Digital Competence Framework for Citizens” were published in 2016 and 2017 respectively)

Terms used (in reference to transversal skills): Digital competence

Terms used in reference to the conceptual framework: competence, dimensions, descriptors, knowledge, skills, attitudes

References: “Ferrari, A. (author), & Punie, Y., & Brečko, N. B. (eds) (2013): DIGCOMP: A Framework for Developing and Understanding Digital Competence in Europe. Luxembourg: JRC, European Union.”

Brief description of the project:

“DIGCOMP: A Framework for Developing and Understanding Digital Competence in Europe” was published in 2013 by the European Commission Joint Research Centre (JRC). It presents a detailed framework for the development of digital competence of all citizens. The framework is the output of a wide stakeholder consultation. It consists of detailed descriptions of all competences that are necessary to be proficient in digital environments and describes them in terms of knowledge, skills, and attitudes. Three proficiency levels are suggested for each competence. The report also provides a self-assessment grid for mapping digital competence levels.

Brief description of the framework/model:

As described in the DIGCOMP report (2013), the shell of the DIGCOMP framework is structured in five dimensions. These dimensions reflect a different aspect of the descriptors and a different stage of granularity:

- Dimension 1: **competence areas** that have been identified
- Dimension 2: **competences** that are pertinent to each area
- Dimension 3: **proficiency levels** that are foreseen for each competence
- Dimension 4: **examples of the knowledge, skills and attitudes** applicable to each competence (examples are not differentiated in proficiency levels)
- Dimension 5: Examples on the applicability of the competence to different **purposes**. Within this report, examples for Learning and Employment are provided. Other dimensions that can be considered are: Leisure; Social; Buying and Selling; Learning; Employment; Citizenship; Well-being.

The areas of digital competence can be summarised as follows:

- *Information*: identify, locate, retrieve, store, organise and analyse digital information, judging its relevance and purpose.
- *Communication*: communicate in digital environments, share resources through online tools, link with others and collaborate through digital tools, interact with and participate in communities and networks, cross-cultural awareness.
- *Content-creation*: Create and edit new content (from word processing to images and video); integrate and re-elaborate previous knowledge and content; produce creative expressions, media outputs and programming; deal with and apply intellectual property rights and licences.
- *Safety*: personal protection, data protection, digital identity protection, security measures, safe and sustainable use.
- *Problem-solving*: identify digital needs and resources, make informed decisions as to which are the most appropriate digital tools according to the purpose or need, solve conceptual problems through digital means, creatively use technologies, solve technical problems, update one's own and others' competence.

Areas 1, 2 and 3 are rather linear while areas 4 and 5 are more transversal. This means that while areas 1 to 3 deal with competences that can be re-traced in terms of specific activities and uses, areas 4 and 5 apply to any type of activity that is been carried out through digital means. This does not mean that areas 1, 2, and 3 are not inter-related. Although each area has its own specificity, there are several forced overlapping points and cross-references to other areas.

For each of the above competence areas, a series of related competences has been identified. Competences in each area vary in number from a minimum of 3 to a maximum of 6. Competences are numbered, however the progression does not refer to a different degree of attainment (proficiency levels are foreseen in Dimension 3). The first competence in each area is always the one that includes more technical aspects: in these specific competences, the knowledge, skills and attitudes have operational processes as a dominant component. However, technical and operational skills are also and embedded in each competence.

The self-assessment grid consists of 5 areas of digital competence and three proficiency levels, going from A (foundation level), to B (intermediate level) to C (advanced level). According to the description of the areas, three proficiency levels were developed for each area.

3.11. Key Skills of Junior Cycle - Framework for Junior Cycle

Title: Key Skills of Junior Cycle - Framework for Junior Cycle

Organisation(s): Department of Education and Skills, National Council for Curriculum and Assessment (NCCA)

Period of work/Date published: The first “Key Skills of Junior Cycle” was published in 2014 by NCCA and in 2015 the updated “Framework for Junior Cycle” by the Department of Education and Skills.

Terms used (in reference to transversal skills): Key skills

Terms used in reference to the conceptual framework: principles, statement, skills, elements

References: www.ncca.ie/en/junior-cycle

Brief description of the project:

The first description of *Key Skills of Junior Cycle* developed for the Department of Education and Skills in Ireland for the needs of the Junior Cycle curriculum, was published in 2014 and included six key skills (Figure 14).



Figure 14: Key Skills of Junior Cycle (NCCA, 2014)

In the updated Framework for Junior Cycle, twenty-four statements, underpinned by eight principles, are central to planning for, the students' experience of, and the evaluation of the school's junior cycle programme. Schools will ensure that all statements of learning, along with eight key skills feature in the programmes offered to their junior cycle students. The detailed learning outcomes will be clearly set out in subject and short course specifications (DES, 2015).



Figure 15: Key Skills and their elements (Department of Education and Skills, 2015)

Brief description of the framework/model:

In 2015 the *Framework for Junior Cycle*, includes eight key skills required for successful learning by students across the curriculum and for learning beyond school analysed in 46 elements (Figure 15). The key skills are named and explained in language that students can access and understand. This will help them to take greater responsibility for their learning. The key skills will be embedded in the learning outcomes of every junior cycle subject and short course. Thus, teachers will have a clear understanding of how they fit into a subject, short course or priority learning unit and how to build the skills into class planning.

3.12. Summary

From the analysis of the above frameworks, it is evident that there is a lot of research and developmental work done on the area of “emerging skills”. Skills, that societies, education institutions, research organisations, industry consider as important for the citizens of the digital era and the 21st century. It is clear though, that more work is needed if we want to reach a common “conceptual framework” that will allow us to approach transversal skills in a comparative model. Terminology used, clustering of skills, structure, level of analysis, nature and content of descriptors are some examples of the different approaches that one can encounter in such a study. Even though, the essence of 21st -century skills is the emphasis on what students can do with knowledge rather than what units of knowledge they have (Silva, 2009), there are hundreds of descriptors of the skill set, including life skills, workforce skills, interpersonal skills, applied skills, and non-cognitive skills, while even more definitions exist for the individual skills that fall under the broader category of 21st -century skills. This is not surprising when considering the different purposes of the various frameworks, the different stakeholders involved, the different needs in different contexts. Comparing descriptions of qualifications across Europe, it is clear that there is a diversity of approaches regarding sources, degree of detail, form and structure (European Union, 2011). The study(2015) also indicates that there is a lack of uniformity in the definition of transversal competencies within and across countries of the Asia-Pacific region, with country-level definitions formed with reference to the social values and political structures particular to each country.

At the same time there are also similarities that enable us to build on. For example, through the above review, we can see a convergence towards an agreement that systemic factors are critical for a framework to have a successful implementation, including teacher training and school support. Furthermore, it seems that through the continuous progress of the process analysis that various partnerships go through, common “themes”, “skills”, “principles” are revealed as underlying elements in the whole structure of the frameworks.

An example of a comparative analysis of various frameworks for 21st century skills, is the one of Voogt and Roblin (2010), presenting differences and similarities on the identification of skills among the various frameworks they studied (Table 2).

Table 2: Similarities and differences between frameworks for 21st century skills (Voogt and Pareja Roblin, 2010)

Mentioned in <i>all</i> frameworks	Mentioned in <i>most</i> frameworks (i.e., P21, EnGauge, ATCS and NETS/ISTE)	Mentioned in a <i>few</i> frameworks	Mentioned only in <i>one</i> framework
<ul style="list-style-type: none"> - Collaboration - Communication - ICT literacy - Social and/or cultural skills; citizenship 	<ul style="list-style-type: none"> - Creativity - Critical thinking - Problem solving - Develop quality products / Productivity (except in ATCS) 	<ul style="list-style-type: none"> - Learning to learn (ATCS, EU) - Self-direction (P21, En Gauge, OECD) - Planning (En Gauge, OECD) - Flexibility and adaptability (P21, EnGauge) <p>Core Subjects:</p> <ul style="list-style-type: none"> - Mathematics; communication in mother tongue; science (EU, P21, ATCS); - History and arts (P21 and ATCS) 	<ul style="list-style-type: none"> - Risk taking (En Gauge) - Manage and solve conflicts (OECD) - Sense of initiative and entrepreneurship (EU) - Interdisciplinary themes (P21) - Core Subjects: economics; geography; government and civics (P21)

As we can see in this table, there is a number of common skills identified in all or most frameworks as important skills for the 21st century. As these skills might be changing according to the purpose and the context of a framework, or might be arranged into different clusters or structure in a framework, what is important is to provide a strong “conceptual model” behind the framework to host them, which can be adaptable and flexible to various situations without jeopardizing the quality of its content.

11. Development and Assessment of Transversal Skills

It is evident from this literature review that education systems realise the potential and challenges of today's digital and global world and that they are undergoing a process to find ways to support young people to develop the knowledge, skills and values they need to live and work in such an environment. While students can't develop and use skills without a core body of knowledge, they must emphasise higher order thinking and problem solving if they are to ultimately learn how to learn for themselves (Silva, 2009).

The combination of teaching a rich body of knowledge and providing engaging opportunities to apply this knowledge is a challenge for teachers. New teaching and learning approaches are needed in order to address transversal competencies, which demand a change of teachers' role, from transmitters of knowledge to facilitators of learning.

The alignment between learning outcomes, teaching, learning and assessment helps to make the overall learning experience more coherent, transparent and meaningful for learners (European Union, 2011). It seems though that while teachers are slowly up-taking the challenge to teach and facilitate the learning of transversal competencies, confidence and motivation is influenced by an over-emphasis in the school culture on good examination results in traditional academic subjects, and by teachers being overwhelmed by work demands. (UNESCO, 2015)

In recent years, new international surveys have for the first time been measuring directly the degree to which young people and adults have the knowledge and skills that they need in order to face life's challenges (OECD, 2005). These surveys are also introducing into their planning and implementation a coherent, long-term strategy for assessments and indicators of transversal competencies among young people and adults.

Education systems are still in must reform to accommodate, facilitate and develop 21st century learning, teaching, assessment and skills (Griffin et al., 2012). It is clear that development of transversal skills calls not only for new teaching approaches but also and equally important for innovative assessment methods. The ATS2020 learning and assessment model, proposes a comprehensive learning model to enhance transversal, 21st century indispensable student skills, within the diverse EU national curricula, including provision of teachers with modern approaches and innovative tools for the assessment of these skills. ATS2020 extends and builds on existing models, elaborating learning as both process and product. It introduces a web of learning activities leading to learning outcomes, supported by technological and scaffolding tools, extended and redesigned. Evidence of learning is collected using an ePortfolio three-level developmental process - repository, workspace and showcase (Abrami and Barrett, 2005) with an embedded continuous reflection cycle of "My Learning" (Eufolio, 2014). Teachers and students collaborate and make evidence-based decisions while (re)designing instruction and learning.

The ATS2020 transversal skills framework will be developed, with the aim to support the ATS2020 learning and assessment model and to guide the assessment of transversal skills being developed. As there are significant differences in the ways that skills are clustered in different frameworks, as well as in the nature and content of their descriptions, the ATS2020 partnership will work towards a new organisational approach of the skills to be under focus its experimentation that would satisfy more the educational context of the partner countries.

12. Conclusions

The ongoing development of conceptual frameworks and models on transversal skills, as well as the ongoing discussions on teaching, learning and assessing such skills, will continuously enrich education systems in their effort of opening up and take advantage of the full potential that digital technologies can offer to the people's personal, social and professional lives. The review of the related literature and frameworks revealed a

plurality of terminologies and descriptors of transversal skills, as well as different schemes and clusters for such a broad area of skills, pointing to the need that more work is still needed to reach common approaches that will enable better discussions, understanding and policy decisions in this field, among researchers, practitioners and policy makers.

At the same time, the study of these frameworks pointed out the need to take into consideration systemic factors as critical factors, when developing or employing transversal skills frameworks, such as teacher professional development, school and education system, curriculum, tools and resources.

The ATS2020 transversal skills to be developed in order to identify and describe the transversal skills for the learning and assessment model experimentation, will be largely based on the work of existing frameworks and will be using existing terminologies and descriptors. An effort will be given for the framework to be flexible and adaptable to the needs of the countries and different learning contexts to be employed, meaning that it will provide a strong “conceptual structure” that will enable new content to be embedded as needed in high quality standards.

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