

A comparative analysis of international frameworks for 21st century competences: Implications for national curriculum policies

JOKE VOOGT and NATALIE PAREJA ROBLIN

National curricula need to change drastically to comply with the competences needed for the 21st century. In this paper eight frameworks describing 21st century competences were analysed. A comprehensive search for information about 21st century competences was conducted across the official websites of the selected frameworks, resulting in 32 documents that were analysed in detail. Travers and Westbury's framework of curriculum representations was used to determine horizontal and vertical consistency between the frameworks. The frameworks were compared on their underlying rationales and goals, their definition of 21st century competences, and the recommended strategies for the implementation and assessment of these skills in educational practice. In addition three international studies were examined to analyse how various countries (EU member states, OECD countries) and schools (SITES studies) deal (or not) with 21st century competences. The findings indicate a large extent of alignment between the frameworks about what 21st century competences are and why they are important (horizontal consistency), but intentions and practice seemed still far apart, indicating lack of vertical consistency. The implications of the implementation of 21st century competences in national curriculum policies are discussed and recommendations are provided.

Keywords: knowledge society; curriculum; 21st century competences; implementation; assessment.

Introduction

The globalization and internationalization of economy along with the rapid development of information and communication technologies (ICT) are continuously transforming the way in which we live, work, and learn. The present society is by many characterized as a knowledge society (e.g. Anderson 2008, Dede 2010b, Halász and Michel 2011), which, according to Anderson (2008), refers to a society in which ideas and knowledge

Joke Voogt is an associate professor at the Department of Curriculum Development and Educational Innovation, University of Twente, PO Box 217, 7500AE Enschede, The Netherlands; e-mail: j.m.voogt@utwente.nl. Her research interests are in curriculum development and innovation in national and international settings. She has been editor (with G. Knezek) of the International Handbook of Information Technology in Primary and Secondary Education (New York: Springer, 2008).

Natalie Pareja Roblin is a postdoctoral researcher in the Department of Educational Studies at Ghent University. Her research interests are focused on curriculum innovation, teacher professional development, and ICT in education.

function as commodities. Notably the (potential) impact of ICT on society was already acknowledged two decades ago. For example, Reich (1992) reflected on the implications of ICT for our society, and more specifically for the types of jobs demanded by it. He mentioned that many of the jobs for routine production workers (i.e. those who perform repetitive tasks) will probably disappear because of the increasing potential of ICT to take over such recurring tasks. At the same time, he predicted an increasing need for in-person service workers, providing professional services, and symbolic analysts or 'mind workers'. For both types of jobs the ability to communicate, to solve problems, and mediate information is essential. Similarly, Levy and Murnane (2004) argue that, due to the rapid development of ICT, an important part of many jobs is no longer related to the exchange of information only, but also to a *particular understanding* of information. The dynamic changes in the types of jobs demanded by the knowledge society pose important challenges to educational systems, as they are currently asked to prepare young people for a job that does not yet exist (Dede 2011, Voogt and Odenthal 1997). Furthermore, Duff (2008) argues that, due to technological developments, traditional human values (e.g. copyright, privacy, and equality) are threatened and that a new normative orientation is required. All these developments, together with the rapid changes in the job markets, ask for increased attention to the identification and acquisition of the competences individuals need to actively and effectively participate in the knowledge society (Ananiadou and Claro 2009, Gordon *et al.* 2009). These competences, commonly referred to as 21st century competences or 21st century skills, are generally characterized as being (a) transversal (i.e. they are not directly linked to a specific field but are relevant across many fields), (b) multidimensional (i.e. they include knowledge, skills, and attitudes), and (c) associated with higher order skills and behaviours that represent the ability to cope with complex problems and unpredictable situations (Westera 2001, OECD 2005, Gordon *et al.* 2009).

With the emergence of an increased attention for the competences required for the knowledge society, schools and educational systems around the world are called to make changes to their curricula (cf. European Commission 2002, OECD 2004, Voogt and Pelgrum 2005). Dede (2010b) argues that implementing 21st century competences is a matter not only of trading the current content and goals of education for those that are required by the knowledge society, but also of re-defining what should be considered as core in the curriculum. Such a change will not be achieved through a pure rational discussion only, but it requires the questioning and unlearning of beliefs, values, assumptions, and perceptions that researchers, practitioners, and policy-makers currently hold about the school system (Dede 2010a). Unfortunately, not many policy-makers seem to be prepared for the this change. The difficulties associated with re-defining curriculum priorities can be illustrated by the discussions derived from the findings of recent PISA studies about the quality of education (see for e.g. the Daily Mail, 8 December 2010). In many countries in the Western hemisphere, the PISA findings ultimately resulted in calls for more attention to basic literacy and numeracy skills

(e.g. Ministry of Education, The Netherlands, 7 December 2010), high stakes testing practices (Au, 2011), and schools being accountable for their results. These calls suggest that policy-makers do not seem to link the findings from the PISA study to the need to restructure curricula in order to realize 21st century competences. Notably, good PISA test scores require students to be able to solve fairly complex problems and to think critically, both of which are regarded as key competences in the knowledge society.

To better understand what the curricular integration of 21st century competences requires from schools and educational systems, in this study we used a conceptual framework of curriculum representations. This framework distinguishes between the intended, the implemented, and the attained curriculum (cf. Goodlad *et al.* 1979, Travers and Westbury 1989, Van den Akker 2003). The 21st century competences needed in the knowledge society can be regarded as the overall rationale and goals for learning—i.e. the *intended curriculum*. However, there may be a gap between the needs of the knowledge society expressed by the advocates of 21st century competences and the ways in which these competences are addressed in national and school curricula—i.e. the *implemented curriculum*. Finally, appropriate assessment practices need to be in place to be able to determine whether expected learning outcomes are achieved—i.e. the *attained curriculum*. One of the major challenges in realizing curriculum change is to ensure consistency and balance between these three different curriculum representations.

Aims of the study and research questions

Several (international) organizations and scholars have attempted to promote the integration of 21st century competences in national curriculum policy by providing descriptions of the competences that are regarded as important for the knowledge society. These descriptions are usually accompanied by specifications of the types of teaching, learning, and assessment approaches associated with the implementation of these competences in school curricula. References to 21st century competences can be found under various terminologies across these initiatives. Some scholars and international organizations refer to 21st century competences as *lifelong learning competences* (e.g. OECD 2004, Law *et al.* 2008), the European Union prefers to use the term *key competences* to emphasize its importance and cross-curricular nature within the curriculum (European Parliament 2007), and in the US the terms *21st century skills* and *21st century learning* have become increasingly popular to designate both the competences needed for the knowledge society and the types of learning related to them (e.g. Partnership for 21st century skills [P21] 2002, International Society for Technology in Education [ISTE] 2007). Moreover, there is ongoing controversy on whether these terms are actually used to designate new competences, or rather to give greater emphasis to a specific set of long known competences that are considered as especially

relevant to the knowledge society. Despite this controversy and the above-mentioned diverse terminology, in this paper we adhere to the term 21st century competences because of its increasing adoption in both political and academic fields. A simple search for 21st century competences and 21st century skills on the Web of Science resulted in three scholarly publications for the period 2000–2003, one for the period 2004–2007, and 19 for the period 2008–2010. A similar search in ERIC (including scholarly publications, educational magazines, and reports) yields 13 results for the period 2000–2003, 43 for the period 2004–2007, and 122 for the period 2008–2010.

This study aims to synthesize literature about various policy frameworks that were developed to support the curricular integration of 21st century competences. The conceptual framework outlined in the previous section was used to gain a better insight into the similarities and differences between the frameworks (horizontal consistency) and the coherence between intentions, implementation, and assessment of outcomes (vertical consistency). The following research questions guided the study:

- (1) Which 21st century competences are distinguished in the various models?
- (2) Do the models address implications for the implementation of 21st century competences in the curriculum?
- (3) Do the models address ways in which 21st century competences can be assessed?

Frameworks for 21st century competences

Based on a preliminary review of literature, well-known frameworks for 21st century competences were identified and selected for in-depth analysis. As a result, the following frameworks were included in the study:

- *Partnership for 21st century skills (P21)*, developed in the US with the goal of positioning 21st century competences at the centre of K12 education. P21 is a national organization formed in 2001 with the sponsorship of the US government and several organizations from the private sector (e.g. Apple Computer Inc., Cisco Systems, Dell Computer Corporation, Microsoft Corporation, National Education Association, etc.) (P21 2009a, b, c, d, e, f).
- *EnGauge*, developed by the Metiri group and the Learning Point Associates with the purpose of fostering 21st century competences in students, teachers, and administrators (Lemke *et al.* 2003, NCREL-Metiri, 2003).
- *Assessment and Teaching of 21st Century Skills (ATCS)*, developed as part of an international project sponsored by Cisco, Intel and Microsoft. This project aims at providing clear operational definitions of 21st century competences for the design of innovative assessment tasks to be used in the classroom (Binkley *et al.* 2010, Csapo *et al.*

2010, Darling-Hammond 2010, Scardamalia *et al.* 2010, Wilson *et al.* 2010).

- *National Educational Technology Standards (NETS)*, developed by the International Society for Technology in Education (ISTE) with the purpose of setting goals for what students, teachers, and administrators should know and be able to do with technology in education (ISTE 2007, 2008a, b, 2009).
- *Technological Literacy Framework for the 2012 National Assessment of Educational Progress (NAEP)*, developed by WestEd at request of the National Assessment Governing Board of the US. The goal of this framework is to establish what students—particularly at grades 4, 8, and 12—should know about and be able to do with technology. The framework is also intended to set forth criteria for the design of future national assessments (WestEd 2010).
- *21st century skills and competences for new millennium learners*, an initiative undertaken by the Organization for Economic Co-operation and Development (OECD) with the goal of providing policy-makers, researchers, and educators with orientations for the design of educational policies and practices that address the requirements of learners in the knowledge society. Central to the New Millennium Learners project is the Definition and Selection of Competences (DeSeCo) programme, specifically launched to develop a conceptual framework for identifying and defining key competences and serve as a theoretical foundation for PISA (Rychen *et al.* 2003, OECD 2005).
- *Key competences for lifelong learning*, a European reference framework developed within the Education and Training 2010 work programme and approved by the Council and European Parliament in 2006. This framework builds on the outcomes from the OECD-DeSeCo programme and has two main goals. On the one hand, it aims 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 (European Parliament 2007, Commission for the European Communities 2008).
- *ICT competency framework for teachers*, 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 organization (UNESCO 2008a, b, c).

Table 1 presents an overview of the various frameworks analysed, specifying their primary focus, the organizations sponsoring them, and the countries (directly) involved in the initiative.

As can be seen in table 1, three frameworks have been developed under the initiative of international organizations (EU, OECD, UNESCO), and the remaining five were developed with the support of

Table 1. Overview of 21st century skills/competences frameworks.

Framework	Main focus	Sponsors	Countries involved
Partnership for 21 st century skills	<ul style="list-style-type: none"> • Identification and definition of 21st century skills/competences • Implementation issues • Considerations for assessment 	<ul style="list-style-type: none"> • US Department of Education • AOL Time Warner Foundation • Apple Computer, Inc. • Cable in the Classroom • Cisco Systems, Inc. • Dell Computer Corporation • Microsoft Corporation • National Education Association • SAP 	USA
En Gauge	<ul style="list-style-type: none"> • Identification and definition of 21st century skills/competences • Implementation issues 	<ul style="list-style-type: none"> • Metiri Group • Learning Point Associates 	USA
Key competences for lifelong learning. European Reference Framework	<ul style="list-style-type: none"> • Identification and definition of 21st century skills/competences 	<ul style="list-style-type: none"> • European Commission: Education and Training 2010 work programme 	European Union member states
New Millennium Learners: DeSeCo	<ul style="list-style-type: none"> • Identification and definition of 21st century skills/competences 	<ul style="list-style-type: none"> • OECD: Centre for Educational Research and Innovation 	OECD countries
National Educational Technology Standards	<ul style="list-style-type: none"> • Identification and definition of ICT competences 	<ul style="list-style-type: none"> • International Society for Technology in Education 	USA, Norway, Costa Rica, Malaysia, Japan, Australia, Philippines, Micronesia, Korea, Turkey (among others)
ICT competency Standards	<ul style="list-style-type: none"> • Identification and definition of ICT competences 	<ul style="list-style-type: none"> • UNESCO • Cisco • Intel • ISTE • Microsoft 	United Nations
Assessment and Teaching of 21 st century skills	<ul style="list-style-type: none"> • Considerations for assessment 	<ul style="list-style-type: none"> • Cisco • Intel • Microsoft 	Australia, Finland, Singapore, United States, Costa Rica, Netherlands and Russia
NAEP - Technological Literacy Framework	<ul style="list-style-type: none"> • Assessment of technology and engineering literacy 	<ul style="list-style-type: none"> • National Assessment Governing Board • West Ed 	USA

private organizations. This indicates that there is a strong interest from society in 21st century competences. However, from the perspective of sustainable curriculum development (Kessels 1999, Van den Akker 2003) it is worrying that the education sector, let alone schools and teachers, do not seem to be actively involved in the 21st century initiatives and in the overall debate about these competences.

Finally, and in order to get a better understanding of how these frameworks informed curriculum policies and educational practices across various countries, the final reports from three international studies concerning the implementation of 21st century competences were reviewed: (a) 'Key competences in Europe. Opening doors for lifelong learners across the school curriculum and teacher education' (Gordon *et al.* 2009), (b) '21st century skills and competences for new millennium learners in OECD countries' (Ananiadou and Claro 2009), and (c) the Second Information Technology in Education Study (SITES) (Pelgrum and Anderson 1999, Kozma 2003, Law *et al.* 2008). These three studies provide an overview of the various initiatives adopted in the educational policies, curriculum regulations, and educational practices of different countries around the world to support the implementation of 21st century competences. Their findings contribute to ascertain the extent to which these competences are being considered in national and school curricula, as well as to identify those aspects that might require further consideration in the analysed frameworks to facilitate and support the implementation and assessment of 21st century competences.

Methodology

Selection of documents

A comprehensive search for information about 21st century competences available across the official websites of the selected frameworks and of the international organizations was conducted and completed in 2010. The search yielded a total of 59 documents (see table 2) consisting of working papers (49%), international standards for ICT competences (12%), reports from international studies (7%), progress reports on initiatives

Table 2. Overview of the search results.

Framework	Total outcome	Selected for analysis
P21	27	9
EnGauge	3	2
ATCS	8	6
NETS / ISTE	9	4
NAEP	1	1
EU	5	4
OECD	3	3
UNESCO	3	3
Total	59	32

and actions taken by different states in the US (8%), and implementation guides with exemplary curriculum materials for teachers (24%). From all the documents found, the working papers, the reports from international studies, and the most recent international standards for ICT competences were selected for further analysis (a total of 32 documents). These documents were selected on the basis of their contribution to understand how different frameworks address issues related to 21st century competences, its implementation and assessment.

From the 32 documents selected for further analysis, 15 documents addressed primarily the definition of 21st century competences and their importance to society and education, 14 documents addressed the implementation of 21st century competences and 10 documents addressed the assessment of these competences (please note that some documents could be categorized under multiple themes, that is why the numbers do not add up to 32).

Analysis of documents

The analysis of documents was focused on three major themes: definition of 21st century competences, implementation issues, and assessment. First the documents were carefully screened with the goal of identifying the main theme(s) reported in the document. Based on the screening, sub-themes related to each major theme emerged (see table 3). Three research assistants helped with the in-depth analysis of the documents. Each research assistant was responsible for one major theme and analysed the documents that were previously identified as major sources of information for that particular theme. The research assistants summarized their findings in an Excel spreadsheet developed per theme. The results were discussed with the entire project team.

Definition of 21st century competences: What should be learnt?

All the frameworks seem to be largely consistent in terms of what 21st century competences are, however, each framework has a different focus and areas of emphasis within the overarching competences. The recommendations derived from the OECD-DeSeCo programme as well as the EU framework and P21 could be regarded as more generic frameworks that provide a conceptualization of 21st century competences from which the other frameworks build on. The NETS, En Gauge, and UNESCO frameworks focus mainly on issues related to digital literacy and the integration of technology in the curriculum, whereas ATCS and NAEP are primarily concerned with the assessment of 21st century competences. Consequently, the importance assigned to a specific set of competences varies within the range of what all frameworks agree to call 21st century competences.

Table 3. Themes and sub-themes used in document analysis.

Theme	Sub-theme	Description
Skills/ competences	Arguments for the need of 21 st century competences	<ul style="list-style-type: none"> • Why are 21st century competences important? • What arguments guide the discussion about the need for 21st century competences?
	Definition of 21 st century competences	<ul style="list-style-type: none"> • What are 21st century competences according to the different frameworks? What are the similarities and differences between the competences stated by the frameworks?
Implementation issues	ICT-related competences	<ul style="list-style-type: none"> • Are ICT skills regarded as part of 21st century competences? • What ICT competences do the frameworks refer to? Are there any differences?
	Curriculum and instruction	<ul style="list-style-type: none"> • What do the frameworks say about the relationship between 21st century competences and the existing curricula? • How can 21st century competences be taught? What instructional approaches are more appropriated for 21st century competences?
	ICT	<ul style="list-style-type: none"> • How can ICT support the implementation of 21st century competences?
	Professional development	<ul style="list-style-type: none"> • According to the different frameworks, what competences and types of support do teachers need to implement 21st century competences? • What should be the characteristics of professional development programmes to support the implementation of 21st century competences?
	Public–private partnerships	<ul style="list-style-type: none"> • What do the models say about the different stakeholders involved in the implementation of 21st century competences? • Do the models mention anything about possible partnerships between public and private organizations?
Assessment	Strategies/conditions for implementation	<ul style="list-style-type: none"> • According to the frameworks, what strategies could support the implementation of 21st century competences?
	Arguments for new assessment models	<ul style="list-style-type: none"> • Are new forms of assessment needed and why? • What are the functions of the assessment of 21st century competences according to the different frameworks?
	Types of assessment	<ul style="list-style-type: none"> • What type(s) of assessment are more appropriate for 21st century competences?
	Assessment instruments	<ul style="list-style-type: none"> • How can 21st century competences be assessed?
	ICT	<ul style="list-style-type: none"> • How can ICT support the assessment of 21st century competences?
	Strategies/conditions	<ul style="list-style-type: none"> • What conditions are needed to assess 21st century competences?

While all the frameworks refer to similar competences, it is important to acknowledge that the categories used to group these competences cannot be easily compared due to the differences in emphasis and lines of

reasoning. Within the limitations that this provides for comparison, we attempted to clarify the similarities and differences between frameworks. Table 4 presents an overview of those competences mentioned by all frameworks (using the same or comparable terminology) as opposed to those that are regarded as important only by a few frameworks.

In line with the findings from other studies that compare different frameworks for 21st century competences (Trier 2003, Anderson 2008, Dede 2010b), our analysis reveals that there are strong agreements on the need for competences in the areas of communication, collaboration, ICT-related competences, and social and/or cultural awareness. Creativity, critical thinking, problem-solving, and the capacity to develop relevant and high quality products are also regarded as important competences in the 21st century by most frameworks. Differences between frameworks emerge mainly from the way of categorizing and grouping the competences, as well as from the importance attributed to them. A main difference concerns the competences that are related to the core subjects, and especially whether or not to consider them while defining 21st century competences. References to 'core subjects' or the 'core curriculum' can only be (explicitly) found in the P21, the ATCS, and the EU frameworks.

ICT is at the core of each of the frameworks. The development of ICT is not only regarded as an argument for the need of new competences by all frameworks, but it is also associated to a whole new set of competences about how to effectively use, manage, evaluate, and produce information across different types of media. While some frameworks emphasize ICT-related competences as separate domains (P21 and ATCS), others call attention to more integrative approaches where the development of ICT skills is embedded within other 21st century competences, such as critical thinking, problem-solving, communication, and collaboration (this is clearly the case for the NETS/ISTE framework).

When defining ICT-related competences, most frameworks refer to three types of literacies: Information literacy, technological literacy, and ICT literacy. *Information literacy* refers to the capacity to access information efficiently and effectively, to evaluate information critically and competently, and to use information accurately and creatively (American Association of School Librarians and Association for Educational Communications and Technology 1998). *ICT literacy* in its traditional form refers to the technical skills related to the use of technology (Anderson 2008). However, this term can also be conceptualized in a much broader way as the use of digital technology, communication tools, and/or networks to access, manage, integrate, evaluate, and create information in order to function in a knowledge society (Committee on Technological Literacy 2002). Finally, *technological literacy* can be defined as the capacity to use, understand, and evaluate technology as well as to understand the technological principles and strategies needed to develop solutions and achieve goals (U.S. Department of Education 2010). The main difference between ICT literacy and technological literacy lies in their emphasis with regard to the competences needed to function in a knowledge society. Technological literacy emphasizes the inter-play between technology and society, as well as the importance of understanding the technological prin-

Table 4. Similarities and differences between frameworks.

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)Core subjects: • 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)

ciples needed to solve complex problems and face the challenges of a knowledge society. Conversely, ICT literacy focuses mainly on how to make an effective and efficient use of digital technologies. References to technological literacy can be found in the NAEP framework, whereas P21, En Gauge, and ATCS emphasize the need for both information literacy and ICT literacy.

21st century competences in educational practice: Implementation and assessment issues

Three key issues concerning the implementation of 21st century competences are typically addressed by most frameworks: the place of these competences in the school curriculum, the role of teachers and teacher professional development, and the involvement of various stakeholders from both the public as well as the private sector.

Perhaps one of the most controversial issues concerning the implementation of 21st century competences is how to define their role and *place within the curriculum*. What education should emphasize as its core outcomes (Dede 2010b), and how to directly and explicitly address the discourse of 21st century competences in the development of curricula (Trier 2003) are some of the complex questions raised when considering the implementation of 21st century competences in the national and school curricula. A number of frameworks refer to different approaches that can guide the curricular integration of 21st century competences. Essentially, these approaches suggest that 21st century competences can either: (a) be added to the already existing curriculum as new subjects or as new content within traditional subjects, (b) be integrated as cross-curricular competences that both underpin school subjects and place emphasis on the acquisition of wider key competences, or (c) be part of a new curriculum in which the traditional structure of school subjects is transformed and schools are regarded as learning organizations (Gordon *et al.* 2009). Although different approaches are acknowledged, most frameworks recommend integrating 21st century competences across the curriculum due to its complex and cross-disciplinary nature.

Overall, and irrespective of the approach adopted for its integration, all frameworks suggest that 21st century competences demand significant changes in the curriculum. These changes are related to the need for restructuring the curriculum in order to make room for 21st century competences, but also to the need for new teaching methods and assessment procedures. According to the P21 and the EU frameworks, the acquisition of 21st century competences can be best supported by specific pedagogic techniques, such as problem-based learning, co-operative learning, experiential learning, and formative assessment. Next to these innovative teaching approaches, most frameworks also emphasize the need for a comprehensive use of ICT to enhance student learning and to promote the mastery of 21st century competences (cf. Dede 2000).

Another key issue in the implementation of 21st century competences concerns the *role of teachers and their professional development*. The key role

of teachers in the implementation of curriculum innovations has been widely acknowledged in the past decades (cf. Ben-Peretz 1990, Fullan 2007, Lieberman and Pointer Mace 2008). Teachers' attitudes, beliefs, competences, and practices are determinant factors in the realization of change in teaching and learning. With more or less detail, references to the central role of teachers in the implementation of 21st century competences and the consequent need for teacher professional development can be found in all frameworks. These competences pose many pedagogical challenges for teachers, as they are expected to find ways to integrate these competences across the various curriculum subjects and to master diverse teaching strategies and assessment procedures (Trier 2003). Furthermore, teachers are not only expected to facilitate the acquisition of 21st century competences in their students, but they are also expected to possess these competences (Gordon *et al.* 2009).

Despite the fact that all frameworks acknowledge the central role of teachers and the need for professional development to support the implementation of 21st century competences, the characteristics that teacher training programmes should have and/or the competences teachers need are only addressed in detail in the P21, NETS/ISTE, EU, and UNESCO frameworks. Within these frameworks, two common features can be identified: (a) the need to develop teachers' abilities to use various teaching methods, and (b) the need to develop teachers' abilities to make use of the affordances of ICT tools to create learning environments which accommodate 21st century learning. In addition, given the complex and cross-disciplinary nature of 21st century competences, P21 stresses the need for teachers to understand the importance of these competences and the ways in which they could be implemented in the curriculum. To do so teachers could be provided with the opportunity to observe real examples, to engage in on-going and work-related professional development initiatives, and/or to participate in professional learning communities (McLaughlin and Talbert 2006). Finally, the EU calls attention to the need for recognition and adequate pay schemas for teachers as key factors for supporting a sustainable implementation of 21st century competences.

A third issue concerning the implementation of 21st century competences is related to the *involvement of multiple stakeholders* (e.g. policy-makers, schools of education, researchers, school leaders, parents and families, etc.). This is explicitly addressed in the P21 and the EU frameworks. Both frameworks consider school leadership as a key factor to support the implementation of 21st century competences, but at the same time they recognize the fundamental role of other stakeholders.

Three main groups of key stakeholders are identified in the P21 framework: the public sector (e.g. state and local authorities), the private sector (e.g. business, parents, and families), and the educational community in general (e.g. teachers, content providers, professional organizations, teacher training institutes, educational researchers, etc.). The EU framework refers to similar groups of stakeholders, but it also stresses the role of the European Commission and other international agencies in supporting the implementation of 21st century competences. The acknowledgement of all these stakeholders indicates that the

implementation of 21st century competences requires an active participation and involvement of different sectors (private, public, education). Consequently, the implementation strategies must consider and address the interests and responsibilities of the various stakeholders implicated in this process.

It is noticeable that, beyond the three key issues mentioned above, concrete recommendations to support the implementation of 21st century competences are explicitly addressed only in three out of the eight frameworks analysed (i.e. EU, P21, En Gauge). Some of the recommendations proposed by these frameworks include: defining goals and standards in national documents regulating the curriculum, embracing a powerful vision, encouraging collaboration between different sectors, building on already existing work and focusing on what is 'doable', ensuring equitable access to education in present and future society, stimulating teacher collaboration, creating learning environments that enhance competence development, and aligning assessment methods and goals. Beyond these recommendations, P21 developed several resources to support teachers and school leaders with the implementation of 21st century competences, including (among others) maps of how these competences could be promoted across several subjects and school grades.

A major challenge associated with the implementation of 21st century competences concerns their assessment. Complex competences, such as the ones emphasized in the knowledge society, require complex tasks to provide students with the opportunities to apply and transfer their understandings to real world situations, to solve problems, to think critically and to work in a collaborative way (Hipkins *et al.* 2005, Dede 2010b). Moreover, learners need to be given the opportunity to practice and demonstrate these competences across multiple settings and diverse situations (Westera 2001, Hipkins *et al.* 2005). The challenge, then, involves the development of new assessment procedures and instruments that (a) facilitate and permit the application of these competences in authentic contexts, and (b) enable the collection of multiple types of information about the learner's application of the competence, including the outcomes produced by the learners, the processes they used, and their rationales (Pepper, 2011).

Most scholars agree that current assessment models, which are mostly focused on the measurement of discrete knowledge, fail to assess 21st competences and call for new assessments grounded in authentic and complex tasks (cf. Silva 2008, Dede 2010c, Pepper 2011). Nevertheless, only two of the eight frameworks analysed explicitly discuss how these new forms of assessment should look: the P21 and the ATCS frameworks. Both frameworks stress the need to move towards formative assessment, regarding it as a powerful way for making students' learning visible while at the same time it provides feedback that can contribute to the capacity building of both teachers and students. The ATCS framework further describes the general characteristics that the assessment of 21st century competences should ideally have. According to this framework, assessments need to: (a) be aligned with the development of significant

21st century goals, (b) be adaptable and responsive to new developments, (c) be largely performance based, (d) provide productive and usable feedback for all intended users and contribute to capacity building of teachers and students, and (e) meet the general criteria for good assessments (i.e. be fair, technically sound, valid for purpose, and part of a comprehensive and well-aligned system of assessments at all levels of education).

The potential of ICT to make the delivery of assessment more effective and efficient is also stressed by both the P21 and the ATCS frameworks, as they acknowledge that ICT can contribute to increase the speed with which results become available, and to reduce the costs and time required to score and to provide feedback. The ATCS framework also suggests that technology can also be used to improve assessment practices by: (a) *changing the business of assessment* (i.e. modifying the core processes that define the enterprise such as developing tests, delivering tests, scoring constructed responses on screen, etc.), and (b) *changing the substance of assessment* (i.e. using technology to change the nature of what is tested or learned). From this perspective, it is argued that technology could be used to expand and enrich assessment tools by including more authentic tasks. Furthermore, technology could also be used to assess new constructs that have either been difficult to assess or which have emerged as part of the information age.

Finally, it is important to mention that the increasing attention given to 21st century competences has also resulted in an increasing interest in whether and how to include the assessment of (some of) these competences in large scale tests. Over the last years, several initiatives at national and international levels have been developed to achieve this. One of these initiatives is the DeSeCo (*Definition and Selection of Competences*) programme set off by the OECD with the purpose of guiding the development of a long-term strategy for internationally comparative assessments of key competences. Another initiative is the development of a Technological Literacy Framework as an addition to the National Assessment of Educational Progress (NAEP) in the US. The main purpose of this framework is to establish what students should know about and be able to do with technology, and to set forth criteria for the design of future assessments. This framework is also an example of how technologies can be used to support the assessment of 21st century competences. Although these initiatives are still only in an early stage, they reveal the intention of educational systems to promote the large scale implementation of 21st century competences.

Policies guiding the implementation and assessment of 21st century competences—Connections between intentions and practices

In a study about the implementation of 21st century competences across 17 OECD countries, Ananiadou and Claro (2009) found that most countries had adopted 21st century competences in their curriculum. In many cases this was inspired and/or supported by the frameworks developed by

international organizations. Gordon *et al.* (2009) arrived at a similar conclusion when studying the implementation of 21st century competences across the education systems of 27 Member States of the European Union. Additionally, they identified that 21st century competences are introduced in the curriculum policies and regulations of Member States under various terminologies. While some countries refer to them as key competences, others prefer to use the term core skills, and others refer to them as goals or core objectives.

Another key finding of the studies conducted by Ananiadou and Claro (2009) and Gordon *et al.* (2009) refers to the ways in which 21st century competences were introduced in the educational systems. Whereas both studies found that these competences were primarily introduced within the context of an educational change, Gordon *et al.* (2009) go one step further in revealing that these competences were typically adopted through either a fundamental curriculum review, changes in the educational legislation, or the introduction of complementary objectives and curriculum guidelines. Hence, the nature and depth of the educational changes accompanying the introduction of 21st century competences in the curriculum varies from country to country. The studies also revealed that most 21st century competences are integrated across the curriculum, with the exception of ICT-related competences which in the majority of the countries were either introduced as separate subjects or accompanied by specific guidelines to facilitate its teaching and assessment (Ananiadou and Claro 2009).

With regard to the assessment of 21st century competences, the studies conducted by Ananiadou and Claro (2009) and Gordon *et al.* (2009) reveal that this is still one of the weakest points in the country's efforts to integrate 21st century competences in the school curricula. Gordon *et al.* (2009) identified four different approaches to the assessment of key competences across 27 Member States from the European Union: (a) assessment of cross-curricular competences explicitly, (b) assessment of cross-curricular competences implicitly, (c) assessment of subject-specific competences, and (d) assessment of knowledge rather than competence. While the first two approaches show some progress in the assessment of 21st century competences, the other two were more common across most countries participating in the study, revealing that the need to assess these competences is not yet fully acknowledged in many countries. These findings are consistent with the results obtained by Ananiadou and Claro (2009), who found that 21st century competences were in most cases assessed either implicitly or by external inspectors as part of school audits.

In those countries that reported the explicit assessment of 21st century competences, standardized tests, teacher assessment and/or portfolio assessment were the most common instruments used (Gordon *et al.* 2009). Standardized tests were mainly used for the assessment of competences related to core subjects (particularly mother tongue, mathematics, and science), whereas teacher assessment and portfolio assessment were more commonly used to assess cross-curricular competences. Some countries also started to experiment with the use of self and peer assessment

procedures, particularly for the assessment of social competences. However, these latter initiatives are still at a very early stage.

The two studies described above demonstrate that, at a policy level, many countries around the world have adopted the development of 21st century competences as a major national goal—although to different extents—and have a strong commitment towards facilitating its implementation. However, these initiatives do not necessarily reflect what occurs in the daily classroom activities. For a decade, the Second Information Technology in Education Studies (SITES) monitored the adoption of 21st century competences in schools (Pelgrum and Anderson 1999, Kozma 2003, Law *et al.* 2008). This has resulted in several interesting findings. For example, from case studies across 26 countries around the world it was revealed that in only 6% of the innovative ICT-supported pedagogical practices identified in the study, ICT was adopted school wide and throughout the curriculum. All of these innovative pedagogical practices had adopted a curriculum that facilitated students' preparation for the knowledge society: they emphasized students' independence and responsibility for their own learning and had restructured their school to realize that vision. The use of ICT was a vital component in the new structure, and had become a routine throughout the school (Voogt and Pelgrum 2005). However, these innovative practices represent only a minority of schools and teachers. In another SITES study, using a representative sample of grade 8 science and mathematics teachers across 22 educational systems, Law (2009) found that educational practices largely reflected the industrial model of schooling. Although many teachers reported to have curriculum goals that were in favour of 21st century competences, they did not apply them in classroom practice. In addition, pedagogical use of ICT in grade 8 mathematics and science classrooms was reported by only 49% (math) and 62% (science) of the teachers, which was considered low given that there was nearly 100% computer and internet access at the schools (Law 2009). The findings of the SITES studies show that, despite the political commitment of most governments, at school and classroom level most teaching practices do not yet foster the learning of 21st century competences.

Conclusion and discussion

In this paper eight frameworks that addressed the rationale, goals, implementation, and assessment of 21st century competences were discussed. From our findings, it is encouraging to see that—ultimately—the frameworks seem to converge on a common set of 21st century competences: collaboration, communication, ICT literacy, and social and/or cultural competencies (including citizenship). Most frameworks also mention creativity, critical thinking, productivity, and problem-solving. The consensus between the frameworks about the competences needed in the 21st century indicates horizontal consistency in curriculum intentions. However, this consistency is largely obscured by the use of different grouping and categorizing procedures, as well as differences in terminology chosen. This

may generate confusion and ambiguity, hindering the implementation of 21st century competences. Our findings also reveal the central role of ICT across the various policy frameworks. ICT is regarded as both (a) an argument for the need of 21st century competences, and (b) a tool that can support the acquisition and assessment of 21st century competences. In addition, all frameworks acknowledge that the rapid development of ICT requires a whole new set of ICT literacy competences that go beyond the mere operational use of ICT tools and applications.

One might question the novelty of this set of 21st century competences. Competences such as problem-solving and critical thinking always have been associated with academic achievement and a characteristic of a desirable education. For example, Dewey (1910) discusses the need to help students to 'think well', thus identifying already then reflective thinking as a key competence. Moreover, developments in the learning sciences have shown the benefits of problem-solving (e.g. Bransford *et al.* 2000) and collaboration (e.g. Sawyer 2006) as valuable instructional strategies. Yet, other 21st century competences have only recently received special attention. This is the case, for example, for competences such as ICT literacy, productivity (understood as entrepreneurship), and risk-taking (e.g. European Parliament 2007). Although 21st century competences are not always new by themselves, the importance of learning them in an integrated manner, their importance for all age levels (e.g. Carr *et al.* (2008) for kindergarteners) and the potential of ICT to realize 21st century competences in curricular activities throughout the curriculum (cf. Dede 2000, Dede 2010a) makes that the implementation of 21st century competences in educational practice is a complex curriculum innovation. The analysis of the implementation of 21st century competences in the EU member states (Gordon *et al.* 2009) and OECD countries (Ananiadou and Claro 2009) suggests that national policies seem to respond to the need for the implementation of 21st century competences in national and school curricula. This seems in accordance with results from the SITES study (Law *et al.* 2008), which revealed that the perceived presence of pedagogical practices that foster the development of 21st century competences in schools across the participating educational systems had increased between 1998 and 2006. However, the precise direction of the change differed across educational systems. Asian countries reported an increase in pedagogical practices that support the development of 21st century competences in their school, whereas some European countries reported a decrease. This was an unexpected finding, since policy-makers in both Europe and Asia use the rhetoric that schools need to prepare students for the knowledge society. For instance, while in Denmark the educational policy had changed from an emphasis on 21st century competences to an increased focus on tests and individual student learning (Bryderup *et al.* 2009), Singapore had implemented curriculum changes to cater for students' different needs, to provide students with more ownership of their learning and to nurture students' different abilities and talents (Koh *et al.* 2009). Such findings clearly show that national policy does matter in the implementation of 21st century competences.

From this study we can derive several recommendations for the facilitation of the implementation of 21st century competences in national and school curricula. First, an operational definition for each of the 21st century competences is required so as to determine what should be expected from students at different age levels in terms of knowledge, skills, and attitudes. Such operational definition can contribute to develop a pedagogical continuum (Voogt *et al.* 2011) for planning and assessing the learning of 21st century competences across age levels and subjects. Second, the connections between core subjects and 21st century competences should be clearly identified. The introduction of interdisciplinary themes, to be addressed within and across subjects, could contribute to make these connections stronger. Moreover, the interdisciplinary themes are dynamic and in continuous change, since they must reflect contemporary societal issues. Third, to assure learning *about* and learning *with* ICT, the ICT literacy competencies (i.e. information literacy, ICT skills, and technological literacy) should be embedded within and across the other 21st century competences and core subjects (cf. Jenkins *et al.* 2006). Fourth, the role of formal and informal education contexts in supporting the acquisition of 21st century competences needs to be acknowledged and taken into account. Strategies to closely link what is learned *in* and *outside* the school should be developed. Finally, the development of national frameworks containing clear-cut definitions of 21st century competences and addressing strategies to support and regulate its implementation and assessment are needed. Moreover, this framework could explicitly describe the emphasis of 21st century competences across educational levels and the multiple contexts associated to their assessment.

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