21st Century skills: Ancient, ubiquitous, enigmatic?

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Introduction

Today, because of rapid economic and social change, schools have to prepare students for jobs that have not yet been created, technologies that have not yet been invented and problems that we don't yet know will arise.

> Andreas Schleicher, OECD Education Directorate, 2011.

The understanding and skills needed to compete in today's global economy are arguably quite different to those upon which 19th and 20th century education systems have traditionally focussed. Life has become much more international, multicultural and inter-connected. Seismic advances have occurred in ICT and in access to it. These have enabled the economies of developed countries, including the UK's, to shift from a basis of material goods and services to one of information and knowledge (Lisbon Council, 2007; Cisco, Intel and Microsoft, 2008). 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 what people can do with the knowledge they can access (Silva, 2009) and on interpersonal skills. In the UK and elsewhere, aspirations towards a more meritocratic society (e.g. Aim Higher, 2011) coupled with these economic and social changes have contributed to intense competition for places at top universities and for jobs, leading applicants to seek new ways to distinguish themselves. Simultaneously, however, some employers and HE tutors complain that new recruits arrive ill-equipped, having been spoon-fed material at school or college (Tickle, 2011). It is unsurprising that references to so-called '21st Century skills' have peppered many debates over what and how today's students should learn, in order to become productive citizens.

The aim of this article is to explore some of the benefits and risks of building pedagogies and curricula around 21st Century skills. I begin by outlining some conceptualisations of 21st Century skills. I then address the question of how their development in young people can best be supported; I describe recent examples of alternative approaches used in the UK and internationally, including extended projects for sixth-form students. I also start to consider the value placed by stakeholders on the summative assessment of 21st Century skills, and finally, the feasibility of such assessment for test developers.

What are 21st Century skills?

There is no single widely-accepted definition of '21st Century skills'. Arguably, this is to be expected, given the diversity of agendas held by different educationalists, policy makers, employers, teaching unions, and higher education institutions. According to Silva (2009), there are hundreds of descriptors of the skills set, including life skills, workforce skills, interpersonal skills, applied skills, and non-cognitive skills.

One of the largest research ventures currently underway is *Assessment and Teaching of 21st Century Skills (ATC21S)*. The stated goal of this international collaboration among academics, governments and three major technology companies is to 'Change the way students are taught in the classroom, to make their education relevant for the 21st Century and beyond' (ATC21S, 2011). An initial objective of the ATC21S project was to develop clear, operational definitions of 21st Century skills. Researchers began by conducting what is probably the most thorough recent review of the literature in this field. They analysed the definitions developed and used by eleven major organisations, including the Partnership for 21st Century skills (2011) in the United States and the Lisbon Council (2007) of the European Union.

The ATC21S researchers concluded that 21st Century skills can be grouped into four broad categories: (i) ways of thinking; (ii) ways of working; (iii) tools for working; and (iv) skills for living in the world (Binkley, Erstad, Herman, Raizen, Ripley and Rumble, *in preparation*). Within these categories, they identified ten skills as encapsulating all others and accommodating all approaches. The four categories and ten skills are shown in Table 1. The table also includes the skills in the key literature reviewed by ATC21S (Binkley *et al.*, *in preparation*; Cisco, Intel and Microsoft, 2008) and outlined by the Confederation of British Industry (2007) following a consultation with its members. It can be seen that none of the organisations in Table 1 agree exactly on the skills that are needed for the 21st Century, but there is considerable overlap among them. In particular, problem-solving, and ICT operations and concepts, are listed by all organisations. Communication, collaboration, and information literacy (the ability to mine new information and interact constructively with it) are also listed frequently.

In addition to the 21st Century skills shown in Table 1, others were discussed at a recent education conference[1]. A Senior Tutor at the University of Cambridge stressed the need for top university applicants to possess 'mental fluency' in their subject of interest; for example, this might be mathematical fluency, fluency in writing, or fluency in scientific thought (Partington, 2011). A closely-related skill is articulacy, an aspect of communication. Partington warned that in the UK, this is becoming the preserve of the middle classes. Other skills mentioned by Partington included high motivation, and an interest in complexity and difficulty which feeds into creativity.

Multilingualism does not feature explicitly in Table 1, but is often considered a key part of communication within a global community. The term can mean different things to different people. For some employers in other parts of the world, multilingualism boils down to employees speaking English, often in addition to a different native language. English must be mastered in order to communicate in international business meetings (virtual or face-to-face), as well as to

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1. *What kind of education enables us to cope with an interconnected world?* A Cambridge Assessment event held at 1 Great George Street, Westminster, London, SW1, on 15/03/11.

Table 1: Definitions of 21st Century skills

ATC21S	*21st Century skills projects reviewed by ATC21S*					*Confederation of British Industry (CBI) (2007)*
Categories of 21st Century skills	*21st Century skills*	*Partnership for 21st Century Skills (2011)*	*Lisbon Council (2007)*	*International Society for Technology in Education (ISTE) NETS (2011)*	*ETS iSkills (2011)*	
Ways of thinking	1. Creativity and innovation	Creativity and innovation		Creativity and innovation	Creativity and innovation	
	2. Critical thinking, problem solving, decision-making	Critical thinking, problem solving, decision-making	Problem-solving	Critical thinking, problem solving, decision-making	Critical thinking, problem-solving	Problem-solving
	3. Learning to learn, metacognition					
Ways of working	4. Communication	Communication		Communication	Communication	Communication
	5. Collaboration (teamwork)	Collaboration	Collaboration	Collaboration		Collaboration
Tools for working	6. Information literacy (includes research on sources, evidence, biases, etc.)	Information literacy, media literacy,	Information literacy	Information literacy	Information literacy	Application of numeracy
	7. ICT literacy	ICT operations and concepts	ICT operations and concepts	Research and inquiry, Digital citizenship, ICT operations and concepts	ICT operations and concepts	ICT operations and concepts
Living in the world	8. Citizenship – local and global					
	9. Life and career	Initiative and self-direction, Flexibility and adaptability, productivity, leadership and responsibility	Flexibility and adaptability			Initiative and self-direction
	10. Personal and social responsibility – including cultural awareness and competence					Business awareness Customer care

read technical and specialised documents which cannot easily be translated into every language. For some educationalists, however, learning another language (not necessarily English) enables people to understand their own first language in a different way, building more sophisticated lifelong learning patterns (Puntis, 2011). Arguably, this latter form of multilingualism is an important contributor to the third skill construed by ATC21S: 'learning to learn'.

Another perspective is that many 21st Century skills, including creativity, problem-solving, decision-making, communication, collaboration, citizenship, and personal and social responsibility, are linked inextricably to personality characteristics and so-called 'emotional intelligence' (EI). Petrides (2001) and Petrides and Furnham (2003) have defined EI as a constellation of behavioural dispositions and self-perceptions concerning one's ability to recognise, process, and utilise emotion-laden information. EI is conceptualised as an aspect of personality, which is malleable and still developing well into a person's twenties, and is unrelated to non-verbal reasoning ability. Petrides and Furnham designed a self-report questionnaire to give comprehensive coverage of all personality traits related to emotion. The questionnaire, which has been well validated in many countries and languages, measures self-perceived skills and abilities such as being a good negotiator and adapting well to new situations. These skills fall within the conceptualisations of 21st Century skills shown in Table 1.

A further usage of the term '21st Century' is to attach it to any subject considered or intended to be fit for purpose in the present century. '21st Century literacy', for example, can be used to describe modern literacy skills or current best practice in literacy, just as '21st Century mathematics' can describe modern approaches in mathematics. The implication is that subjects must evolve to meet new needs. Conceptual leaps in pedagogy as well as substantial changes in subject content may sometimes be evident. GCSE courses in 21st Century Science, for example, have been developed through a partnership among an educational foundation, a university, an academic publisher and an awarding body (21st Century Science, 2011). The courses focus on the knowledge and understanding needed in order to recognise the impact of science and technology upon everyday life, and contemporary contexts such as air quality and sustainable energy are used. Subject-specific uses of '21st Century' are not considered further in this article.

Approaches to developing 21st Century skills

The question of how best to support the development of 21st Century skills in young people is posed frequently. Several diverse solutions have been mooted, which are now discussed in turn.

Continue with long-standing methods of teaching 21st Century skills

One view is that the skills now termed '21st Century' skills have long been recognised by educationalists and are nothing new. Whilst a focus on their importance by the media might be novel, it is a consequence of deficits in current education systems, and the skills themselves are ubiquitous. According to Silva (2009), creative, critical and analytical thinking skills have been valued by many philosophers and educators, from Socrates 2400 years ago, to John Dewey in the twentieth century. Many long-established vocational courses can be seen to nurture 21st Century skills. For example, Rose (2011) has articulated some of the highly sophisticated analytical, problem-solving and creative skills developed on electricians' courses. Puntis (2011) has argued that traditional academic subjects such as mathematics and the sciences can also be reconceptualised in terms of the 21st Century skills they engender — a position shared by the Advisory Committee on Mathematics Education (2011). This may explain why performance in these subjects correlates highly with personal career earnings in the 21st Century (Chevalier, *in press*).

Consider the cognitive domain of Bloom *et al.*'s (1956) taxonomy of educational objectives, which comprises six levels: knowledge, comprehension, application, analysis, synthesis/creation, and evaluation. A relatively recent revision of the cognitive domain (Anderson and Krathwohl, 2001) presents the three lowest levels as ordered hierarchically, but the three higher levels as parallel. In Figure 1 I show how many of the 21st Century skills identified by ATC21S (Table 1) can be captured by the taxonomy. The exceptions are communication, collaboration, and ICT literacy. While the latter skill could not have existed widely in 1956, communication and collaboration skills certainly did, but were conceptualised more implicitly, as necessary components of the successful usage of other cognitive abilities.

Although the positioning of 21st Century skills in Figure 1 is only approximate, it suggests that they tend to be higher order thinking skills. Arguably, the focus of present day educationalists has drifted up the hierarchy, since many routine tasks are now performed by computers and other machinery. This drift can be perceived as being part of a wider phenomenon of downwards pressure within the educational system, with higher education approaches to pedagogy and curriculum being implemented in secondary schools, and primary education approaches being applied in early years settings. The origin of such pressure is unlikely to be exclusively economical. It may also reflect recent developments in the understanding of children's cognitive capabilities. According to Oates and Grayson (2004), higher order thinking skills develop earlier in childhood than Piaget's popular theory of cognitive development would suggest. For example, infants seem able to differentiate among types of things much earlier than previously thought. Oates and Grayson argue that as development proceeds, mental representations become progressively more abstract and freed from the concrete examples and specific contexts in which they originated, and that abstraction begins before many children begin formal schooling. There is therefore a need to support the development of higher order thinking at a younger age, through the teaching of traditional school subjects or otherwise.

Develop curricula covering 21st Century skills explicitly

An alternative view on the optimal development of 21st Century skills is that curricula should be developed to cover them explicitly. Over the past decade, critical thinking, for example, has become a subject in its own right for many sixth-form students in England. According to the website of a major English awarding body offering AS and A level courses in critical thinking:

> *Critical thinking is a skills-based rather than content-based A Level. It develops the ability to interpret, analyse and evaluate ideas and arguments and can support thinking skills in all subject areas, from arts and humanities to sciences.* (OCR, 2011)
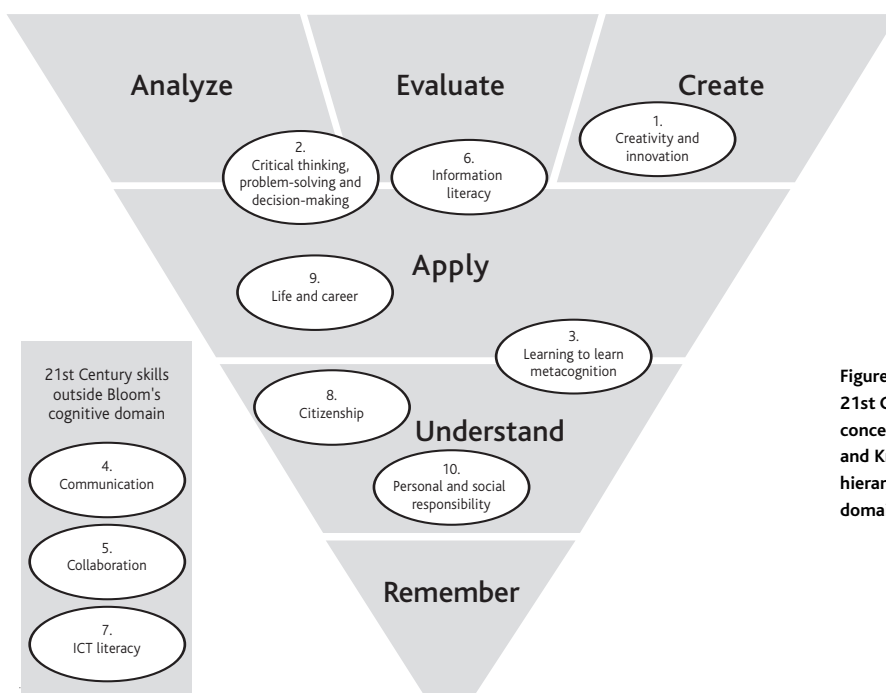

Figure 1: Approximate mapping of 21st Century skills (ATC21S conceptualisation) onto Anderson and Krathwohl's (2001) revised hierarchy of Bloom's cognitive domain

The popularity of critical thinking courses has soared over the past decade. While in 2001, just 2000 students sat AS level examinations in critical thinking, by 2009 that figure had risen to 22000 students (Black, 2010). Other thinking skills curricula have been around for longer. In 1998, for example, the implementation of three thinking skills programmes among younger secondary school students in England was reviewed by Baumfield and Oberski (1998). Findings from their case study indicated that experienced teachers faced considerable difficulties when attempting to develop the new skills needed to teach the programmes. Similar concerns over teaching capacity have been raised in the US, where thinking skills courses are well established (Sternberg, 1987). One challenge is that focussing not on a student's answer, but on the thinking underpinning that answer, is a crucial but less familiar process for many teachers. According to Black (2010), the difficulty of introducing a critical thinking course is more than that of the subject's novelty; it requires a fundamental re-orientation prior to teaching.

Critical thinking is by no means the only 21st Century skill to be taught as a separate subject. There has been considerable debate in schools and advisory services in England about whether ICT literacy (knowledge, skills and processes) should be developed through teaching ICT as a separate subject or through integrating ICT across the school curriculum (Webb, 2002). In her exploration of the positioning of ICT in the curriculum, Webb (2002) identifies three discrete approaches: (i) learning ICT as a subject; (ii) using ICT as a tool for learning (for example, using word processing software to redraft an essay or running a simulation to test a scientific prediction); and (iii) learning through ICT (situations in which the ICT facility becomes the whole learning environment by providing learning materials and acting as the tutor and assessor). Webb (2002) raises multiple concerns over ICT teaching capacity, some of which apply also to the teaching of thinking and other 21st Century skills. These concerns include a lack of skills and content knowledge among teachers, loosely defined pedagogical content knowledge, and loosely defined general pedagogical knowledge (subject specific interpretations are less well-defined for ICT than for other subjects). Borovik (2011) raises a further concern about ICT education. Whilst acknowledging the need for modern employees to be able to use ICT (that is, to be ICT *literate*), he suggests that producers and 'creators' of ICT are needed as well as users. Borovik argues that the IT industry wants schools to teach the fundamentals of actual computing, that is, the development of algorithms and their subsequent implementation in computer code. This entails sophisticated abstract thinking, not dissimilar to that used in mathematics.

Adopt a skills-centred pedagogy in schools and colleges

To encourage the development of multiple 21st Century skills, the Royal Society for the encouragement of Arts, Manufactures and Commerce (RSA) has devised a pedagogical framework called *Opening Minds*. The framework has been created to promote 'innovative and integrated ways of thinking about education and the curriculum' (RSA, 2011). It entails five key competences: citizenship, learning to learn, managing information, relating to people, and managing situations. Teachers use the competences to develop curricula to suit their own schools, and can use whatever content they like. The idea is that they teach *through* the competences, which become the lesson objectives. According to the RSA's *Opening Minds* website:

A competence based approach enables students not just to acquire subject knowledge but to understand, use and apply it within the

context of their wider learning and life. It also offers students a more holistic and coherent way of learning which allows them to make connections and apply knowledge across different subject areas. (RSA, 2011)

Through another lens, *Opening Minds* can be viewed as a pedagogical framework with a focus on strengthening emotional intelligence. It is being used in two hundred secondary schools across the country, including the RSA Academy in Tipton, near Birmingham. The RSA Academy has an underprivileged intake, and according to James (2011), the competences help to give students a sense of being and of where they fit into the world. Affluent students arrive at other secondary schools already knowing who they are and how they can make a contribution to the global community. In contrast, students at the RSA Academy are far less sure of themselves as they do not absorb such understanding by osmosis from their home and social environments. The RSA Academy aims to develop a culture and love of learning which, James argues, is vital for becoming a global citizen but is not usually prevalent in underprivileged areas.

Students in Key Stage 3 (ages 11 to 14) at the RSA Academy spend considerable time on: global integration; creativity; critical thinking; problem-solving; collaborative approaches; ICT; and global citizenship. Each day comprises two three-hour lessons, and students work through a set of themes, where teachers attempt to show how subjects are inter-related. James (2011) claims that new students entering Key Stage 3 lack confidence and are inarticulate because they are not used to engaging in discussion. Students in Key Stage 4 (ages 14 to 16) who have successfully grasped the *Open Minds* competencies are better learners because they understand who they are, and are beginning to develop an appreciation of what education can offer them.

Nurture 21st Century skills through extra-curricular activities

Another perspective is that 21st Century skills can be nurtured successfully outside of lessons. This longstanding position has been described by Haensly, Lupkowski and Edlind (1985):

Many students seek, and seem to thrive on, activities outside of the traditional classroom setting. Such activities are variously termed the co-curriculum or the extra-curriculum, apparently depending on whether they are specific extensions of academic coursework, or are peripheral to it. Thus, students may extend and enrich previously learned academic skills through competitions (e.g. interscholastic debates) and by applying them to the real world simulations (e.g. writing skills in school publications). In the co/extra-curricular setting they may also develop and practice artistic, musical, and psychomotor talents; leadership skills, and future career and occupational skills. Interpersonal and social strategies – proficiencies not considered basic elements of the academic curriculum – may especially be constructed through participation in the extra-curriculum. (Haensly, Lupkowski and Edlind, 1985, pp.110–111)

Whilst the broad benefits of extra-curricular activities are rarely disputed, concerns over inequity and inequality have been raised. Penney and Harris (1997), for example, have drawn particular attention to the disadvantaging of girls, and of lower ability pupils, in physical education in terms of the opportunities and experiences typically available to them in extra-curricular settings. Resources can be expensive with the

consequence that both internationally and nationally, the least affluent students may struggle to compete. Bourdieu (1984) famously argued that despite the apparent freedom of choice in the arts, individuals' artistic preferences and tastes align closely with their social positions. Contributing to Bourdieu's concept of 'cultural capital', extra-curricular activities (such as playing an orchestral instrument) may play a major role in securing university places and higher-paid, higher-status jobs not through the skills engendered, but through the status conferred. More recently, Partington (2011) reports that university admissions tutors are aware of these difficulties and have an ambivalent attitude to applicants' extra-curricular achievements.

Cultivate 21st Century skills through independent research projects

In order to improve equity, some schemes and activities have been designed to be flexible enough to function both within and beyond the curriculum. The British Science Association's (2011) Crest awards offer a modern example of how 21st Century skills are being nurtured in this way. The scheme operates at three levels spanning secondary education (11 to 19 years), and awards are given for project work in science, technology, engineering and mathematics (STEM subjects), produced either individually or in teams. It is intended that Crest projects link the personal passions of students to curriculum-based learning, and at the highest level, students spend over seventy hours on their projects. The scheme is designed to enrich the curriculum but can also link into work experience placements and after-school clubs. It is difficult to ensure complete equality of opportunity, since this kind of scheme ultimately depends on teachers and resources, but scheme flexibility is an important contributor.

The Crest awards in STEM subjects resemble several more formal educational routes entailing independent project work, which lead to accredited qualifications. These routes include Project Qualifications, which have been developed for students in all subjects at three levels: Foundation (Level 1), Higher (Level 2), and Extended (Level 3). Project Qualifications are administered by several different awarding bodies in England and Wales. At Level 3 (16–19 years) Extended Project Qualifications (EPQs) can be taken alongside A levels, as well as being a compulsory element in Diplomas. Students explore a particular interest which may be unrelated to anything else they are studying. They undertake purposeful, cross-curricular study both inside and outside the classroom. This leads to the composition of a 5000-word dissertation or to a shorter report of 1000 to 3500 words accompanying a project artifact (such as a piece of furniture or a musical performance). The students' project supervisors mark their work, which may then be moderated by an assessor employed by the awarding body. The Blair government envisaged that the task of carrying out a research project of this kind requires many 21st Century skills, including creativity and imagination, problem-solving skills, independent thinking, cooperation with others, and using people as resources, while relying on solid subject disciplines (DfES, 2005).

Similar educational routes exist elsewhere, both locally and internationally. Students at The Sixth Form College, Farnborough (2011) carry out projects (without a qualification attached) which were originally a precursor to EPQs. (The college worked closely with the AQA awarding body to develop the latter.) The students identify research questions that take them beyond the confines of their A level syllabuses/specifications, and which link at least two subjects. They then

conduct their research during their holidays or alongside their other courses, generating formally-structured reports of 4000–5000 words. Assessment is formative: teachers provide their students with detailed written comments. Internationally, the International Baccalaureate's Diploma students engage in independent research through an in-depth study of a question relating to one of the subjects they are studying (International Baccalaureate Organisation [IBO], 2011). This study culminates in the production of an extended essay of up to 4000 words, which is often followed by a short concluding interview with the student's supervisor. The extended essay, which is marked by external assessors, is intended to promote 'high-level research and writing skills, intellectual discovery and creativity' (IBO, 2011).

Develop 21st Century skills in the workplace

The extent to which 21st Century skills could and should be developed in the workplace in addition to, or instead of, in schools and colleges, is a controversial issue. Apprenticeships, internships, and work experience placements provide young people with rich opportunities to develop the generic and transferable skills desired by members of the Confederation of British Industry (2007, see Table 1). Reporting on the German dual apprenticeship system, which entails alternation between training in vocational schools and training in firms, researchers have commented:

> Workplace apprenticeship is the fundamental principle of vocational training in Germany and is thought to combine the most favourable conditions for developing skills. Skills include the capacity to take on the responsibilities involved in completing tasks, the ability to communicate and work in a team, the ability to think in terms of systems, and the ability of learning to learn. (Tremblay and Le Bot, 2003, p.14)

Whilst in Germany, companies provide apprenticeships for social and moral reasons and assume the costs of practical training (Tremblay and Le Bot, 2003) such obligations are felt less strongly by many companies in the UK and elsewhere. As participation and engagement in work placement schemes can be expensive, many businesses and other organisations attempt to recruit ready-trained people who already possess skills corresponding to their immediate and particular needs. In some sectors within the UK, such as journalism, fashion, and politics, unpaid internships are common. As with extra-curricular activities, however, concerns over inequity and inequality have been raised. For example, the deputy prime minister recently commented that making young people work for nothing is barring entry to those from poorer or less well-connected backgrounds and harming social mobility (BBC, 2011).

Assessing 21st Century skills

The above approaches to developing 21st Century skills are diverse, each presenting different challenges for those wanting to assess the skills cultivated. Although these challenges (discussed subsequently) may be considerable, there is nonetheless a strong desire for assessment from some quarters. ATC21S, for example, places a strong emphasis on the importance of assessing 21st Century skills. At its launch, the project's director commented:

> Reforming assessment is essential to enabling any systemic change in education. And change on a global scale is required to equip students

of today with the skills they need to succeed in the workforce of tomorrow. The international education assessments in the Program for International Student Assessment (PISA), with which I was involved as Director for Education at the Organization for Economic Co–operation and Development (OECD), focus on key competencies in reading, mathematics and science but we always wanted to extend the scope to cover important new skills. In PISA 2003, we took a step by adding an assessment of problem solving, but one limited to analogical reasoning. We hoped to add information and communications technology (ICT) competence in PISA 2006 but did not succeed. We all need now to work together to advance assessment practice.
(McGaw, 2008)

This comment conveys the implicit message that assessing a construct summatively adds meaning and extrinsic value to it for a greater number of people. If a 21st Century skill can be quantified, then measurements of it (that is, assessments and qualifications) can be utilised in application processes for jobs and university places, thereby making them more meritocratic. A further argument in favour of assessment is that it can drive curriculum and pedagogical developments, and for newly defined skill sets, these are often sorely needed. At a major testing organisation in the US, novel constructs have been clarified and articulated through the process of developing new tests in listening skills, people skills, and problem-solving skills (ETS, 2011).

There are mixed views on whether and how research projects for sixth-formers should be assessed. According to Guy (2011), students' projects at The Sixth Form College, Farnborough are assessed only formatively, to prevent them becoming 'high stakes'. In Guy's opinion, formal summative assessment and grading reduces highly desirable risk-taking behaviours among students. Instead of playing safe to obtain a qualification, the focus of the research process ought to be on opening up a new world of intrinsically pleasurable learning, thereby developing knowledge. On completing their projects, Farnborough students ask each other, "What did you do yours on?" rather than, "What grade did you get?".

In contrast, External Project Qualifications (EPQs) are assessed summatively by teachers, using assessment objectives provided by the awarding bodies administering them. As with Farnborough projects, however, the focus is intended to be on the investigative process that the student undertakes in order to achieve and evaluate his or her final outcome, rather than on the outcome itself. That is, the generic research and 21st Century skills displayed by the student are to be rewarded, rather than the subject content. This assessment approach is encountered infrequently in general secondary education in England and Wales, and presents considerable challenges relating both to marking task demands, and to assessors' personal expertise. Challenges relate to the complexity, variety, novelty and interdisciplinary nature of the project work and skills demonstrated. On the other hand, the EPQ's assessment framework provides an overt and tangible means of steering students and teachers towards focusing upon 21st Century skills. Moreover, recognition of the EPQ by the Universities and Colleges Admissions Service (it attracts 20 to 70 UCAS tariff points, for grades E to A* respectively), which is contingent upon assessment, may have widened uptake. UCAS recognition[2] is likely to have increased awareness and encouraged many schools and colleges to provide their students with new opportunities to carry out projects, which would not otherwise have been offered.

Finally, it is worth noting that not all attempts to assess 21st Century skills are successful. A common difficulty is that some skills are too subjective and enigmatic to be measured objectively. Since creativity, for example, can involve every sense (sight, hearing, touch, smell and taste) and is almost infinite, it defies precise definition. Whilst it may be possible to assess the quality of products of creative (and additional) processes, the skill itself may not be readily assessable. Similarly, Unwin (2010) considers collaboration and initiative-taking to be highly contextual capabilities; they therefore elude comparable quantification. Whilst new conceptualisations of skills often call for innovative assessment approaches, over-ambition can be costly. In England and Wales in 2007, a £26 million project to develop computerised tests of Key Stage 3 ICT skills had to be abandoned after a novel adaptive assessment model proved unworkable and theoretically insecure (Mansell, 2007). The tests were intended to transform ICT teaching and improve ICT infrastructure in schools, but ultimately, these goals could not be realised.

Conclusions

In this article, multiple conceptualisations of 21st Century skills have been outlined. The diversity of usage of the term has been highlighted, as well as the common ground among major organisations. The inter-disciplinary skills most commonly regarded as essential for the 21st Century are problem-solving, ICT operations and concepts, communication, collaboration, and information literacy. Some would argue that these skills are as ancient as Socratic philosophy, others would argue that they are ubiquitous in education, and others would argue that they are enigmatic since they elude objective measurement.

The article also contains an exploration of the key approaches to developing 21st Century skills currently in use in England and Wales as well as in some international contexts. While some educationalists wish to continue with long-standing teaching methods, others favour the construction and adoption of new pedagogies, curricula and extra-curricular activities, which incur both risks and benefits. Several of the approaches discussed can be used in combination with one another. Assessment is a major consideration for many stakeholders, and opinions are divided over its value and feasibility. In the case of research projects for sixth-formers, summative assessment faces challenges relating to task demands and assessor expertise, and may reduce risk-taking behaviour in students. However, it provides a tangible means of widening access, as well as guiding students and teachers towards the need to focus upon skills and processes rather than outcomes. For many teachers, this entails a fundamental re-orientation in pedagogical approach which is likely to be supported by emerging communities of teaching and assessment practice.

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2. The qualification was first considered for UCAS tariff points in 2007. Points came into effect for entry to higher education from 2010 onwards.

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