NSW GOVERNMENT

FUTURE FRONTIERS ANALYTICAL REPORT

Key Skills for the 21st Century: an evidence-based review

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The Centre for International Research on Education Systems, located at Victoria University, conducts strategic research that identifies how well education systems work, for whom, and how they can be improved to work well for all. The Centre undertakes large-scale survey and policy-related projects covering every state and territory in Australia and every sector of education and training. It also undertakes international comparative research examining the features and performance of education systems around the world.

EDUCATION: FUTURE FRONTIERS

EDUCATION: FUTURE FRONTIERS is an initiative of the NSW Department of Education exploring the implications of developments in AI and automation for education. As part of this initiative, the Department has commissioned background reports on future skills needs. The views expressed are solely those of the authors.

Executive Summary

Recent analysis examining trends in technology, the economy and the labour force shows that the world of work is changing. Based on an analysis of trends in the work of Australians each year, a new study has predicted that 'as technology reduces the need for workers to complete routine, manual tasks they will spend more time focusing on people, solving more strategic problems and thinking creatively' (FYA, 2017). This has led some to the view that as well as deep and broad knowledge in key disciplines, students will need a range of skills and capabilities, including creative and critical thinking and problem solving, in order to thrive in the future world. But, what are the skills future generations will need? Have they found their way yet into teaching and learning in schools? How can we make sure that schools are able to teach and transmit them?

This report considers the implications of these crucial questions for Australia, and it does so recognising that while there is a lot of discussion around the topic of key skills for the 21st century, there is little agreement yet about what the skills actually are, let alone whether they can be taught, measured or assessed. The reflections in this report, therefore, are somewhat speculative and need to be viewed as adding to the ongoing discussion around the skills our education system needs to consider in building courses and curricula for better preparing young people for their future lives. Its aims are modest: to bring together some of the current thinking around this topic and also to consider some of the work on the teaching and assessment of the skills future generations will need.

Key points

What are the key skills?

There is general agreement that schools need to be more than 'ATAR factories'. In other words, school systems are expected to do more for students than just focus on preparing them for academic tests and improving their test scores. From a holistic point of view, schooling should be helping to equip young people with the tools they need to become engaged thinkers, resilient and resourceful learners, creative problem solvers and active members of their communities.

A wide range of skills and related dispositions are regularly considered as vital for schooling in the 21st century, including thinking skills, social and emotional skills, and attitudinal skills such as motivation and self-efficacy. The relevant skills form a dense conceptual web, that is, the constructs are related in complex ways and sometimes overlap one another. It is difficult to establish a clear distinction between knowledge, skills and dispositions based on student behaviours. Accordingly, various theoretical frameworks attempt to make sense of this complexity.

While identifying the skills considered most important is challenging, the following have in particular received close and concerted attention from policy makers, researchers and practitioners:

- critical thinking
- creativity
- metacognition
- problem solving
- collaboration
- motivation
- self-efficacy
- conscientiousness, and
- grit or perseverance.

This list, while neither exhaustive nor unassailable, is the product of a careful review of educational literature and research, as well as Australian and international frameworks for learning. These skills and related constructs include those most frequently found in different frameworks and related 21st century skills discussions. All of these skills can be learned and developed, although the extent to which their development can be induced in a school context varies. Evidence suggests that most of these skills and dispositions can be transferred across contexts, although they are better considered as partly context- or content-dependent rather than purely generic. For example, being skilled in creative and critical thinking in mathematics may not translate into creative and critical thinking in English. Some of the skills are correlated with academic achievement, though it is important to note that there is limited understanding of the causal mechanisms at play.

Teaching key skills for the 21st century

A number of jurisdictions across the world have selected different skills and attributes and established them as learning outcomes for students in primary and secondary schools. Jurisdictions have deployed system-level approaches seeking to improve the acquisition of key skills through improved teaching and learning. Several education jurisdictions are presented in this report, showcasing a range of implementation models, with consideration of successes and challenges. Most, if not all, of these jurisdictions have developed learning frameworks that are consistent with the national goals for schooling articulated by Australian Education Ministers, which call for schooling to support the development of broader skills in areas such as social interaction, cross-disciplinary thinking and the use of digital media, as well as in areas such as citizenship and contribution to community *(Melbourne Declaration on Educational Goals for Young Australians,* MCEETYA, 2008, p. 5).

Jurisdictions have typically articulated their commitment to improving key skills for the 21st century by defining broad goals of learning and establishing a list of interconnected skills needed to promote these learning outcomes. As an example, Alberta has placed the notion of a 21st Century Learner as a central fulcrum for its curriculum design. It has established three broad goals of learning, with schooling geared towards ensuring young people are given opportunities to become (1) engaged thinkers, (2) ethical citizens and (3) entrepreneurial. As well as literacy and numeracy skills, critical thinking, problem solving, decision making, creativity and innovation, communication, self-management, social responsibility and digital fluency are the interconnected skills viewed as critical to promoting the Albertan 21st Century Learner.

While most systems have been active in developing learning frameworks and looking at ways to incorporate skills into their curricula, and while some jurisdictions have invested in teacher training and professional development to promote these key skills, there is limited evidence to date of a widespread and successful transformation of classroom practice and assessment. Most systems recognise that the key skills need to be developed through teaching disciplines and subject content, as well as potentially *across* subject areas; yet no school system can yet demonstrate a generalised and consistent focus on key skills across schools, subjects and year levels.

Effective reform is likely to involve approaches that consider teaching standards, assessment, curriculum and instruction, professional development and learning environments. It is the interrelated impact of these facets of education that can foster the conditions for more systematic learning of key skills. Successful policy implementation needs to be accompanied by strategic investment in building the capacity of all teachers, across school and classroom contexts.

Measuring and assessing skills

A critical hurdle for many school systems in developing and implementing key skills is establishing valid and reliable measures and assessment tools. While

there has been significant attention paid to the development of frameworks and typologies of skills, much less attention has been given to their measurement and evaluation.

The three main ways of assessing student skills are: (1) student surveys (to obtain self-reported estimates of skill levels); (2) direct assessment using tests similar to those used for literacy and numeracy; and (3) teacher judgements (or reporting) on skill levels. All three have their strengths and limitations.

The suitability of an assessment method depends on the type of skill being assessed. The skills that are sometimes referred to as traits or 'soft skills' (e.g. grit, self-efficacy, conscientiousness or communication), are difficult to measure using direct assessment, and measurement tends to rely on self-reporting (generally based on psychological survey inventories). Direct assessment is more easily applied where the skills are closer to those traditionally recognised as 'cognitive' and where tests have historically been used.

Purpose is another critical aspect to consider when choosing a method of assessment. There are four primary assessment purposes in school systems: (1) monitoring student learning and progress (individually and collectively), (2) supporting instructional improvement, (3) monitoring system performance, and (4) setting priorities by signalling to teachers and parents which competencies are valued. A given assessment purpose can be better served by some assessment methods than others: for instance, teacher judgement can be particularly beneficial to instructional improvement, as it is direct and immediate, and many systems currently favour student self-report when considering broader skills, as it provides brevity at a relatively low-cost.

A judicious combination of various assessment methods, based on scores as well as qualitative assessment and determined by the assessment purpose(s) and the skill(s) being assessed, appears likely to improve the assessment of key skills and their acquisition by students. Assessment of key skills for the purpose of monitoring system performance would require careful attention to the strengths and limitations of each assessment method.

Further work

The review undertaken for this report has confirmed, among other things, that many systems and schools have invested considerable effort in broadening their conceptualisation of the skills young people require for their future. At the same time, there is little evidence providing clear direction on the most effective approaches to the teaching and learning of the identified skills, as well as the best ways to assess them. It also remains uncertain whether these policy designs are reinforced with appropriate support provided to teachers and schools to meet the expectations placed upon them. While examples of successful practice exist in the research literature, school systems are still working to provide a coherent approach to embedding key skills across the various stages of schooling, and to evaluate more systematically how the emphasis on key skills impacts on the work of teachers, schools, as well as on student learning and outcomes.

Table of Contents

1. Introduction

Major changes have taken place in the Australian economy over recent decades with deregulation and the rise in global economic trade and competition. Fast-paced technological change has had a significant impact on the structure of the workforce, altering, and in some cases replacing, demand for human labour, affecting blue- and white-collar workers alike. Many are predicting that automation, artificial intelligence and digital disruption will continue to displace workers and create new types of work and occupations at an unprecedented rate, and that these will require different sets of skills and knowledge (McKinsey Global Institute, 2017).

Many school systems are considering how best to 'future-proof' the next generation in light of these profound predicted changes. A number of public commentators, including politicians and business leaders, are calling for education systems to respond to this growing demand for '21st century skills' as a national economic imperative. Frey and Osborne (2017) predict that the future workforce of advanced economies will increasingly demand roles that involve perception and manipulation, creative intelligence and social intelligence. Other reports suggest that young people now require skills transferrable between jobs, such as problem solving, communication skills, digital literacy, teamwork, presentation skills, critical thinking, creativity and financial literacy (as opposed to technical skills, considered to be specific to a particular task, role or industry) (FYA, 2016). As a consequence, critique is often levelled that school systems focus too much on teaching content and knowledge as though this comes at the price of other desirable learning outcomes such as good skills in communication and collaboration, critical thinking and problem-solving abilities, conscientiousness, and concepts like citizenship and global awareness.

Discussions on the key skills students will need in the future workforce are valuable. However, it does not mean that the supposedly 'new' skills periodically identified by commentators have not been part of educational thinking for some time, including in Australia. In 1973, the Karmel report pushed for consideration of general competencies in Australian curricula, based on a concern with how 'curricula and teaching methods tend to be unresponsive to differences between pupils and to address themselves to the development of a range of attributes which is narrow in relation to the possibilities of life in a complex technological society' (Interim Committee for the Australian Schools Commission, 1973, p. 139).

In 1985, the *Quality of Education in Australia* report, taking up Karmel's earlier concern, proposed that education needed to emphasise general competencies for students, including skills in acquiring information, conveying information, applying logical processes, practical tasks and group tasks (Quality of Education Review Committee, 1985, pp. 70-71). Several years on, a review of participation in post-compulsory education and training described how young people needed to develop 'key competencies' in preparation for employment, including cultural understanding, problem solving and personal and interpersonal characteristics (Australian Education Council Review Committee, 1991). Later again, in 1997, a key recommendation of the McGaw review of the Higher School Certificate (HSC) in New South Wales was for the curriculum structures supporting the HSC to be more conducive to student learning in the management of their own learning and the development of their capacity to work with others (McGaw, 1997). All these reports acknowledge that traditional learning outcomes, including knowledge and mastery of subject content, continue to be important, but that young people also need additional skills, including in how to apply this knowledge, in order to successfully make the most of what they have learned.

More recently, the *Melbourne Declaration on Educational Goals for Young Australians*, the overall strategic direction document for all state and territory education systems, declared that the acquisition of

key skills should be one of the outcomes of schooling in Australia:

Literacy and numeracy and knowledge of key disciplines remain the cornerstone of schooling for young Australians. Schooling should also support the development of skills in areas such as social-interaction, cross-disciplinary thinking and the use of digital media, which are essential in all 21st century occupations. As well as knowledge and skills, a school's legacy to young people should include national values of democracy, equity and justice, and personal values and attributes such as honesty, resilience and respect for others. (MCEETYA, 2008, p. 5)

These statements echo previous national statements concerning the purposes of schooling, such as the 1999 Adelaide Declaration on National Goals for Schooling in the Twenty-First Century and the 1989 Hobart Declaration on Schooling.

While there may be little that is 'new' about most 21st century skills, many school systems are now placing a stronger and more deliberate focus on teaching related capabilities and skills such as critical thinking and problem solving, given their predicted importance for future careers and living (see OECD, 2015, reporting that the inclusion of 21st century skills within education policy statements is a common trend across many OECD jurisdictions). Though many education systems, including Australia, increasingly recognise that skills required for the 21st century are broader than what traditional cognitive measures capture and mandate their value within curriculum frameworks, very little is formalised beyond that in terms of teaching, learning, and assessment (Care & Luo, 2016). Successfully providing all young Australians with equal opportunity to acquire a skillset deemed essential for the 21st century calls for a sustained research and policy effort. This report provides an opportunity to consider what we know and don't know about key skills, enabling us to step back and critically consider educational reform and direction in relation to these skills.

This report

The purpose of this report is to provide a review of the most up-to-date research, policies and thinking related to the topic of key skills for schooling in the 21st century. It takes a critical look at evidence and action around these skills, drawing on published and peer-reviewed research, as well as 'grey' literature such as policy, think-tank and government reports. It offers a state-of-the-art overview of research and implementation of key skills and addresses related issues across three chapters. The first chapter identifies the skills considered as essential for success in the 21st century in five prominent frameworks and discusses the relevant skills individually. The second chapter then outlines the approaches taken by different jurisdictions in adopting and incorporating key skills into their school system, including in policy documents, curricula, teacher standards, and teaching and learning practices. Finally, the third chapter examines the different approaches to the assessment of these key skills.

Chapter two provides an overview of the skills many frameworks consider vital for young people in the 21st century. The chapter first presents some landmarks in the development of the debate on key skills for school systems to adopt. After this brief historical account, the chapter presents five valuable frameworks developed to conceptualise and organise the various skills students are expected to need to be successful in the future. It then goes on to examine each relevant skill on a case-by-case basis, before providing a summary of some lessons to be learned from the analysis of key skills.

Chapter three looks at how aspirations for the inclusion of skills into school system are translated into policies and practices in different jurisdictions. Although little evidence exists for best practices in teaching and learning for the development of these skills, it is possible to examine how different systems have approached the inclusion of broader skills into their schools, programs and teaching and learning. In this chapter, seven case studies of school systems

are presented to showcase the various approaches taken and to emphasise each system's mode of engagement with the skills, as well as its strengths and weaknesses. An additional case study is included, not of a school system but of a curriculum framework, one that has been at the forefront of the inclusion of key skills into its design and content: the International Baccalaureate.

Chapter four turns to the purposes and modes of assessment of key skills. It outlines the three main forms of assessment currently used, which are student self-reporting, direct assessment and teacher judgement. The report argues that there is no single best method for assessing various key skills, since each one of the three common methods has distinct methodological limitations. To circumvent this, an effective and well-rounded assessment infrastructure uses a range of modes of assessment. Linking with the previous chapter and supporting the analysis of assessment of key skills, this chapter also brings in case studies of how different assessment approaches have been applied by select jurisdictions.

The report concludes with an overview of some of the key messages included in the three core chapters and argues for considering them as part of a broader discussion on the role of schooling in the 21st century.

2. The skills needed for the 21st Century

What are the skills future generations will need? This is a critical question which this chapter takes up, but it does so recognising that while there is a lot of discussion around the topic, there is little agreement about what these skills actually are. The reflections provided in this chapter, therefore, partly depend on a particular conception of 'key skills' (detailed below) and need to be viewed as adding to the ongoing discussion around the skills our schools need to consider in building courses and curricula for better preparing young people for their future lives. The chapter offers an overview of the evidence available on the types of skills being discussed as vital for young people today. But before discussing each of the skills that have been prominent in recent thinking, the chapter sketches the terrain by discussing the way skills are defined and some promising frameworks for organising them. In the subsequent chapters, the report will look at how schools and school systems have been working to include such skills in their programs, teaching and assessment.

It should be noted that the concept of '21st century' or 'key' skills is wide-ranging, rather vague and not easy to define. While the term has come to be used fairly widely in education, it is not always clear what it covers or means. Highlighting this, a number of terms—social and emotional learning skills, broader skills, soft skills, transferable skills, transversal skills, traits, characteristics, non-cognitive skills, among others—are also commonly used to refer to the same general competencies and capabilities. While the different terms may not be strictly synonymous and they may have different meanings in certain technical contexts, the diverse sets of skills are being treated here in the same way.

What are key skills?

Reflections on the knowledge and skills students must acquire in education for future success and wellbeing are not new. More than 100 years ago in France, Émile Durkheim was already delivering lectures to future French teachers on the knowledge and skills that they would need to 'turn our pupils into men [and women] of their times' (Durkheim, 1938). Such reflections constitute an essential part of educational discussions and proposals for improving, enhancing, or reforming what is to be learned in school.

More recently, the question of the skills and knowledge students should learn in school has been shaped in various and sometimes conflicting ways, including from academic research in education, psychology and economics. Drawing on all these successive developments, the term '21st century' skills has been progressively used since the end of the twentieth century to describe and amalgamate the broad range of skills that students would need to master in order to succeed in life. But knowing where 'key skills' start and end remains a matter of debate.

Even a brief search of the terms '21st century' or 'key' skills shows that their potential scope is far-reaching. The issue is not only that there are dozens of skills deemed as vital for students to acquire from their education for future success; it is also the case that discussions on the skills suffer from the 'jangle fallacy' (Coleman & Cureton, 1954), where different terms are used to refer to often overlapping ideas and concepts. In this context, it comes as no surprise that there is little consensus on what the key skills actually are, or which skills will be vital for young people to succeed in the future.

For this report, the term 'key skills' is used to refer to the skills identified in current thinking and policy as important for students to acquire in their schooling if they are to be successful. This success is not only in school but more importantly beyond

school – in being able to build their careers, live fulfilling lives and participate effectively as citizens in their communities. This definition allows for a broad conception of skills, where acquiring a skill is synonymous with developing a form of expertise cognitively, behaviourally or emotionally which can be applied in key areas of activity. Skills are not only technical; they can be fairly generic and represent complex forms of expertise. This comprehensive definition of skills makes it possible to consider the range of dispositions, knowledge and capabilities a student needs to possess in order to demonstrate a given form of expertise.

It would be unrealistic to explore all the skills that interest educators, psychologists and economists as forms of valuable expertise for students to develop. Therefore, for the purpose of this review, the focus is specifically on the most commonly discussed competencies that primarily link to academic achievement and are seen as important for students to learn for promoting success in their future lives. This includes skills that are perceived as 'cognitive' as well as broader skills that relate to a person's emotional, psychological, and social attributes, such as attitudes, habits and competencies (sometimes referred to as 'non-cognitive' skills). It is important to recognise that conceiving of the skills needed by students to succeed in school and beyond as 'cognitive' versus 'non-cognitive' can prove unproductive, since it undermines the complexity of student learning. Skills all entail some cognitive processes while also relying on important dispositions, so that so-called cognitive and non-cognitive forms of expertise are mutually connected (Farrington et al., 2012, p. 2).

The conception of skills in this report is grounded in two definitional principles. The first is the conception of skills as a form of developing expertise (Sternberg, 1998). Just as intellectual ability (what is generally referred to as 'intelligence') is a form of developing expertise, the range of key skills explored in this review are best conceptualised as forms of developing expertise. In other words, these skills can be learned and developed, although the extent to which their development can be induced in a school context is variable.

The second is that it is useful to think of skills as context-based forms (or aspects) of expertise rather than as general and stand-alone skills, at least when it comes to schooling. One of the reasons for this epistemological position is that learning in schools is organised in curriculum areas (or areas of knowledge) and subjects, making it necessary to articulate subject-based learning and transversal skills. The question of the generality and transferability of skills will be returned to throughout the report, but the demonstration of expertise tends to be context specific. Generally speaking, if the transfer of expertise is possible, it is likely to be limited to situations and contexts with comparable properties. In short, skills may be transferable, but they rely on specific knowledge in a given domain of activity or practice.

Conceptual and organising frameworks for skills

A key implication of the conceptual nature of 21st century skills is that there is not a single, unified and universal framework for organising them. A number have been proposed over time. This section presents five frameworks that offer a starting point for thinking about key skills for schooling. The first two frameworks that are introduced are the *Partnership for 21st Century Skills* and the *Assessment and Teaching of 21st Century Learning* which are two of the most commonly cited and used skill frameworks. They give primacy to technology (ICT) skills as key ingredients in what young people need for success in a world in which digital technologies are prominent and have rapidly developed. Following this are three frameworks that take a broader perspective on the skills and dispositions viewed as important to succeeding in school as well as in later life, attempting to conceptualise the relationships between constructs and their influence.

The five frameworks are neither the only available frameworks nor necessarily the definitive ones, but they are selected for their logical and coherent articulation of different categories of key skills.

The selection of the first two was based on their influence in recent debates about 21st century skills. The following three were selected for their relatively systematic articulation of different types of skills and their clear focus on academic performance and learning. Together, the frameworks provide a schematic overview of the skills most commonly seen as shaping student success in school and after.

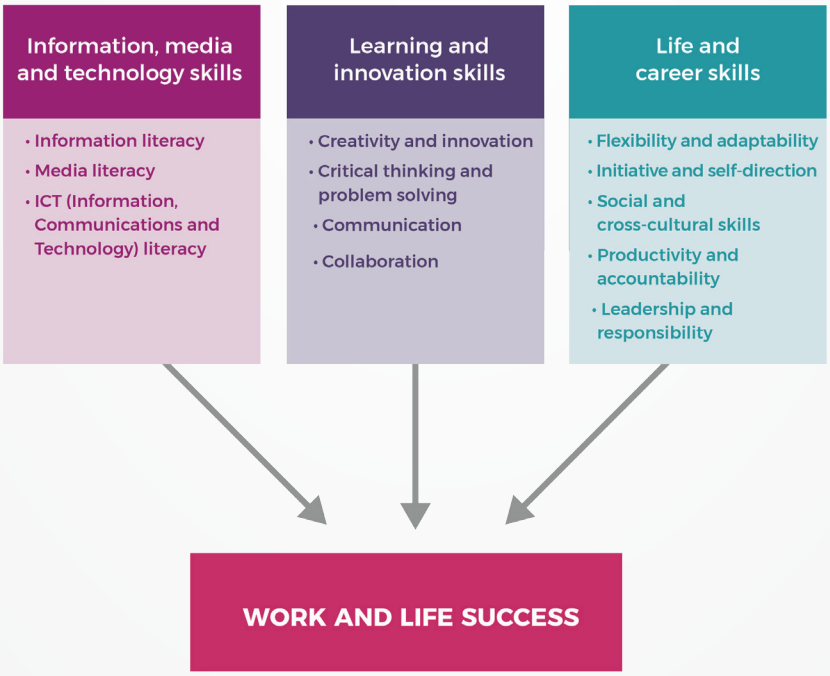
A previous review of 21st century skill frameworks found that most include skills such as critical thinking, creativity, problem solving, ICT literacy, as well as interpersonal and intrapersonal skills such as communication and collaboration (Voogt & Roblin, 2012). The frameworks presented here are those which incorporate most of these types of skills.

Framework 1: Partnership for 21st Century Learning

The US *Partnership for 21st Century Learning* (P21) framework, outlined in Figure 2-1, is perhaps the most widely known and adopted framework for key skills (Dede, 2010). It is included in most reviews of existing frameworks (e.g. Dede, 2010; Voogt & Roblin, 2012) and has received widespread coverage since the foundation of P21 in 2002. P21 is an organisation dedicated to positioning '21st century readiness at the centre of US K-12 education' (Partnership for 21st Century Learning, 2017). Within the framework, from kindergarten to Year 12, students are expected to master nine key subjects, learn about five interdisciplinary themes, and develop three categories of skills (Partnership for 21st Century Learning, 2015).

The framework places 'life and career' and 'information, media and technology' skills on par with 'learning and innovation' skills. In other words, the framework considers technological and media skills as essential for students to acquire in school, and it also emphasises the occupational function of education under the 'life and career' category. Finally,

Figure 2-1 Partnership for 21st Century Learning Framework



Source: derived from Dede, 2010

the 'learning and innovation' category groups both individual skills (problem solving, critical thinking and creativity) and social skills (collaboration and communication) but only refers to a limited range of individual skills (e.g. metacognition is absent).

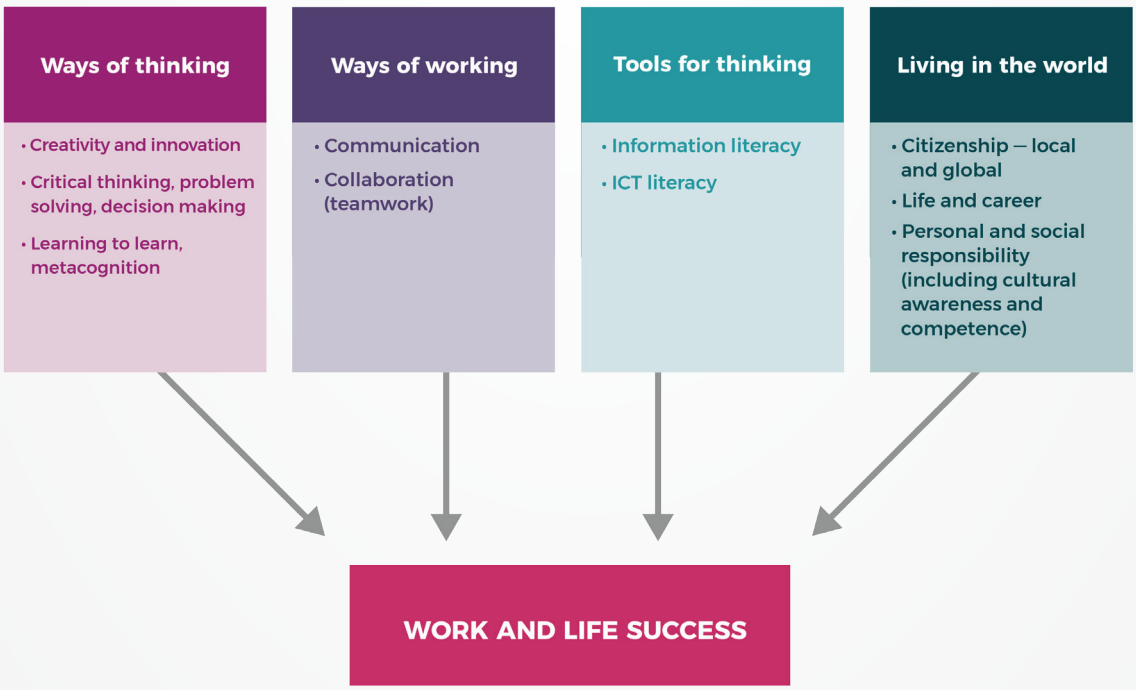
Framework 2: Assessment and Teaching of 21st Century Skills

The second common framework was developed by the *Assessment and Teaching of 21st Century Skills* (ATC21S) group. The group was formed for research purposes by three technology companies—Cisco, Intel and Microsoft—for better integration of ICT and educational assessment. It focused on developing instruments and strategies for assessing key skills using ICT. The Assessment and Teaching of 21st Century Skills Framework contains four broad categories of skills as portrayed in Figure 2-2.

The framework was based on 12 previously existing frameworks from the international literature (Binkley et al., 2012, p. 18). The principles and processes behind the construction of this framework remain unclear; however, its authors hold that the skills contained in the framework are only an example to be adapted to different contexts.

The ATC21S framework has similarities and differences with the P21 framework. As with the P21 framework, it places ICT-related skills (information and ICT literacy) in a stand-alone 'tools for thinking' category, on the same level as 'ways of thinking' and 'ways of working'. It thus considers that technology-related skills play a crucial role for work and life success. On the other hand, the interpersonal and intrapersonal skills subsumed under the 'learning and innovation' category in the P21 framework are separated into 'ways of thinking' (problem solving, critical thinking, creativity, and metacognition) and 'ways of working' (collaboration and communication). The influence of the P21 framework on the ATC21S framework is apparent. At the same time, the

Figure 2-2 Assessment and Teaching of 21st Century Skills Framework



Source: derived from Binkley et al., 2012

latter includes a broader range of thinking skills (i.e. metacognition and learning to learn).

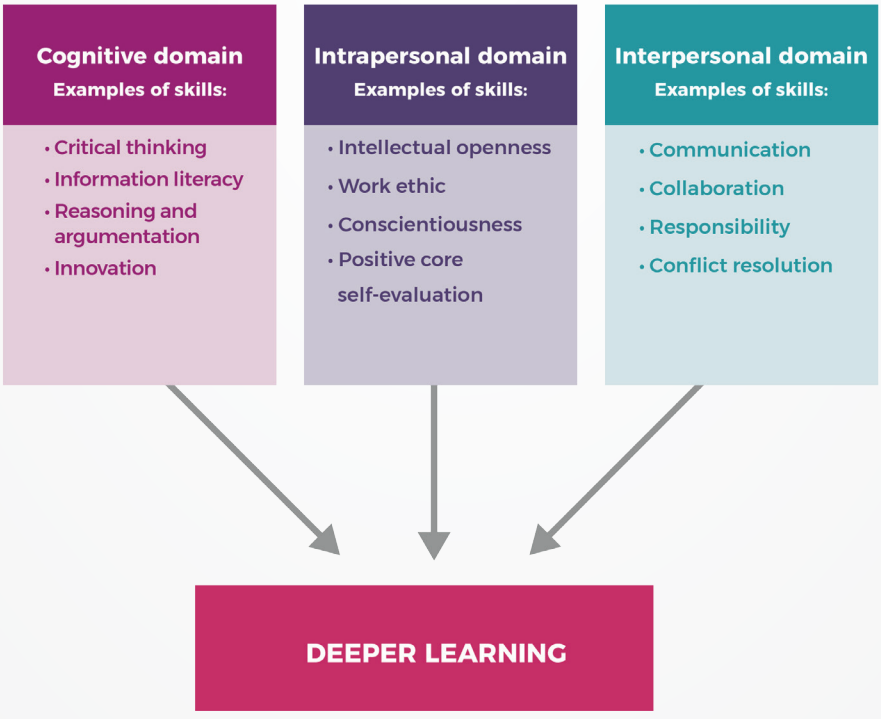
As with the P21 framework, the ATC21S framework encourages school systems to help students acquire skills that will prepare them for the world of work, careers and modern living. It sees student acquisition of work skills and ICT-related skills as vital learning goals for schools. It represents an example of skill frameworks that make ICT skills primary. Other frameworks and models, with examples presented below, adopt a different strategy by focusing on a range of skills separate from ICT-related skills (Ananiadou & Claro, 2009).

Framework 3: US National Research Council

The most authoritative framework for making sense of key skills is the one established by the *US Committee on Defining Deeper Learning and 21st Century Skills* from the National Research Council, presented in Figure 2-3. In the publication, edited by Pellegrino and Hilton (2012, p. 4), skills for the 21st century are grouped into three categories: (1) cognitive, (2) intrapersonal, and (3) interpersonal. The skills viewed as vital for young people to acquire in school are those that the committee saw as contributing to or empowering young people to become 'deeper learners', skills which could be transferable to different contexts or domains of learning. 'Deeper learning' is defined as learning leading to the acquisition of transferable competencies, which the committee identified through an investigation of economic and psychological research on the skills found to be associated with adult outcomes.

The framework is a useful visualisation of the range of skills that are expected to shape student learning and achievement. The division into three categories of skills offers a simple way of grasping the various types of skills students would need to do well in school and more broadly. The authors provide

Figure 2-3 US Committee on Defining Deeper Learning and 21st Century Skills Framework



Source: Derived from Pellegrino and Hilton, 2012

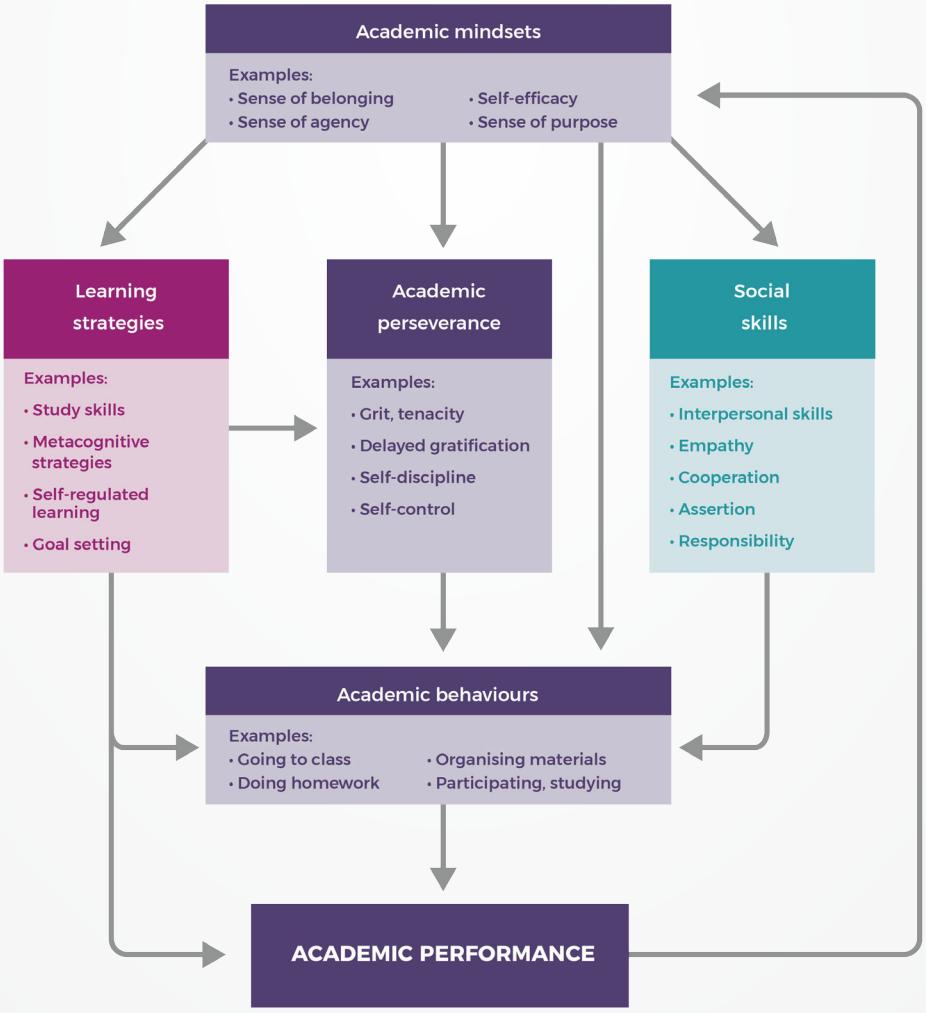
a detailed analysis of skills generally classified in the intrapersonal and interpersonal domains and critically assess evidence for the transferability of these skills when acquired in educational contexts. The Research Council publication is a reference point for evidence-based analysis of the transfer of skills. Some of its strengths include its simplicity, broad coverage, and relationship with the objective of transferable learning. The authors also analyse each construct extensively. However, the classification of skills into three domains remains based on an *a priori* conceptualisation of cognitive versus 'other' skills. Further, despite its logical coherence, it is elaborated based on a review of existing frameworks and only partially captures the complex sets of skills needed by students for success in school and beyond.

Framework 4: University of Chicago School Consortium

The fourth framework was generated by the University of Chicago Consortium on Chicago School Research and is presented in Figure 2-4.

The Chicago consortium offers a framework for thinking about the skills students need grounded on a view of what it takes to be successful in today's and tomorrow's world (Nagaoka et al., 2015). Their paper, *Foundations for Young Adult Success*, suggests that while economic wellbeing and doing well in the workforce is one of the elements of success for young people, it is far from the only goal. Success also means that "young people can fulfil individual goals and have the agency and competencies to influence the world around them" (Nagaoka et al., 2015, p. 1).

Figure 2-4 University of Chicago Consortium on Chicago School Research's 21st Century Skills Framework



Source: Derived from Farrington et al., 2012

Their framework of skills was derived with a view on the sorts of skills they thought would help young people achieve this.

Rather than dividing the dispositions and abilities needed by students into 'cognitive' versus 'non-cognitive' components, Farrington et al. presented sets of factors identified from other work as foundational to success in work as well as in promoting individual goals and agency and contributing effectively to the world around them. The factors are classified into five categories ranging from academically beneficial dispositions (i.e. 'academic mindsets') to actual student behaviours ('academic behaviours'), mediated by learning strategies, perseverance and social skills.

The framework captures the range of skills and related dispositions that directly and indirectly influence student learning. Social skills and 'academic perseverance' skills are viewed as indirectly affecting academic performance (via academic behaviours), while learning strategies represent a different category of skills that shape academic performance both directly and indirectly. A strength of this framework is its clear focus on identifying the individual skills that students need to do well in schools. The framework provides a holistic conception of learning and achievement and provides an outline of the key dispositions, skills, strategies and behaviours. More importantly, it is one of the rare approaches available that does not elude the question of the articulation of different skills with one another, as well as the fact that the skills are only effective once expressed in activities or behaviours.

On the other hand, although Farrington and her colleagues find the term non-cognitive to be 'unfortunate' (Farrington et al., 2012, p. 2), they analytically separate skills in this category from 'cognitive factors' defined as academic skills (problem solving, academic writing) and content knowledge. Non-cognitive skills are thus defined as distinctly separate as "sets of behaviours, skills, attitudes, and strategies that are crucial to academic performance in classes, but that may not be reflected in their scores on cognitive tests" (Farrington et al., 2012, p. 2). As a conceptual framework, it has yet to be tested empirically in various contexts.

Framework 5: International Study of City Youth

The final framework presented in this section has been developed by Lamb et al. (2015) for research purposes (Figure 2-5). Presented in a technical paper for the *International Study of City Youth* project and inspired by the previous framework, it aims at capturing the broad sets of skills that potentially shape student progress and integration into work and community life as they ascend school and transition to post-school study, careers and family life. Designed as a 'conceptual framework' to be explored and refined with empirical studies in different countries, it organises skills in five categories (Lamb et al., 2015, p. 15):

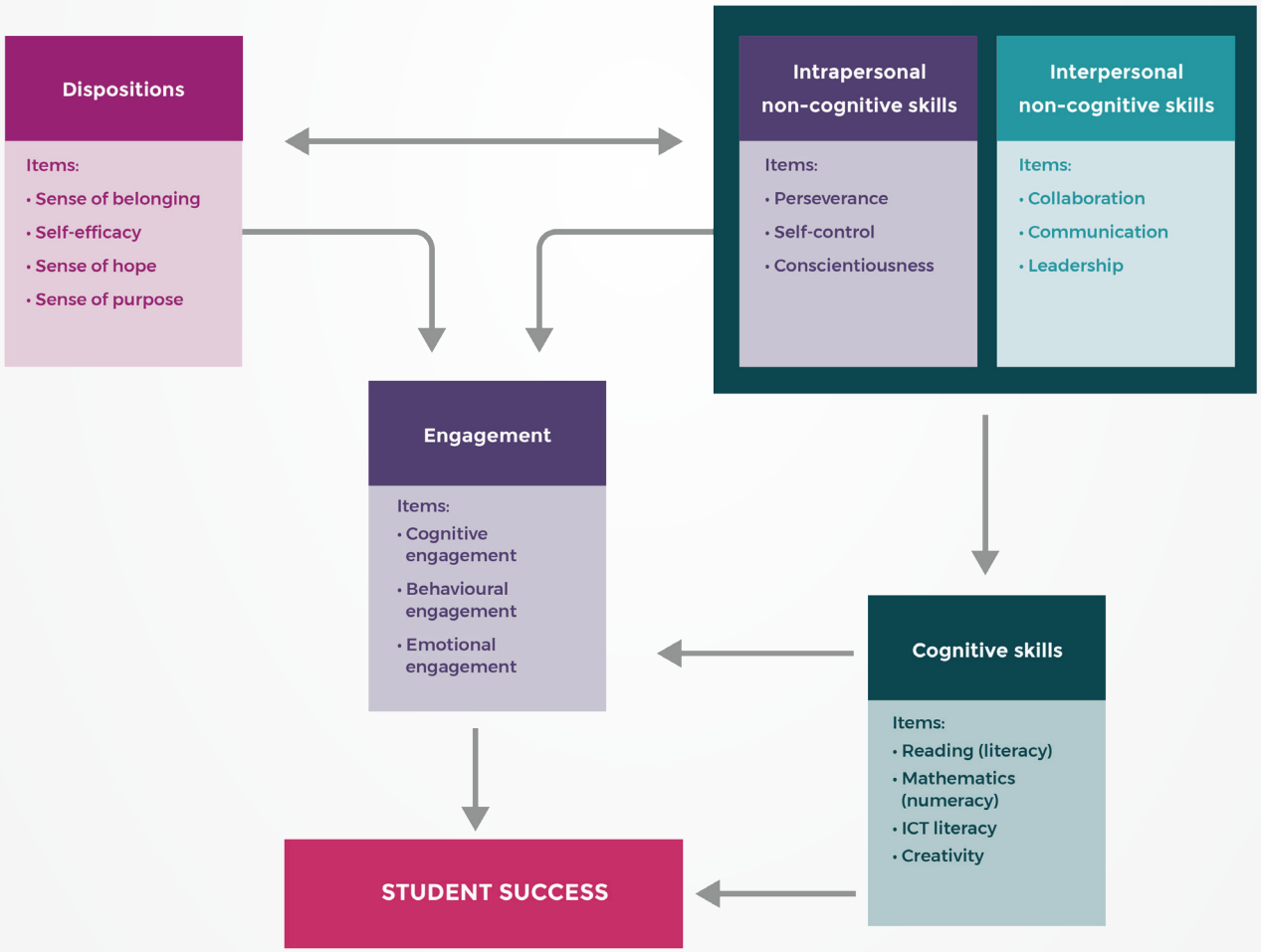
In this model, student engagement mediates the influence of dispositions and inter- and intra-personal skills on student outcomes, while cognitive skills act as both direct and indirect influences. The analytical coherence of this framework and the extent to which various kinds of skills shape student success is currently being researched. One of the main strengths of this framework is its explicit focus on educationally-relevant skills and its comprehensive integration of traditional academic skills (i.e. literacy and numeracy) and non-traditional skills (including social skills). Moreover, it is one of the only frameworks in which the grouping of constructs into broader categories was grounded in an empirical analysis (using principal component analysis with international data) rather than *a priori*. Unlike the P21 and ATC21S frameworks, ICT-related skills are included in the 'cognitive skills' category. On the other hand, the distinction between cognitive and 'other' skills remains. The analytical separation between intra-personal skills, such as conscientiousness and perseverance, and student engagement may also be difficult to sustain since student skills and dispositions are generally

visible in behaviours only (even though they can be measured indirectly in self-rating questionnaires). Finally, further analysis is needed to determine the extent to which these theoretical constructs are helpful for teachers and systems to use and whether they result in improved student learning and development.

Key skills for the 21st century

The reason for presenting the organising frameworks was to offer an overview from different sources of the range of skills seen as important for education in the 21st century. All focus on student learning and progress, and propose comprehensive sets of skills that influence young people's future success. The models recognise the importance of cognitive skills, but also emphasise the role of other sorts of skills such as those associated with social and emotional learning and student dispositions towards and engagement in learning. The different sets of skills included in the frameworks form models of relationships representing the mechanisms by which student skills and dispositions shape student learning and future success.

Figure 2-5 International Study of City Youth Framework for 21st Century Skills



Source: Derived from Lamb et al., 2015

While the frameworks are useful as a preliminary classification of the complex phenomenon understood under the concept of 21st century skills, it is also important to explore individual skills in depth, in order to identify the evidence supporting their importance for schools. Therefore, attention now turns to the individual skills that the literature identifies as vital for young people to acquire in order to do well in school, work and the world more broadly. For each skill, existing literature was reviewed to clarify the meaning of the construct, its relationship with academic performance, its malleability in educational contexts and its possible transferability. It is important to note at the outset that more work is needed to gain a comprehensive understanding of each skill. The case-by-case overview below presents just a brief outline of current research on the most commonly cited skills.

Nine skills or constructs are presented:

1. critical thinking
2. creativity
3. metacognition
4. problem solving
5. collaboration
6. motivation
7. self-efficacy
8. conscientiousness, and
9. grit or perseverance.

This list, while not exhaustive, highlights the skills that have received the most attention in recent educational policy and research. It is also important to note that this section does not provide a systematic analysis of the complex relationships existing between the different constructs, though the importance of this is acknowledged. Rather, relationships between skills are considered on a case-by-case basis, when it is important for making sense of linked constructs and their educational relevance.

It is also worth noting that there are important skills not analysed in this report. The teaching of literacy and numeracy skills, for example, is well established and accepted as a legitimate and critical part of the goals of schooling. So too it is assumed that quality schooling encompasses an appropriate breadth and depth of core subjects. For this reason, they are not discussed in this report. ICT-related competencies, defined as the mastery of various technology-based environments and tools, are also now stated learning objectives in Australian schooling, and their formalisation into teaching, learning and assessment materials and practices is becoming well established. An in-depth study of this and digital literacy more broadly, whilst acknowledged as important components of many 21st century frameworks, is considered outside of the scope of this current investigation.

Critical thinking

Critical thinking as a concept has a long tradition of research in different fields. Critical thinking research primarily involves two academic communities: cognitive psychologists on the one hand (Halpern, 1998) and philosophers on the other (Ennis, 1991)[1]. These communities have contrasted conceptions of critical thinking. While cognitive psychologists tend to emphasise the cognitive processes and ways of thinking that define critical thinking, philosophers tend to outline the ideal dispositions and attributes of a critical thinker. Despite their disagreements, researchers from different traditions agree that critical thinking entails a *judgement or evaluation* for analysing claims, arguments and evidence and for making inferences using deductive and inductive reasoning to solve a problem or make a decision (Lai, 2011; Lai & Viering, 2012, p. 12). Critical thinking as a skill refers to the ability to assess the value of a claim or information and come to a conclusion about what to believe or to do about it. This could be taken as a generic definition of critical thinking.

While the psychological stream of research has received more attention than the philosophical one,

including in educational debates, critical thinking researchers from all horizons recognise that cognitive processes and modes of thought are insufficient to exhibit critical thinking. Dispositions (or 'habits of mind') are an integral part of critical thinking as well (Facione et al., 1990; Facione, et al., 1995). The most commonly mentioned dispositions include open-mindedness (Bailin et al., 1999b), inquisitiveness (Facione et al., 2000), the desire to seek information (Ennis, 1985) and a willingness to consider the point of view of others (Facione et al., 1990).

As with all the skills discussed in this report, the question of the generality or domain specificity of the skill divides researchers. This is a major tension in the research on skills in general. Nevertheless, critical thinking researchers tend to agree that a level of background knowledge is imperative for thinking critically (Bailin et al., 1999a; McPeck, 1990; Toplak & Stanovich, 2002; Willingham, 2008). To think critically, students need to apply thinking on *something* for which they need certain content knowledge, and a lack of content knowledge hinders the expression of critical thinking skills.

There is also the matter of context dependence. Students may be skilled at thinking critically in mathematics while failing to do so in English or science (Lai & Viering, 2012, p. 44). Yet, there is no consensus on the *extent* to which critical thinking is context-dependent (or domain specific), partly because of the different meanings given to domain specificity by different researchers. This lack of agreement on the meaning of a 'general' or 'specific' skill is another framing line of the entire field of research on skills.

The lack of agreement on the degree of domain specificity for critical thinking implies, by definition, that researchers do not agree on the extent to which critical thinking is a transferable skill. Little research exists that examines the conditions of transferability of critical thinking across tasks within a subject or across subjects within the curriculum (not to mention transfer beyond the classroom and the education system). Definitional and measurement issues make this type of research difficult to conduct.

The malleability of critical thinking is less debated than its context specificity. Researchers have accumulated reliable evidence—including a meta-analysis of previous research—showing not only that critical thinking can be developed and learned, but also that it can be learned at school, i.e. instructional interventions support the development of critical thinking skills (Abrami et al., 2008; Kennedy et al., 1991; Lai, 2011). In other words, based on the way critical thinking is commonly defined and measured in the literature, critical thinking is a teachable skill.

There is little research investigating whether critical thinking is a correlate to higher student achievement in school or to longer term outcomes linked to work, social integration and citizenship. Tentative results have been found for an association between critical thinking skills and achievement in a narrow range of contexts in higher education (Gadzella et al., 1997; Williams et al., 2003), but more research is needed at different levels of education and in other contexts to obtain more conclusive results. Nevertheless, critical thinking is, along with possibly metacognition, one of the most well-researched skills.

Creativity

Creativity is often associated with critical thinking in discussions on skills. The Australian Curriculum, for example, acknowledges the strong links between them through the general capability of 'critical and creative thinking'. In some respects, this is understandable, since critical thinking is often seen as a condition for creativity and vice versa. At the conceptual level, however, critical thinking and creativity can be distinguished in a meaningful way.

The same absence of consensus over the meaning of the construct is as evident in research on creativity as it is on critical thinking. There is no agreed-upon definition of creativity that most researchers use, even though most argue that it entails the production of something recognised as novel or useful in a given social context (Plucker et al., 2004). The fact that an output must be *socially recognised* as valuable

(in addition to being original) to be considered as creative highlights that (1) creativity is a skill sitting at the intersection between the individual and society, and (2) creative skills can be restricted to specific social contexts.

The social 'situatedness' of creativity explains the difficulty researchers have in addressing the question of transferability. Since accepting a product or performance as creative rests on a social judgement, the degree of originality needed to label something as creative cannot be decided *a priori*.

Another similarity with critical thinking is that creativity is generally seen as requiring more than technical skills (Sternberg, 2006a). Important dispositions and related skills underpin students' creative abilities, such as motivation, the ability to take risks, open-mindedness to new ideas and a capacity to tolerate ambiguity (Sternberg, 2010). Creativity is also seen as closely related with other cognitive skills such as problem identification, idea generation, and problem solving.

As is common with most skills mentioned in this review, the question of the context-dependence of creativity is highly debated (Baer, 2016; Barbot et al., 2016). A wide range of theories of creativity exist (e.g. developmental, economic, psychometric, cognitive, problem-based, evolutionary, typological) with different approaches to the meaning of creativity and its context dependence (Kozbelt et al., 2010). Some of these approaches highlight the importance of social and cultural contexts for creativity (Lubart, 2010) and the context specificity of creativity even within a given domain (e.g. art) (Lubart & Guignard, 2004), while others argue that creativity is both a general and domain-specific ability (Milgram & Livne, 2005; Plucker, 2005; Sternberg, 2005). Drawing on these arguments, it appears that creativity depends on a familiarity with contextual knowledge, but the extent to which it is possible to identify generic components to creativity is uncertain. At the very least, current empirical research suggests that creativity cannot be considered as generic only (Han & Marvin, 2002).

Creativity has received particular attention from researchers interested in gifted and talented education (Guignard et al., 2016; Runco, 1993). While the extent to which creativity can be developed by all students in educational contexts is unclear, it is generally believed that creativity is not a skill reserved to a small minority of students only. Developing creative skills is accessible to all students when adequate didactical and pedagogical conditions exist. Anecdotal evidence also suggests that deliberate interventions can improve student creativity in educational contexts (Maker, 2004).

Interestingly, creativity has been found to be a good predictor of future achievement (in higher education), even after accounting for past academic results (Sternberg, 2006b). As with most critical skills, however, the results are overwhelmingly correlational in nature: there is no agreement on the causal relationship at play between creativity and student success.

Metacognition

The term 'metacognition' was used by Flavell to describe thinking about an individual's cognitive processes and activity (i.e. thinking about thinking, or meta-thinking) (Flavell, 1979). This form of cognitive self-management (Kuhn & Dean, 2004) is a complex skill comprising both cognitive self-knowledge and active cognitive self-monitoring (Schraw et al., 2006; Schraw & Moshman, 1995).

Metacognition is often subsumed under the broader term of 'self-regulated learning', encompassing 'the set of intrapersonal processes by which individuals remain on course in their pursuit of goals they have adopted' (Hoyle & Davisson, 2011, p. 6). As a dimension of self-regulated learning, metacognition is associated with improved learning and academic performance (Ford et al., 1998; Pintrich & de Groot, 1990; Winne & Nesbit, 2010; Zimmerman, 1990). Yet, the literature still faces issues for making sense of the firmly established correlation existing between self-regulated learning and academic achievement, especially since the emergence of a consensus on

an adequate instrument for assessing self-regulated learning is yet to come (Lennon, 2010). One of the main ways in which self-regulated learning in general (and thus metacognition in particular) appears to influence academic achievement is through students' sense of agency (Hacker et al., 2009).

The question of the domain specificity of metacognitive skills is a complex debate extending beyond the pure question of definition and measurement. The domain specificity of skills such as metacognition is a theoretical and empirical question that shapes the educational use of psychological research and evidence (Dunlosky et al., 2009). While it is possible to develop a relatively general level of metacognitive knowledge, metacognitive monitoring is shaped by the task at hand or the problem to be solved. As with all other skills, the domain specificity of metacognition (and self-regulated learning skills in general) is uncertain (Tobias & Everson, 2009). Psychologists have progressively come to emphasise the social aspects of self-regulation (Alexander, 1995; Pressley, 1995), and the contextual factors shaping metacognitive regulation are to be taken into consideration.

Metacognition can be taught and metacognitive skills tend to develop over the school years (Bryce & Whitebread, 2012; Schneider, 2008, 2015; Veenman, 2015; Weil et al., 2013). An analysis of research on metacognitive teaching strategies, published in 2014, reported a range of effective strategies for promoting metacognition for both primary and secondary school students, concluding that "metacognitive strategies are applicable across different disciplines and grade levels and they are effective for teaching both content knowledge and academic skills." Instructional practices most frequently used included teacher modelling with Think Aloud, diagramming, practice, answer checking, checklists, and goal attainment (Ellis et al., 2014, p. 4021). A similar study looking at the application to science teaching reported that among effective classroom strategies were enquiry-based learning, the role of collaborative support, strategy and problem solving instruction, and the construction of mental models. These instructional strategies were identified, according to the authors, because they reflected extensive research over the previous decade within the science education literature and were essential to metacognition and self-regulation (Schraw et al., 2006).

Metacognition is seen as involving both knowledge about cognitive processes and strategies for monitoring these processes (Serra & Metcalfe, 2009). The development of student metacognition is best engaged in specific curriculum areas, since metacognitive skills depend on content knowledge and expertise (Bransford et al., 2000). Teaching metacognitive skills can be organised systematically, and researchers recommend doing so within the context of subject areas (Bransford et al., 2000, p. 21). Adopting a metacognitive approach to student learning in school subjects can help them in taking ownership of their own learning and developing the sense of agency mentioned above (Bransford et al., 2000, p. 18; Hacker et al., 2009).

Problem solving

Problem solving is a core skill relevant to most academic activities, but also to most tasks in the workplace. Problem solving is traditionally seen as having three main components involving: (1) the selection of strategies to solve a given problem, (2) the application of strategies to this problem, and (3) the monitoring of the strategies used to solve the problem (Newell, 1990). Metacognition (the third component) is thus an integral part of problem solving. In most conventional measures of cognitive ability, complex problem solving is one of the skills being tested. It is thus logical that (complex) problem solving is associated with cognitive ability (Greiff & Neubert, 2014; Lotz et al., 2016; Stadler et al., 2015).

In the context of education, the OECD has defined problem solving as follows (OECD, 2014, p. 30):

'An individual's capacity to engage in cognitive processing to understand and resolve problem situations where a method of solution is not immediately obvious. It includes the willingness

to engage with such situations in order to achieve one's potential as a constructive and reflective citizen'

Based on its review of 21st century skills, the US National Research Council places a particular emphasis on problem solving and metacognition as part of their overview of transferable skills (Pellegrino & Hilton, 2012, p. 169). Both are cognitive skills that have a demonstrated relationship with improved educational outcomes, although this relationship is mainly expressed via an improvement in cognitive ability. For example, a recent study showed that problem solving is not correlated with academic achievement once cognitive ability is accounted for, except in mathematics (Lotz et al., 2016). However, the extent to which problem solving is associated with academic performance after accounting for cognitive ability depends on the definition and measurement of cognitive ability and problem solving (Greiff & Neubert, 2014; Stadler et al., 2015). Generally speaking, problem-solving skills seem to have broad ranging relevance in academic contexts and beyond.

Problem solving is one of the key skills for which the possibility of transfer is most promising. Problem solving skills can be transferable when students understand the 'underlying principles of what was learned' when encountering the initial problem (Pellegrino & Hilton, 2012, p. 98). However, it is important to note that such transfer is only likely to occur when faced with structurally comparable problems, often within a given subject. Another important condition is to teach specifically *for* the transfer of problem solving skills rather than assuming that the transfer will take place automatically (Phye, 2001). Student understanding of the 'underlying principles' behind a problem and its solution(s) can be supported through instruction, as is the mental representation of a problem and the ability to navigate different representations of a problem (all elements of transferable problem solving skills). This provides supporting evidence that problem solving skills are malleable and susceptible to improvement within educational contexts.

Structuring student learning around problems to be solved can be beneficial for a range of cognitive skills. Learning activities structured around problems to solve or projects to conduct seem to be prime vehicles for the acquisition of transferable cognitive skills (Pellegrino & Hilton, 2012, p. 147). Ideally, such problems should be authentic and grounded in scenarios common to daily life, but these types of learning activities are much more difficult to assess in a standardised manner.

Promising recent developments have emerged in collaborative problem solving, based on the premise that these skills are most useful in the types of problems encountered by workers in Western economies. The OECD's focus on collaborative problem solving in PISA 2015 (OECD, 2017) is an interesting initiative. It is also worth mentioning that researchers have developed a framework to teach collaborative problem solving that breaks the construct into social and cognitive skills that students need in equal measure (Hesse et al., 2015). Problem solving may provide an avenue through which education systems could support more collective forms of learning and assessment, requiring interpersonal skills such as cooperation.

Collaboration and cooperation

In some respects, interpersonal skills such as collaboration and cooperation are the most contentious skills amongst those discussed in this report. Collaboration is often conceived of as a social skill, alongside assertiveness, responsibility and empathy (Malecki & Elliott, 2002). In addition to customary definitional issues about the meaning of 'collaboration' and 'cooperation', 'there are few well-established practical assessments for interpersonal competencies that are suitable for use in schools' (Pellegrino & Hilton, 2012, p. 148). The difficulty in measuring collaboration in schools (Webb, 1995, 1997) makes its systematic inclusion into classroom practices problematic.

Most education is structured around individual learning and assessment, and the role of collaboration and cooperation is only recognised at the margins of individual student learning. Compared to most other skills, social skills such as collaboration, empathy or responsibility tend to have a weak correlation with student grades (Farrington et al., 2012, p. 11). No clear consensus emerges from the literature on social skills and achievement across all stages of education. Most of the research on the relationship between social skills and academic performance has been conducted at the primary school level. Longitudinal research suggests that social skills can predict achievement in primary and secondary education (Teo et al., 1996). A more recent meta-analysis asserts that social skills are associated with academic learning in schools (Durlak et al., 2011). However, in their review of social skills, Farrington et al. (2012, p. 48) outline the difficulty of drawing any conclusions from the literature on the relationship between social skills and academic achievement since most studies 'confound social skills with other variables'. In fact, most correlational studies provide little information as to the direction of the relationship between constructs.

However, it would be a mistake to expect a technical answer to a political or social question. Just as correlations between individual skills and academic achievement are insufficient to turn these skills into legitimate learning outcomes, the lack of association between interpersonal skills and academic achievement is not sufficient for regarding the skills as legitimate learning outcomes. Indeed, the lack of association is largely a consequence of the way academic achievement is currently defined and measured, i.e. as the individual mastery of knowledge and skills in specific disciplines or areas of knowledge. In fact, certain collaborative practices in the classroom can foster student learning (Bossert, 1988).

While the recent OECD initiative of including collaborative problem solving in PISA 2015 is an original endeavour, inferring individual competency from group performance remains problematic (Dijkstra et al., 2016; Frykedal & Chiriac, 2011; Webb, 1993), even with the use of information technology.

Motivation

Motivation is a field of research with a longer history than most other skills. It is often defined as the impetus to engage in purposive behaviour (Ryan & Deci, 2000). The literature has come to distinguish intrinsic motivation, where individuals are moved by personal interests and desires, from extrinsic motivation, where individuals' purposive behaviour is driven by external rewards or sanctions. Although the distinction between intrinsic and extrinsic motivation is not always clear-cut, this dichotomy offers the advantage of facilitating empirical research on interventions aimed at enhancing motivation. In short, motivation is based on specific interests, preferences, and perceptions that drive individuals to engage (or not engage) in an activity.

Motivation researchers have progressively come to uncover a 'greater complexity of motivational processes and multiple levels of influence' than previously envisaged (Wentzel & Wigfield, 2009, p. 2). Motivation is a multifaceted construct aggregating beliefs, values, goals and needs (Wentzel & Wigfield, 2009). The growing recognition of social and contextual influences on student motivation has also resulted in a more elaborate conception of motivation. Moreover, motivation is related in complex ways with other dispositions and skills. The next section shows that self-efficacy and locus of control are associated with student motivation. Similarly, interests (Hidi & Harackiewicz, 2000; Hidi & Renninger, 2006) and goals (Broussard & Garrison, 2004) shape student motivation for academic tasks and thus indirectly influence their educational chances. This increasingly sophisticated picture of student motivation has made the task of conducting applied research on 'best practice' in school settings more difficult.

Categorising motivation as a skill is somewhat questionable, since identifying motivation as a form of developing expertise raises conceptual

challenges. Based on the *International Study of City Youth* framework, it is perhaps best described as a disposition or mindset expressed through behaviours and engagement. In any case, researchers have found a stable association between motivation and performance in mathematics and reading, especially in elementary school (Broussard & Garrison, 2004; Gottfried, 1990). Motivation is also associated with transferable learning (Yeager & Walton, 2011): students who are motivated by an activity, problem or subjects are more likely to develop transferable knowledge and skills (at least within a certain area of transfer) in this activity. However, this must not be interpreted as meaning that motivation itself is a generally transferable skill.

In fact, in the field of motivation research, domain specificity is more firmly established than it is in research on critical thinking or creativity. Moreover, the domain specificity of motivation is not identical for all students: empirical research suggests not only that academic (intrinsic) motivation tends to decrease with age, but also that particular subjects influence this trend, with motivation declining at a greater rate in mathematics than in social studies (Gottfried et al., 2001). This confirms that the structures of the curriculum and the educational conditions in which students are placed can affect their level of motivation. One general implication from this finding is that academic motivation can be taught and learned, and a range of effective interventions have proven successful at fostering student motivation in schools (Wigfield & Wentzel, 2007). A recent meta-analysis of academic motivation interventions found them to be generally effective (Lazowski & Hulleman, 2016).

Self-efficacy and locus of control (sense of agency)

As suggested above, motivation is shaped by perception of self and the task or problem at hand. In this respect, self-efficacy, defined as perceived ability to succeed, as well as sense of agency (i.e. locus of control), defined as belief that you are in control of the outcome of the activity, underpin motivation (Bandura, 1982, 1993; Eccles & Wigfield, 2002; Pintrich & de Groot, 1990). This is a clear illustration of the complex web of relationships existing between various dispositions, attitudes and skills. At a conceptual level, this complex web of relationships may also allude to the existence of mechanisms of circular causation at play between various skills which are generally measured independently.

Self-efficacy and locus of control are often studied together in the literature, as they both refer to an individual's sense of control over the outcome of a task or activity. As noted above, self-efficacy can be defined as a belief in one's own ability to do or complete something and can be expressed with the statement 'I can do it' while locus of control is the sense of influence an individual feels over things and can be expressed with the statement 'Doing well is up to me, rather than others'. Both of these mindsets have been found to be consistently associated with student outcomes (Bandura, 1997; Cury et al., 2006; Pajares, 1996; Pajares & Graham, 1999).

The two constructs, sometimes labelled as 'academic mindsets' (Farrington et al., 2012, p. 10), have been shown to influence school success (as measured by student grades). They also have another feature in common: their influence on academic performance is primarily indirect, that is, via their impact on behavioural expressions measured by other constructs such as academic perseverance and motivation. Interestingly, student perceptions of the nature of cognitive ability are particularly important for shaping student behaviours. Students who see success as a product of effort are more likely to engage and persevere in academic endeavours as opposed to those who see it more as a product of 'innate' ability (Yeager & Walton, 2011).

While tentative evidence suggests that educational interventions can improve self-efficacy and sense of agency, further research is needed to broaden the evidence base (Yeager & Walton, 2011). Specific instructional and pedagogical approaches can support self-efficacy and locus of control mindsets, at least within the context of a given activity. This implies that the constructs are malleable and students'

self-efficacy and sense of agency are susceptible to change. The malleability of these academic mindsets has been demonstrated in experimental contexts, and contextual factors in more natural settings (e.g. a classroom) also shape students' sense of agency and self-efficacy (Farrington et al., 2012, p. 32). As mentioned above, supporting the development of metacognitive skills and practices is likely to enhance self-efficacy and locus of control beliefs.

One of the more uncertain aspects of research on these two constructs is the question of transfer. As the analysis of all the skills so far demonstrates, the question of the transferability is the most contentious area of research. As of yet, researchers seem to know little about the individual contextual and task-related conditions of transferability of skills.

Conscientiousness

As a first approximation, conscientiousness can be defined as a form of self-discipline. Conscientiousness is expressed as a diligent behaviour based on self-control and application to a given problem, task or activity. It is a multi-faceted skill, with some researchers identifying three facets: industriousness, impulse-control and orderliness (Costantini & Perugini, 2016) while others identify as many as eight dimensions (Rikoon et al., 2016).

Conscientiousness entertains complex relationships with various other skills, including motivation, locus of control and, above all, tenacity or grit. Conscientiousness is considered by personality psychologists as one of the big five personality traits, alongside openness to experience, extraversion, agreeableness and neuroticism. In differential psychology, these personality traits are seen as relatively stable over time (Matthews et al., 2009). They are often considered as useful signposts to characterising an individual's personality. While 'relatively stable' may be of little help in understanding the malleability of personality traits, a recent review of available evidence suggests that personality traits are at least 'not set in stone' (Almlund et al., 2011, p. 9) and can be shaped by educational experiences or other interventions.

Interestingly, conscientiousness is the only one of the 'big five' personality traits that shows a consistent association with performance in school and higher education (Farrington et al., 2012, p. 24; Richardson & Abraham, 2009; Tackman et al., 2017). Recent meta-analyses of previous research even suggest that the effect size for the association between conscientiousness and academic performance is comparable to the effect size for the association between cognitive ability (as measured with IQ tests) and academic performance (Poropat, 2009, 2014). Conscientiousness is also the only personality trait correlated with work performance across a range of performance measures (Barrick et al., 2001). Finally, amongst the competencies classified as 'non-cognitive' by the US Committee on Deeper Learning, conscientiousness (staying organised and being committed to study or work) is the one most highly correlated with desirable educational and occupational outcomes (Pellegrino & Hilton, 2012, p. 4).

Although the availability of causal evidence remains limited, conscientiousness seems to have a significant influence on achievement, above and beyond IQ (Duckworth & Seligman, 2005). In schools, this can take the form of 'academic tenacity' (Dweck et al., 2014). Although the importance of such academic mindsets for achievement seems well established, the evidence available for the ability to develop these skills in the classroom is scant.

Conscientiousness, like other personality traits, is a complex construct shaped by a range of developmental influences (Srivastava et al., 2003) and associated with a range of social factors (Furnham & Cheng, 2014). Evidence suggests that personality traits can change over time. They also depend on life experiences (Roberts & DelVecchio, 2000). Importantly for educational practice, persistence in a given activity or task can be supported by specific

interventions and the shaping of the environment. This bring us to the notions of 'perseverance' and 'grit'.

Grit and perseverance

Perseverance can be conceptualised as a dimension of conscientiousness. In an academic context, grit can be defined as commitment and perseverance in learning tasks and activities (long-term goals) despite difficulties (or obstacles). Academic perseverance or tenacity generally relies on goal-setting and accepting delayed gratification (Farrington et al., 2012, p. 9).

Answering the question of the malleability of perseverance depends significantly on the definition used. While the 'relatively stable' nature of conscientiousness, defined as a personality trait, would suggest that educational interventions aimed at improving student conscientiousness are fruitless if they focus on *academic perseverance*, specifically, research shows that this disposition or skill is malleable. As Farrington et al. summarise it: 'There is significant empirical evidence that students demonstrate different amounts of perseverance at academic tasks under differing conditions, supporting the idea that academic perseverance as a behaviour in a specific context is highly malleable' (Farrington et al., 2012, p. 24). In other words, if the context specificity of perseverance is taken into consideration and the focus is on *academic tenacity*, there is reliable evidence that perseverance is a malleable disposition or skill.

The flipside of this approach is that it complicates the question of transfer to other, non-academic contexts. Since academic perseverance is more specific than conscientiousness (defined as a trait), the malleability of academic perseverance does not imply that it will necessarily transfer to other contexts. Evidence is strong to support that demonstrating persistence in one activity does not necessarily translate into a persistent behaviour in other contexts. Yet, there is a recent construct that has gained currency in the psychology literature for its more generic conceptualisation than task specificity.

The concept of grit, as defined by Duckworth and her colleagues, refers to a relatively stable characteristic or trait of displaying continuous application towards tasks or perseverance on tasks (Duckworth, 2016). Findings on grit are contrasted. On one hand, research indicates that there is a significant association between grit and school grades (i.e. academic performance) (Duckworth & Seligman, 2005). On the other hand, 'despite the intuitive appeal of this idea, there is little evidence that working directly on changing students' grit or perseverance would be an effective lever for improving their academic performance' (Farrington et al., 2012, p. 7). In other words, the correlational nature of evidence between grit and academic achievement does not imply that students would benefit from interventions and practices specifically aimed at developing their grit (compared to other forms of interventions on cognitive skills such as problem-solving, for instance). In addition to being correlational in nature, the literature on grit or tenacity offers little clear implication for educational practice.

Conclusion

From the skill-by-skill overview, it is apparent that the different skills are similar to one another in some aspects but not in others. Overall, two key challenges evident in the literature on most skills are the issues of domain specificity and transferability. Both are relevant questions for educators and policy makers to consider in order to decide the suitability of specific skills for inclusion in teaching and learning. Before addressing these two issues, it is important to summarise some key observations from the discussion above.

The first point to be made is that defining the constructs considered to be the 'key skills' is not a simple task. Various academic fields are involved and there is no process in place for organising the convergence of approaches or agreeing on the meaning of terms. In fact, it appears that there is significant overlap between several of the skills included under the '21st century skills' banner, and several skills defined separately tend to measure the same thing, at least in part. This is the case for locus of control and self-efficacy, for instance (Judge et al., 2002). This absence of mutual exclusivity at

the construct level may be a first way of explaining the fact that authors have frequently noted that complex relationships exist between skills. For instance, Farrington et al. remark that 'many non-cognitive factors are mutually reinforcing and [...] relationships are often reciprocal' (2012, p. 11). Beyond this cyclical causation mechanism, key skills such as critical thinking and creativity, or motivation and metacognition have been described as conceptually interrelated in complex ways (Lai & Viering, 2012, p. 29).

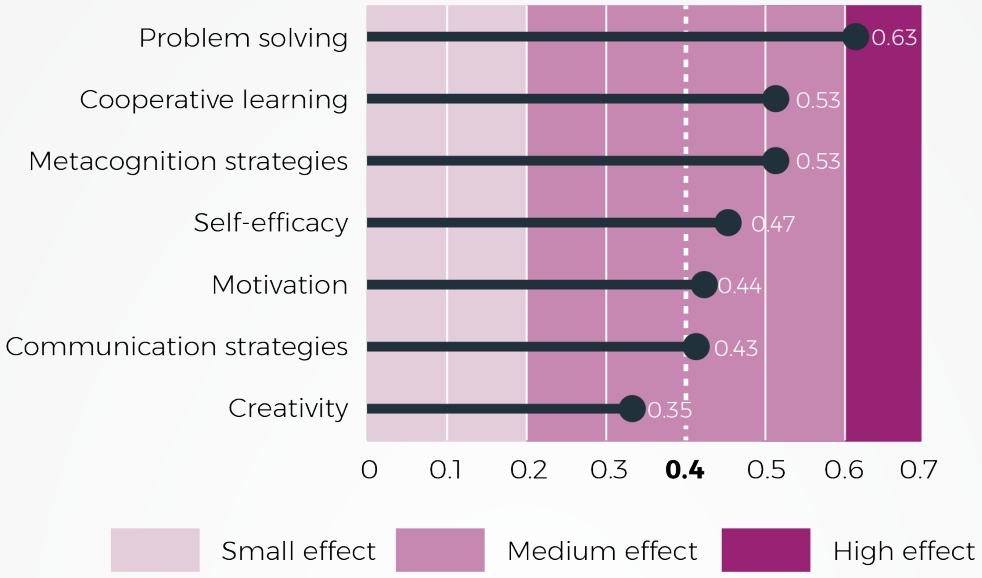
The next point to be made concerns the quality and volume of evidence available for the study of key skills. Research into these skills is less advanced than research into traditional academic skills such as numeracy and literacy. In particular, 'non-cognitive' competencies, as defined by the US Committee on Deeper Learning (i.e. inter-personal and intra-personal competencies), have received far less attention than those labelled as cognitive ones. One interesting finding to emerge is that, on the whole, the key skills listed in this chapter are reported to be malleable to some extent, with students able to develop levels of skill expertise. On the other hand, our understanding of the acquisition of the different skills remains limited (Binkley et al., 2012). Most of the cognitive and non-cognitive skills reviewed here seem to be especially malleable during childhood, which has important implications for early educational interventions in particular. At the same time, recent evidence also suggests that the skills not measured by cognitive tests are malleable until a later age than cognitive skills measured by IQ tests (Kautz et al., 2014), which can have implications for the later years of schooling as well. This is encouraging for the prospect of systematically teaching these skills beyond the early years or primary education only.

There is a large body of evidence demonstrating correlations between various skills and grades, test scores and academic achievement. A few studies have even developed convincing arguments of causal relationships between some of the skills and future student success at school and in the workplace. In his synthesis of prior meta-analyses, Hattie (2008) examined, among many other factors, the degree of association existing between a range of key skills and academic achievement. Based on an analysis of effect sizes, Hattie reported that among different skills and dispositions, motivation, engagement in learning, self-efficacy (and related self-concepts), and persistence (interpretable as a form of perseverance) were among the more significant correlates with traditional measures of academic achievement (Hattie, 2008, 2015). Other skills such as creativity show only a limited association with achievement. The effect sizes available for the skills covered in this chapter are presented in Figure 2-6. Effect sizes of 0.4 are considered average (Hattie, 2008). Scores between 0.2 and 0.6 could be considered as modest, below 0.2 as low and above 0.6 as high.

Creativity, motivation and communication are at the lower end of the scale, while problem solving, cooperative learning and metacognition are higher. Unfortunately, there is no estimation of the interrelationships between skills and their combined effects on achievement. This is a limitation, given that the constructs are not always clearly mutually exclusive and do not necessarily work independently of each other.

The epistemological vigilance needed when interpreting correlational studies is an important methodological principle for the broader literature on *all* skills. The existence of correlational evidence between a skill (or disposition) and success (school or work or life) *does not* provide evidence or proof that focusing on interventions to help improve such skills will lead to future success, and 'it is not even true that intense correlations are more likely to represent cause than weak ones' (Gould, 1996, p. 272). Finally, the existence of strong correlations between specific skills and success does not provide a *logical* foundation for intervention. The fallacy with this form of reasoning becomes evident with the example of social factors associated with valuable outcomes: the fact that higher socioeconomic status, for instance, is consistently associated with enhanced educational outcomes has never been used as a justification to design interventions aimed at changing students' socioeconomic status.

Figure 2-6 Estimated relationship of selected skills with academic achievement based on effect sizes



Source: Hattie, 2015

However, the results still have two important implications. First, a complex range of skills, dispositions and attitudes, is associated with—and hypothetically influences—student outcomes. Second, all the different skills and dispositions reviewed in this chapter do not appear to be equally associated with student outcomes. In addition, while the volume of research on the potential relationships between different constructs and academic achievement is large, there is little detailed and robust work discussing the relationships between key skills and career success and community life, for instance. 'The available research evidence is limited and primarily correlational in nature; to date, only a few studies have demonstrated a causal relationship between one or more 21st century competencies and adult outcomes' (Pellegrino & Hilton, 2012, p. 65). More research is needed, especially research going beyond cross-sectional designs and moving towards longitudinal analyses.

The findings from the case-by-case analysis have significant implications for the various frameworks on 21st century skills. Most of the frameworks propose that the skills they retain causally influence student outcomes, conceived in a broader sense than academic achievement. As our analysis of skills shows, the scientific literature is unclear about the extent to which many of these skills (or dispositions) directly impact on academic performance. At the same time, it should be acknowledged that traditional measures of student performance may be too narrow to capture some of the potential benefits that a focus on these skills might bring. The authors of all five frameworks presented above recognise the hypothetical nature of the causal mechanisms they include in their conceptual maps, and this is certainly one of their strengths. The gap between frameworks and research evidence suggests that more research is needed to understand the complex web of student skills and dispositions that *causally influences* student outcomes. Research would also benefit from examining how the *relationships* existing between different skills shape academic performance, rather than focusing on specific skills taken individually.

It is worth considering the question of domain specificity, which has emerged as an issue throughout the literature on key skills. This issue is as theoretical as it is empirical, since the definition

of a given skill largely determines its context specificity. Perhaps a more useful question to ask is not whether a skill is generic or specific, but rather which conception of a given skill is the most useful for educators and students to focus on. If we reflect on the usefulness of different conceptions of key skills, it is possible that these are best conceptualised as context-based 'dimensions of expertise that are specific to—and intertwined with—knowledge within a particular domain of content and performance' (Pellegrino & Hilton, 2012, p. 3) rather than as generic skills applicable to many tasks in a wide range of dissimilar contexts.

The question of domain specificity directly leads to the issue of transferability. To what extent can a demonstration of skill expertise in a given lesson or subject be evidence of the ability to use the same skill in other contexts? For example, to what extent can it be assumed that perseverance demonstrated by students in a task will be likely to transfer into perseverance in a different class of tasks? How different can these other contexts or tasks be until the transfer becomes much less likely to occur? These questions have proven challenging to answer for researchers, and more investigations are needed in this area.

A range of factors influences the ability to transfer across domains, including the learning model (understanding versus memorising), learning time, motivation, the approach to transfer (active versus passive) and the context of learning (Bransford et al., 2000). Transfer of learning is more likely to occur between closely related domains (near-transfer) than between unrelated domains (far-transfer) (Mestre, 2005). Overall, there are significant difficulties in transferring knowledge and skills between school and non-school contexts (Sala & Gobet, 2016). Although certain approaches to teaching and learning can facilitate transfer between tasks or situations *within* a given context (or area), 'over a century of research on transfer has yielded little evidence that teaching can develop general cognitive competencies that are transferable to any new discipline, problem, or context, in or out of school' (Pellegrino & Hilton, 2012, p. 8). Perhaps the main lesson to be drawn from this statement is that there is a need to adopt a more reasonable conception of the transfer of skills students learn in classrooms. The transfer of general principles *within subjects or curriculum areas* has received encouraging evidence, at least when effective pedagogical practices are used. Therefore, so long as there is not held an overly ambitious conception of transfer, the accumulation of evidence suggests that knowledge and skills learned in school can transfer to related domains if attention is paid to the conditions of acquisition and transfer (Bransford et al., 2000).

The conception of a skill as primarily context-dependent versus generic underpins the way skill transferability is approached, but it also raises the question of measurement. For researchers, the usefulness of a construct for understanding inter-individual differences is not entirely defined by the way this construct is measured. For educators, on the other hand, the instruments and techniques used for measuring student levels of expertise are crucial for the quality of educational practice. For any given skill to be considered as a legitimate learning outcome, teachers must be able to (1) systematically foster student skill acquisition in a learning progression, and (2) assess student levels of expertise for formative (and potentially summative) purposes. Skills can certainly be legitimate learning outcomes even if there is no way of measuring student levels of expertise with *standardised tests*, but they can hardly be legitimate learning outcomes if there is no way of monitoring student skill acquisition.

Finally, there is much that is not yet known about the key skills needed for the 21st century. The broad range of dispositions and skills students need to succeed in school and beyond can be unpacked with different frameworks of skills, and many of the constructs included in such frameworks display complex interrelationships between skills. Education systems around the world have attempted to come to grips with this complexity, and the next chapter illustrates the ways in which skills have been taken up by different systems.

3. Teaching skills for the 21st century

Introduction

As the previous chapter noted, current debates around the key skills needed for the 21st century encompass a wide set of behaviours, skills and dispositions. This chapter considers how different jurisdictions, including Australia, have sought to embed key skills for the 21st century within their education system. Seven case studies are presented to showcase a range of implementation models, with consideration given to their apparent successes and challenges:

1. Ontario, Canada
2. Alberta, Canada
3. New Zealand
4. Finland
5. California CORE districts, United States
6. North Carolina, United States
7. Australia

In addition to these, a case study of a curriculum framework—the International Baccalaureate—is provided given its particular focus on the articulation of skill acquisition within and across different subjects. The last section of this chapter will comment on the limited available evidence of impact by which to evaluate these policy steps taken by jurisdictions to embed 21st century skills within teaching and learning.

System case studies

Many countries have invested considerable effort in recent years to include a focus on 21st century skills in their school education systems. Nearly all OECD countries and partner economies have included a consideration of these skills in their national and subnational school education policies, including learning frameworks and curriculum standards (OECD, 2015). The case studies highlight the existence of policy to support the inclusion of key skills in schools, rather than point to evidence of change in terms of actual teaching, learning and student outcomes.

Ontario, Canada

Canada's education system is organised provincially, and there are 2.1 million students, 5,000 schools and 72 school districts within the Ontario education system (Beckett et al., 2017). There is a K-12 curriculum with identified knowledge and skills for students in each subject and grade level, and key skills for the 21st century are expected to be embedded across the curriculum (Beckett et al., 2017). The province is focused in particular on the development of the following, which are referred to as '21st century competencies' (Council of Ontario Directors of Education, 2017):

1. Critical Thinking and Problem Solving
2. Innovation, Creativity and Entrepreneurship
3. Learning to Learn / Self-Aware & Self Directed Learning
4. Collaboration
5. Communication
6. Global Citizenship and Sustainability.

Work is ongoing in terms of developing and implementing assessment measures for each of these competencies. Ontario has placed a strong focus on using information and computer technology to help develop these competencies and support teacher professional development. The province introduced a $150 Million Teaching and Learning Fund to help schools develop innovative and effective 21st century learning and teaching practices enhanced by technology (Beckett et al., 2017). This program helps to upskill the 'professional core', including teachers and school leaders, through professional dialogue and resource sharing. Participating schools design their own projects and, together with the evaluators

from Curriculum Services Canada, document each project's evidence of impact. To date there have been five funding rounds, and key findings of each project's evaluation are published in order to build a publicly available evidence base for what works best (Beckett et al., 2017, p. 10). Successful pedagogical models to build 21st century competencies have included flipped classrooms, blended learning, collaborative problem solving, inquiry, interdisciplinary projects, immersive authentic simulations, and digital learning platforms (Ontario Ministry of Education, 2016, p. 40). A key finding of evaluations to date is that these successful pedagogical models have implications for assessment practices as well, 'especially assessment *as* and assessment *for* learning' (Ontario Ministry of Education, 2016, p. 35).

Ontario's view is that 'the primary purpose of assessment and evaluation is to improve student learning' and their assessment mechanism places a strong emphasis on relevant skills (Ontario Ministry of Education, 2010). Every year the progress and provincial reports assigned by student name and Ontario Education Number are collated and stored centrally by schools and this data is not made publically available. Both the progress and provincial reports have templates that frame the importance of learning skills and work habits across all grade levels. In each report, teachers report specifically on six learning skills and work habits: responsibility, organisation, independent work, collaboration, initiative, and self-regulation. Interestingly, some of these concepts can be aligned to the 21st century competencies identified by the jurisdiction while others are loosely aligned. Each concept is evaluated on a scale of excellent – good – satisfactory – needs improvement, with plenty of space for teachers' comments. The report card template differs between primary and secondary levels, with different specifications. From Grades 1-8, the homeroom teacher is expected to complete the learning skills and work habits section, whereas in Grades 9-12 teachers in every subject area report on each learning skill and work habit (Ontario Ministry of Education, 2010). The district mandates that 'the evaluation of the learning skills and work habits, apart from any that may be included as part of a curriculum expectation, should not be considered in the determination of letter grades or percentage marks for subjects/courses' (Ontario Ministry of Education, 2010, p. 55). Despite the clear demarcation when it comes to assessment, the Ministry considers that 'the development of the learning skills and work habits is further strengthened through the achievement of the curriculum expectations' (Ontario Ministry of Education, 2010, p. 12)

Alberta, Canada

Alberta currently has 703,214 students, 2388 schools and 375 school authorities/districts (Alberta Education, 2017). The province has long engaged with the notion of a 21st century learner as a central fulcrum for their curriculum design. The Ministerial Order on Student Learning released in 2013 declared that education in Alberta should be reorientated towards ensuring that all young people are given opportunity through formal schooling to become engaged thinkers, ethical citizens and entrepreneurial spirits. These guiding statements are particularly pertinent in capturing their approach:

'Education in Alberta will be shaped by a greater emphasis on the education than the school; on the learner than on the system; on competencies than on content; on inquiry, discovery and the application of knowledge than the dissemination of information; and on technology to support the creation and sharing of knowledge than on technology to support teaching'

'Students will study subjects; learn reading, writing and mathematics; and focus more deeply on a curriculum that allows for more interdisciplinary learning through competencies that are explicit in all subjects'

(Alberta Education, 2015)

The jurisdiction has largely undertaken curricular development to work towards the aspirations set out in the Ministerial Order on Student Learning.

In 2010, they developed Alberta's *Framework for Student Learning*, a curriculum framework which outlined competencies that encompass the idea of a 21st century learner who can participate in a 'knowledge-based and globalised society' while also learning traditional subject areas (Government of Alberta, 2010, p. 9). Eight general competencies were identified:

1. Critical Thinking
2. Problem Solving
3. Managing Information
4. Creativity and Innovation
5. Communication
6. Collaboration
7. Cultural and Global Citizenship
8. Personal Growth and Wellbeing.

These competencies were defined as 'interrelated sets of attitudes, skills and knowledge that are drawn upon and applied to a particular context for successful learning and living' (Government of Alberta, 2016). Competencies 'transcend subject areas and are developed through learning approaches that include subject/discipline-specific learning outcomes' (Government of Alberta, 2010, p. 9). The learning objectives or tasks chosen by teachers within traditional academic areas provide students with the context to develop the identified general competencies. It is at the teacher's discretion as to how they embed the skills or competencies into learning opportunities within the traditional subject areas, since 'while Alberta Education determines 'what' students need to learn in provincial curriculum (programs of study), teachers use their professional judgement to determine 'how' students achieve the learning outcomes in the provincial curriculum' (Government of Alberta, 2016, p. 12). There is no information on how effectively teachers are embedding the competencies within their subject areas, or whether this has led to the system reorientation proposed in the *Ministerial Order on Student Learning*. Alberta now is undertaking a new curriculum redesign, to replace the older framework with the expressed goal to more explicitly incorporate the 8 general competencies across all subjects and all grades.

New Zealand

The case of New Zealand is interesting for its growing engagement with the question of non-traditional skills for education. Following a comprehensive review of the 1992 national curriculum, New Zealand adopted a new national curriculum in 2007, which included a renewed focus on 'non-traditional' skills (Ministry of Education, 2007a).

The revised curriculum is structured around five key competencies to be developed across the different learning areas:

1. thinking
2. using language, symbols and texts
3. managing self
4. relating to others
5. participating and contributing (Ministry of Education, 2007a).

Formulated as such, they seem rather vague (perhaps to enable their development across all learning areas) and hardly recognisable as 'skills'. However, the meaning of each one is developed in the national curriculum, including the skills that each type of competency requires. For instance, 'thinking' refers collectively to the skills of critical thinking, creativity, problem-solving and metacognition. 'managing self' encompasses student motivation, positive self-efficacy beliefs and locus of control, and resilience (i.e. grit). Meanwhile, 'relating to others' draws on key skills such as competition and cooperation (Ministry of Education, 2007a).

As this brief overview demonstrates, the New Zealand curriculum contains most of the skills discussed in the previous chapter (as well as additional skills) in its list of five key competencies. In terms of key skills for the future, the Ministry of Education considers that

students need to be given opportunities to 'become self-reliant, critical, and creative thinkers; to be team players; to learn to use initiative; and to engage in ongoing learning throughout their lives' (Ministry of Education, 2012). However, it seems unclear from policy documents how teachers and schools are meant to achieve this outcome.

The national curriculum provides little guidance as to how students are expected to learn and teachers to teach these skills. It is true that the articulation between curriculum areas and the key competencies is presented in another document (Ministry of Education, 2007b), but it only details learning outcomes across skills. The ways in which this form of learning is meant to occur is unclear. From the documents consulted in this review, little guidance is provided in terms of assessment, and there does not appear to be a systematic approach to teacher professional development to facilitate the desired transition between 'traditional' and 21st century learning. In short, it appears that New Zealand has developed a (primarily) *curricular mode of engagement* with key skills for the 21st century.

In the absence of centralised guidance, it appears to be the role of individual teachers to foster student skill development within their subject, even for cross-curricular competencies. There is no clear indication of cross curricular coordination for supporting the transferability of skills developed in specific subjects. Recent evidence suggests that the demand for the development of new skills has challenged school principals and teachers in their educational and leadership practices (Benade, 2017; Benade et al., 2014). Nevertheless, school-based initiatives driven by school leaders and teachers appear to have driven the development of pedagogical tools for facilitating the acquisition of non-traditional skills by students (Ministry of Education, 2012). Yet, with limited guidance, it is unclear whether teachers receive enough support to engage in a systematic and generalised conversion towards broader learning objectives.

The New Zealand Council for Educational Research has engaged in research aimed at evaluating how this new curriculum based on key skills actually transforms educational practices and student learning (Bull & Gilbert, 2012). The importance of changing teacher practice in order to change both the way learning takes place, and the skills students acquire when learning at school, is recognised in this literature. Here, the role of teachers' professional development is clearly emphasised (Bull & Gilbert, 2012). This stance represents a major step for progressing towards a comprehensive embedding of non-traditional skills in New Zealand schooling. Little evaluation has occurred as of now, and it can be expected that additional research will help gain a better understanding of the changes that have taken place in skill formation in New Zealand schools.

The New Zealand curriculum is driven by the overarching objective of helping students acquire the taste and skills for engaging in lifelong learning (Charteris, 2014). Learning to learn is at the core of the New Zealand curriculum, and the acquisition of a broad range of skills is meant to facilitate the development of dispositions towards lifelong learning (Bull & Gilbert, 2012). The acquisition of a range of skills is thus an end in itself and a means to enable further learning beyond school.

Various documents from the Ministry of Education and the New Zealand Council for Education Research display a strong enthusiasm for 21st century learning and for promoting a significant change in educational practice, to place New Zealand 'at the forefront' of educational innovation. It is interesting to note that some of the reference documents shaping the direction New Zealand education is taking are grounded in recent educational research (Bolstad & Gilbert, 2012). For instance, the Ministry of Education recognises that dispositions underpin the use of skills, and they include these as an integral part of students' developing expertise (Ministry of Education, 2007a). The Ministry also seems to think critically about the role of digital technology for 'future-oriented learning' and the acquisition of key skills for the 21st century (Ministry of Education, 2012).

In the case of New Zealand, it is clear that stakeholders promoting a new agenda for learning in the 21st century are very enthusiastic about it. The 'reinvention' of education as it is practiced in New Zealand schools is presented as an imperative to cope with the momentous transformations that would be altering the defining features of modern societies. The view is presented of a new paradigm or approach to learning, one of new concepts and frameworks used for thinking about student learning and skill development in the 21st century which breaks substantially from what learning meant and how learning was approached in the past (e.g. Bolstad & Gilbert, 2012; Ministry of Education, 2012). Comprehensive evaluations are underway to measure the extent to which current New Zealand school practices are positively influencing student learning and life outcomes compared to what was taking place at the turn of the century. Recent results from the 2015 national survey of secondary schools suggests that 'little progress [has] been made since 2012 in [...the] inclusion of the key competencies in students' learning opportunities' due to factors including heavy workloads, lack of time for collaborative curriculum planning and the demands placed on them by the national senior secondary school-leaving certificate (Wylie & Bonne, 2016, p. 2).

Finland

Finland has had a relatively long engagement with considering broader skills for success, and the inclusion of these skills into schooling has generally been aligned with the calendar of national curriculum reforms. The Finnish terminology for such skills is 'transversal competencies', alluding to their development across the curriculum.

Finland was one of the early adopters of key skills for the 21st century, with a particular emphasis on metacognition and the objective of 'learning to learn' (Adamson & Darling-Hammond, 2015). The implementation of 21st century skills into the Finnish curriculum occurred via national curriculum reform, starting with the 1995 Finnish framework for evaluating educational outcomes (Hautamäki & Kupiainen, 2014). By 2002, Finland had published its 'learning to learn' framework for basic education where learning to learn was defined as the 'ability and willingness to adapt to novel tasks' (Hautamäki & Kupiainen, 2014). Students were expected to acquire skills that would enable lifelong learning, in order to prepare them for life beyond school. In this perspective, the concept of 'learning to learn' involves the cognitive processes of thinking and reasoning, but it also 'comprises several motivational and attitudinal subsystems' (Hautamäki et al., 2002).

The Centre for Educational Assessment at Helsinki University collaborated with the National Board of Education to design the framework used for assessing 'learning to learn' in Finnish schools (Hautamäki et al., 2002). Rather than simply including the skills into the curriculum, Finland sought to build mechanisms so that teachers would be provided with instruments to *assess* student skill acquisition, even for non-traditional skills. The tasks retained for the assessment of 'learning to learn' included a multiple-choice question test, self-report questionnaires, and contextual (including background) variables (Hautamäki et al., 2002; Hautamäki & Kupiainen, 2014). It is important to note that this assessment framework was not imposed upon teachers, as they retained their autonomy for teaching and assessing students.

One of the strengths of the Finnish model of educational policy reform was its evaluation system. For the 'learning to learn' framework, Hautamäki and Kupiainen (2014, p. 173) note:

In total, some 120,000 students have participated in the different national, municipal, and school-level assessments between 1996 and 2013, providing one of the largest data sets worldwide of the competences and learning-related attitudes of students of different ages, gathered with statistically comparable instruments.

In addition to having a large amount of data, their longitudinal nature makes it possible to develop causal models of student learning and skill development. Research has been conducted

to examine inter-individual differences in student learning, revealing the importance of attitudes towards, and engagement in, academic activities (Vainikainen, 2014). However, it is relevant to note that to date evaluations of the impact of the skill reform on student outcomes are not readily available.

The national core curriculum implemented in 2004 presented seven cross-curricular themes, considered as the central emphases for student learning and development:

1. growth as a person
2. cultural identity and internationalism
3. media skills and communication
4. participatory citizenship and entrepreneurship
5. responsibility for the environment, well-being, and a sustainable future
6. safety (including road safety)
7. technology and the individual (OECD, 2015).

These themes were not characterised by a prominent desire to make students ready for the workforce, instead they tended to focus on other aspects of development and flourishing. Their objectives and focus were infused into the different curriculum subjects at various levels of education. This model of cross-curricular competencies, in which work skills were prominent, was the precursor to the national curriculum currently in place in Finland.

In the current national curriculum, 'learning to learn' is not a discrete objective, but has become one of the seven core competencies of the Finnish National Curriculum. The latest national core curriculum was adopted in 2014 and has been implemented in Finnish schools since 2016. The seven core categories of competencies for primary education in the new National Curriculum Framework are:

1. thinking and learning to learn
2. cultural literacy, communication and expression
3. managing daily life, taking care of oneself and others
4. multiliteracy
5. ICT-skills
6. entrepreneurial and work life skills
7. participation and building a sustainable future (Finnish National Board of Education, 2016).

The seven sets of skills represent a revised version of the previous transversal competencies, and the importance of work-related skills has been reasserted across several categories in the new framework.

One of the peculiarities of the Finnish education system is its educational governance model. In Finland, the National Board of Education designs national core curricula for the different levels of education, but these core curricula are then *retranslated* into local curricula, in order to take account of local needs for learning and teaching (Kaupinnen, 2016). In effect, there are three layers of curriculum in Finland: the national core curriculum, municipal curricula, and school curricula. The Finnish model of governance has been characterised as a combination of 'central steering [and] local decisions' (Finnish National Agency for Education, 2017a). This does not only apply to the curriculum: assessment is largely classroom-based in Finland and designed locally rather than nationally. In primary schools, for instance, school-based assessments include portfolios, self-assessment and performance assessment (Sahlberg, 2015).

The decentralised model of educational governance is evident in the way teaching and learning for transversal competencies occurs. 'Local authorities and schools are encouraged to promote the development of these competences and to consider their own innovative ways in reaching the goals' (EURYDICE, 2017). Teachers are expected to monitor and assess student development of transversal competencies in their own subject. Moreover, 'municipalities and schools have been able to further define the [transversal] competences

according to their individual areas of emphasis' (Finnish National Agency for Education, 2017b). This autonomy reflects a broader feature of Finnish education: teachers are expected to be pedagogical experts, researchers and leaders, and they have a comparatively high degree of autonomy (Sahlberg, 2015). The professional status of teachers underpins their involvement in professional development, where teachers can learn from other teachers—and schools from other schools—to support student acquisition of transversal competencies.

Given the decentralised nature of the Finnish school system, the limited weight of standardised assessment, and the discretion teachers and schools have to adapt the national curriculum to their local context (Sahlberg, 2015), the national guidelines for teaching and learning key skills are limited. Teachers' professionalism and their engagement in professional development is seen as the best way to support their expertise in fostering student acquisition of the transversal competencies. In the English-speaking literature, little is known about the ways in which the curriculum (including the seven key competencies) is applied into daily practice of teaching and learning. Since schools and teachers' autonomy is a defining feature of the Finnish education system, it is plausible that that the development of tools and techniques for helping students learn key skills is deliberately a grassroots movement in Finland. In other words, there is no standard model of best practice for the teaching and learning of key skills, since local needs determine the best ways of meeting them.

In summary, Finland has adopted a *curricular mode of engagement with skills*, defined as transversal competencies, to be taught by teachers in their respective subject(s). Finland has developed instruments to help teachers assess student acquisition of these transversal competencies, and the elaboration of adequate teaching methods or pedagogies appears to be purposely left to teachers and schools' discretion. In this respect, the model seems more comprehensive in its embedding of key skills in the school system than similar skill models in other countries (New Zealand, for instance). Although little evidence is available in the English-speaking literature on how teachers foster the development of skills in their students, it can be hypothesised that the pedagogical models commonly used in Finnish school (e.g. cooperative learning and peer coaching) are used for the acquisition of transversal competencies as much as for subject-based knowledge and skills.

California CORE districts, United States

There is much variability between states and school districts in the United States in school governance. States have responsibility for the majority of educational decisions and policy, and within them school districts can have a high degree of autonomy as well. There is no national curriculum in the United States, neither is there a mandatory guiding statement for states to adhere to which emphasises the value of key skills within educational policy. Recently there has been the development of the Common Core State Standards for Mathematics and English Language Arts, but these standards in no way prescribe teaching and learning in the classroom context.

In the state of California, eight of its largest school districts (Fresno, Garden Grove, Long Beach, Los Angeles, Oakland, Sacramento, San Francisco and Santa Ana Unified) have formed a coalition, called the CORE Districts, to 'improve student achievement by fostering highly-productive, meaningful collaboration and learning' (CORE Districts, 2013). The CORE districts represent over one million students and 1,500 schools. The intention of the group is to facilitate high and low-performing schools working together to build capacity across the districts by offering professional development, tools, research, and opportunities to support educators and district leaders in sharing best practices and lessons learned (Transforming Education, 2016).

A big focus for the CORE districts is the development of skills that they have advanced by building the measures into their school performance framework, as opposed to relying on the development of

curricular standards more common in other jurisdictions. In 2013, the CORE districts were granted an exclusion from Federal educational accountability requirements and enabled to develop their own School Quality Improvement System (SQIS) (Transforming Education, 2016). The SQIS is a comprehensive approach to assessing school performance, including both academic and non-academic measures (Transforming Education, 2016). This multi-metric index used within the SQIS includes a non-traditional measure along with academic test scores which broadens their accountability regime compared to others in which the focus is more on typical student performance data (Whitehurst, 2016a). Forty percent of the total assessment is linked to school climate indicators (absenteeism rates, student/staff/parent climate surveys, suspension/expulsion rates and English Language Learner (ELL) re-designation rates) in addition to four measures of student skill development gathered via self-reported surveys. The four measures are:

1. growth mindset
2. self-efficacy
3. self-management
4. social awareness.

The four measures together constitute eight percent of the total school performance index and were chosen as they were regarded as meaningful, measurable and malleable. The SQIS was designed and implemented in the CORE district to counteract 'the type of punitive and compliance-orientated accountability that operates in so many education systems' (Transforming Education, 2016). The ability of the CORE districts to track the development of what they term social and emotional skills is designed to provide data for schools and districts to better understand the interconnection these concepts have with student outcomes (Transforming Education, 2016; West, 2016).

Trialling of the mechanisms by which to collect the data concerning skill development has commenced, and a full field-test of the refined survey was run in 2015 with 1,500 schools (Transforming Education, 2016). More information on this and the robustness of this method of evaluation is discussed in chapter 4. Early findings are that schools with similar levels of academic performance do vary in terms of the information collected on student skills. Preliminary findings are that self-management best predicts student performance at elementary and middle school, while growth mindset is the most predictive skill in terms of high school student performance (Transforming Education, 2016).

Researchers are uncertain whether the CORE District's focus on social and emotional learning skills as a pillar of accountability will 'alter teacher practice and, ultimately, student achievement' (West, 2016, p. 7). However, the district is putting in resources to assist their development. The district has funded some employees to have Social-Emotional Learning Fellowships to play a leadership role in their districts to support socio-emotional learning survey administration, practice improvement and data reporting (Krachman et al., 2016, p. 24). There are toolkits for teachers to use to encourage growth mindset, self-efficacy, self-management and social awareness, which are downloadable and designed to be used by all teachers across all subjects and year levels. The toolkits have been developed in conjunction with the experts in each of the fields. Schools and districts with poor performance on any aspects of the accountability system also gain access to increased levels of professional development and support, designed to assist in the teaching and learning of key skills.

North Carolina, United States

The North Carolina Public Schools district has close to 1.5 million students in the public sector and approximately 78,000 students in charter schools (Public Schools of North Carolina, 2016). The mission of the North Carolina State Board of Education is to have 'every public school student graduate from high school globally competitive for work and postsecondary education and prepared for life in the 21st century' (Public Schools of North Carolina, 2015). To achieve this, North Carolina adopted the

P21 Framework for 21st Century Learning, designed and coordinated by a non-profit organisation with substantial funding from technology companies (Partnership for 21st Century Learning, 2015). There are currently 21 jurisdictions in the United States that have made a commitment to include the P21 framework right across all facets of the school system including standards, assessment and professional development. The framework has four general concepts:

1. Life and Career Skills
2. Learning and Innovation Skills (4Cs - Critical Thinking, Communication, Collaboration, Creativity)
3. Key Subjects (3Rs and 21st Century Themes)
4. Information, Media, and Technology Skills.

Participating states, including North Carolina, encourage teachers to embed these key concepts into teaching and learning within all subject domains, however it is largely up to each teacher and school to decide how they will integrate components of the framework into their pedagogy and practice to have maximum impact on student learning. P21 provides resources and definitions of each concept but it does not provide content or achievement standards.

The North Carolina Board of Education endorsed the integration of 21st century skills into teaching and learning by mandating their inclusion within the North Carolina Teaching Standards in 2007. The standards describe the key role that teachers have in developing the skills and also which skills North Carolina views as particularly important. In one standard (Standard III: 'Teachers Know the Content They Teach'), the expectation is that "teachers incorporate 21st century life skills into their teaching deliberately, strategically, and broadly. These skills include leadership, ethics, accountability, adaptability, personal productivity, personal responsibility, people skills, self-direction and social responsibility" (Public Schools of North Carolina, 2013).

There is also mention of key skills under a further standard which expects teachers to 'use a variety of methods to assess what each student has learned', whereby teachers are charged with the responsibility to 'use assessment systems to inform instruction and demonstrate evidence of students' 21st century knowledge, skills, performance, and disposition' (Public Schools of North Carolina, 2015, p. 11). Since the ratification of the Teaching Standards, initial teaching education providers have changed their programs, a new teacher evaluation process is now in place and new professional development opportunities aligned to the standards were rolled out across North Carolina, all of which are aligned with the jurisdiction's intention to improve student skills (Public Schools of North Carolina, 2015). The state also has resources available to support educators in devising units that encourage the development of these skills within their classrooms.

North Carolina's reforms reaffirm the importance of teacher instructional improvement to embed key skills into teaching and learning. All teachers across all subject areas are expected to be able to incorporate the skills into their curriculum and 'teach existing core content that is revised to include skills like critical thinking, problem solving, and information and communications technology (ICT) literacy' (Public Schools of North Carolina, 2015). Teachers have the opportunity to reflect on how they do this through the Teacher Evaluation Process. An evaluation occurs annually whereby teachers at the very least have to take part in a self-assessment, document their professional development plans, participate in classroom observations (formal and informal) and partake in a summative evaluation conference which has a particular focus on some standards over others (Public Schools of North Carolina, 2015).

The evaluation processes 'are designed to encourage professional growth, to be flexible and fair to the persons being evaluated, and to serve as the foundation for the establishment of professional goals, and identification of professional development needs' (Public Schools of North Carolina, 2015, p. 4).

Teachers are assessed via a rubric where they are graded either developing, proficient, accomplished, distinguished or not demonstrated. As part of their evaluation conducted annually, teachers have to demonstrate their professional engagement across all standards. Placing skills into their teaching standards and evaluation ensures that they cannot be left out of teaching and learning within any classroom, no matter the year level or subject domain. The development of the key skills becomes each teacher's responsibility. Every teacher needs to support the claim that he or she has fulfilled each standard through collecting evidence such as student work or lesson plans where they need to show how they have planned for problem-based learning, enabled students to demonstrate creativity, or challenged the thinking processes of students.

Australia

Australia is a federal system, with education policy largely a jurisdictional responsibility. There is a centrally agreed *Australian Curriculum Framework for Foundation/Prep until Grade 10,* with achievement standards specifying progress for each year of schooling. Within the Australian Curriculum there are the traditional subject domains, three overarching goals and seven general capabilities. The general capabilities encapsulate many of the key skill areas and they are:

1. literacy
2. numeracy
3. ICT capability
4. critical and creative thinking
5. personal and social capability
6. ethical understanding
7. intercultural understanding.

The Australian Curriculum framework suggests that these general capabilities should be embedded across subject domains. There is no prescribed content or assessment standards in the general capabilities, rather general learning standards.

It is a school-based decision as to when and how the general capabilities will be introduced and within what subject. Schools have the autonomy to decide whether or not professional learning or additional resources are required to better support key skills within their teaching and learning. Each state and territory authority determines 'whether and how student learning of the general capabilities will be further assessed and reported' (ACARA, 2014). For instance, in South Australia there is no requirement for schools to report separately on general capabilities and cross curriculum priorities. However, schools are encouraged to refer to the key skills in their learning areas and use them in their reporting across the various subject domains (DECD, 2012). The capabilities are not referred to in the *Australian Institute for Teaching and School Leadership* teaching standards, nor do initial teacher education providers have to provide courses about how to implement the capabilities.

The state of Victoria implements the Victorian Curriculum, which is an interpretation but still differs from the Australian Curriculum. Alongside learning areas such as the Arts, English, Health and Physical Education, the Humanities, Languages, Mathematics, Science, Technologies, there are four capabilities: (1) critical and creative thinking, (2) ethical capabilities, (3) intercultural capabilities, and (4) personal and social capabilities. These capabilities are considered cross-curricular, however unlike other jurisdictions, Victoria has codified these concepts with content descriptors and achievement standards mapped from Kindergarten to Year 10 (K-10). Guidelines provided indicate that 'the content or the what of the curriculum, both procedural and declarative knowledge, can and needs to be explicitly defined rather than left as an implicit component of the learning experience' (VCAA, 2015, p. 4). Teachers are expected to assess and report student progress on these measures across the learning continuum. Whole-school curriculum planning is the context

where it is decided which teacher in what subject introduces the content associated with the capabilities (e.g. for critical and creative thinking, the context within the curriculum that students learn how to '*experiment with alternative ideas and actions by setting preconceptions to one side*'). A similarity with other Australian jurisdictions is that the cross-curricular capabilities are included only until the end of Year 10, and in Year 11-12 there is a reorientation towards traditional subject areas within the upper secondary curriculum.

Curriculum case study

International Baccalaureate

The final case study is different from the previous ones insofar as it does not present a specific school system. Rather, it focuses on the curriculum and examination packages that the International Baccalaureate (IB) organisation has implemented in participating schools around the world. An important reason for the inclusion of this case study is the unique structure of IB curricula and the place of skills in different subjects across the range of curricula. This is a relevant factor since key skills are generally expressed primarily in the curriculum. Even more important for this review is the fact that IB curricula have been researched perhaps more than any national curriculum. There is an extensive literature on IB curricula compared to the other case studies presented here, including quality assurance research and evaluation studies.

The IB has curricula, examinations, and related educational resources and services. The four IB programs range from the start of primary school to the end of secondary education: (1) the Primary Years Programme (PYP) is for (preschool and) primary education, (2) the Middle Years Programme (MYP) is for junior high school, (3) the Diploma Programme (DP) is a pre-university senior secondary certificate, and (4) the Career-related Programme (CP) is the vocational counterpart of the DP. Since the CP is only in its infancy, the focus will be on the other three programs.

With regards to key skills for the 21st century, one of the interesting features of the IB education is the existence of a transversal Learner Profile for all IB students in all IB programs (International Baccalaureate, 2013a). The other interesting aspect is the IB transversal set of Approaches to Learning Skills (International Baccalaureate, 2014b, 2014d).

The IB Learner Profile outlines 10 attributes that, ideally, all IB students are expected to develop. According to the IB policy documents, IB students should become:

1. inquirers
2. knowledgeable
3. thinkers
4. communicators
5. principled
6. open-minded
7. caring
8. risk-takers
9. balanced
10. reflective.

The ten terms represent an ambitious set of attributes that all IB teachers are expected to strive to nurture in their students. The Learner Profile first appeared in the PYP, a program designed to provide an innovative approach to primary education using inquiry-based and holistic learning.

It is interesting to note that this list of 10 attributes contains some of the key skills mentioned in the previous chapter (e.g. critical thinking, creativity, problem solving) under the 'thinker' banner. It is also noteworthy that the 10 attributes of the Learner Profile are not all comparable types of constructs: some of them represent skills, while others represent attitudes or dispositions. For instance, 'Open-mindedness' is one of the dispositions seen as necessary for students to develop their critical thinking skills, and a 'Reflective' attitude underpins metacognition and self-regulation.

The IB Learner Profile thus seems to embody part of the key skills for 21st century learning previously discussed. It is expressly defined as the translation of the IB mission statement 'into a set of learning outcomes for the 21st century' (International Baccalaureate, 2008) and was designed to cover the cognitive, conative and affective aspects of learning (Bullock, 2011). However, the process by which the IB organisation reached this list of 10 virtues has been criticised for its lack of clarity or logic (van Oord, 2012; Wells, 2011).

The IB organisation offers some guidelines for teachers and school leaders on how to embed the development of the Learner Profile in their daily classroom practices, assessment and reporting, management and leadership practices (International Baccalaureate, 2008). The development of student learner profiles is formally assessed in the Primary Years Program, while it is only encouraged in the Middle Years Program and Diploma Program. In the PYP, schools are asked to report on students' acquisition of the Learner Profile attributes for formative purposes. The IB suggests using portfolios to gather evidence on the development of students' learner profiles. In the MYP, some schools have developed short self-assessment questionnaires for students to monitor their own learner profile. In 2016, researchers developed a formal Learner Profile Questionnaire for all year levels (Walker et al., 2016). It is yet to be seen how this instrument will be used in IB schools.

Research supported by the IB has also assisted with the establishment of pedagogical principles and instruments for helping students in developing the skills of the Learner Profile. For instance, researchers have offered recommendations for IB teachers to teach and assess thinking skills (Swartz & McGuinness, 2014), collaboration (Wright et al., 2014) and even open-mindedness (Stevenson et al., 2014).

Interestingly, a recent case study suggests that Middle Years Program students do not believe their 'character' (as expressed by the Learner Profile attributes) is different from students who do not study an IB program (Wells, 2016). Research also shows three conceptions of the Learner Profile by teachers and students in the Diploma Program: (1) the Learner Profile as knowledge to acquire, (2) the Learner Profile as modes of engagement in learning, and (3) the Learner Profile as a student's identity (Rizvi et al., 2014). The plurality of conceptions is evidence of the gap that can exist between curricular approaches to skills and their perception and practice by students and teachers in schools (at least at the senior secondary level). Embedding key skills primarily in the curriculum is liable to having them retranslated into *something different* by teachers and students. In fact, it appears that Diploma Program students generally conceive of the Learner Profile as a set of *ethical attributes* rather than learning skills, and most of them are faced with the contradiction of intense time pressure and a strong focus on examinations that leaves little time for developing non-assessed 'attributes'. Diploma program students were ambivalent when asked whether the diploma helped them in developing the attributes of the Learner Profile (Billig et al., 2014). Similarly, teachers are unevenly equipped to make sense of the Learner Profile, which some of them mentioning their confusion with the Learner Profile (Rizvi et al., 2014). Research shows that just a curricular mode of engagement with key skills can be insufficient for creating the conditions most likely to foster their development.

As the previous paragraph shows, one of the issues with the Learner Profile is its potential distance or lack of relevance for teachers' practices and student learning. The IB Approaches to Learning (ATL) partly compensate for this remoteness. ATL are defined as 'deliberate strategies, skills and attitudes that permeate the IB teaching and learning environment' (International Baccalaureate, 2014a). The five ATL are specific skills that student use to engage in learning and meta-learning (i.e. learning to learn) and are defined as (1) thinking skills, (2) communication skills, (3) social skills, (4) self-management skills, and (5) research skills. While ATL were initially exclusive to the Primary and Middle Year Programs, they have

now been generalised to all IB programs, albeit in an adapted manner.

Key skills encountered in the scientific literature are partly covered by ATL. For instance, 'thinking skills' contain critical thinking and creativity, and 'self-management skills' include conscientiousness, motivation and tenacity (International Baccalaureate, 2013b). The development and choice of ATL seems more aligned with research on learning than the Learner Profile. In fact, the IB has released its own review of literature on 'emerging educational objectives' such as critical thinking, creativity, metacognition and self-regulation, and intrapersonal and interpersonal skills (Li, 2012). This literature review provides a clear rationale for the choice of key skills and offers an evidence base for its selection of skills. It also makes the logic underpinning ATL evident to teachers. However, the length of the document and its limited readability are likely to deter teachers who would be likely to focus on ATL in their subject from engaging with it. Little research is available on the impact of ATL on student acquisition of skills.

IB offers workshops and professional development opportunities specifically dedicated to ATL (International Baccalaureate, 2017), which may be a way of enhancing teacher commitment to their implementation in IB classrooms. Clear and detailed guidelines about the use of ATL and the tasks that students can complete (or problem they can solve) with these ATL skills exist in the MYP program guidelines. All teachers 'are responsible for integrating and explicitly teaching ATL skills' (International Baccalaureate, 2014c). While these are promising features of ATL in IB programs, little research has examined the development of these skills in students across different IB programs. Studies focussing on a limited range of skills do exist, but a more comprehensive evaluation of IB student skill development would be valuable to assess the effectiveness of ATL to foster key skills for the 21st century.

Shared features in design and development

Table 3-1 shows the take up of the skills identified in chapter two across the case studies. It shows that it is common for skills to be termed differently even though they appear to be the same construct. For instance, collaboration and communication are expressed variously as social-management, social awareness, social skills, relating to others and 'cultural competence, communication and expression'. This affirms the 'jangle fallacy' typically surrounding skills, which at times can confound shared meaning and possibly thwart shared approaches (Coleman & Cureton, 1954).

Table 3-1 also illustrates that many of the skills perceived to be educationally relevant and important to foster in young people are a focus within the case studies, although it appears that there is more confidence in the tangibility and malleability of some key skills than others. Critical thinking, creativity, problem solving and collaboration/ cooperation were more likely to be included as part of system frameworks and policy. These skills have a strong lineage within education debate and policy documents. They also figure strongly in Care and Luo's comparative study of ten Asia-Pacific countries, which also established that interpersonal skills and creativity were more commonly referenced than other skills within curriculum frameworks.

Skills sometimes viewed as dispositions or intra-personal skills, such as motivation, self-efficacy, conscientiousness and grit/perseverance, are less frequently featured in the curricular frameworks and policies reviewed in our case studies. Partly this could be attributed to some of the constructs being more recent additions to educational research (e.g. grit) and adapted from psychological studies.

Table 3-1 Take up of skills and dispositions

		School system/jurisdiction							Program
		Australia	**CORE Districts***	**North Carolina**	**Ontario**	**Alberta**	**New Zealand**	**Finland**	**International Baccalaureate**
Skills	Critical Thinking	Critical & Creative Capability		Critical Thinking	Critical Thinking	Critical Thinking	Thinking	Thinking & learning to learn	Thinking skills
	Creativity	Critical & Creative Capability		Creativity	Innovation, Creativity & Entrepreneurship	Creativity & Innovation	Thinking		Thinking skills
	Meta-cognition (self-regulation)	Self-management (Personal & Social Capability)	Self-management	Productivity & Accountability	Learning to Learn/ Self-Aware & Self Directed Learning		Thinking	Thinking & learning to learn	
	Problem Solving				Problem Solving	Problem Solving	Thinking	Thinking & learning to learn	Thinking skills
	Collaboration & Cooperation	Social-management (Personal & Social Capability)	Social Awareness	Collaboration	Collaboration	Collaboration	Relating to Others	Cultural competence, communication & expression	Social skills
Dispositions	Motivation		Growth Mindset				Managing Self		
	Self-efficacy		Self-efficacy	Initiative and Self-Direction					
	Conscientiousness								Self-management skills
	Tenacity & Grit						Managing Self		

* Taken from the customised School Quality Improvement System rather than from the curriculum framework.

Despite the place of key skills within the policy thinking and planning statements of school systems represented in the case studies, there is a sense in which the policy statements are statements of design—attempts at promoting the skills in the work of schools—rather than reflections on actual achievement in the work of teachers and schools. This may be because there is often a distinction between expectations outlined in policy statements and curriculum frameworks, and what is actually delivered within schools. Binkley et al. (2012, p. 36) claim that 'these national statements of twenty-first century aims and goals are unlikely to be reflected in the actual learning experience of students or in the assessments that are administered'. The integration of skills into the on-the-ground work of schools involves various transformations and requirements of which the publication of curriculum statements and frameworks is but one approach (Pellegrino, 2014). Successful policy implementation needs to be accompanied by rigorous support mechanisms across the education system including investments in building the capacity of teachers. The desired skills need to be codified and incorporated into standards, measured and made tangible through assessment, with prescribed curriculum and instruction materials, content and methods, and built into teaching and schools through professional development and the establishment of learning environments (Partnership for 21st Century Skills, 2009). There is little evidence yet of a school system that has managed to achieve all of these goals or outcomes. But the statements of many systems reveal intent.

Evidence of impact

The policy steps taken by jurisdictions to re-emphasise and improve skills within teaching and learning are relatively new, and unfortunately at this point there are no rigorous evaluations publicly available of the success of their implementation or impact. It is difficult to find research that addresses the effectiveness and impact of the inclusion of key skills for the 21st century within curriculum statements and frameworks. Therefore, the case studies tend to highlight the existence of policy to support the inclusion of key skills in schools, rather than point to evidence of change in terms of actual teaching, learning and student outcomes. Similarly, Care and Luo's work found that the link between 'policy and actual practice in the classrooms' was not well developed or understood (Care & Luo, 2016). In all of the case study jurisdictions, there is little evidence in the form of large-scale evaluations or accounts (qualitative or quantitative) involving rigorous analysis that can assist in answering whether or not there has been any major change in teaching and learning as a result of the inclusion of the relevant skills. This could be explained in part by the complexities in assessment and evaluation of the skills, which will be discussed in the next chapter.

The dearth of research on how school systems have sought to improve and integrate key skills highlights the value of research and reform running in tandem. Across all case study jurisdictions the expectation is that all teachers play a role in the development of key skills using a school-wide cross-curricular approach. Without research tracking reform in a concurrent manner, it is not possible to know how teachers operationalise new curricular frameworks that emphasise key skills alongside traditional subject areas. Do teachers feel supported in being able to meet the policy objectives set out within their curriculum objectives? Do teachers regard key skills as an equal or lesser-order priority to the delivery of subject-specific content? What learning approaches or pedagogies do teachers feel work best to develop such skills? There is a gap here between policy and practice.

There are small-scale studies that suggest the depth of effort required to successfully embed an approach that improves key skills within teaching and learning. Lucas's work on creativity is an example (Lucas, 2016). His research team initially worked with a group of teachers on the definitional framework of creativity. Teachers from all schools involved in the study were then brought together to share current practices and explore new methods to develop creativity. Researchers were also included in these discussions and provided some advice

concerning their pedagogical approach. Assessment tools targeting creativity were developed in partnership with teachers, which were trialled and refined through the study. Researchers kept in touch with schools and observed practice throughout to understand the ways in which schools were able to make it operationally possible to develop student creativity and then use formative assessment. Unfortunately, the intensity of this approach to develop student creativity makes it difficult to replicate across whole systems.

Without an evidence base providing insight into how best to incorporate or ground skills within the daily practices of schools, the system-level attempts at emphasising the integration of key skills into teaching and learning will tend to remain statements of aspiration and mere rhetoric. A risk is that educational change is again dependent on the efforts of the 'heroic' teacher. There is a real danger that the skills will be perceived as nebulous and unable to be realised within the day-to-day practicalities of schools, the crowded curriculum and the already substantial workload of teachers. This has clear implications for systems, whereby developing and investing in teacher capacity in particular is critical to supporting system-level change.

Curricular development is but one strategy to better embed skills into teaching and learning, and risks by itself being more a rhetorical exercise. It is clear from the different accounts that many systems are now starting to move beyond statements of aspiration and are considering how to better integrate identified skills within classrooms. It is via widespread and transformative systemic reform that whole cohorts of students are likely to have better opportunity to cultivate desirable skills within formal schooling. More effective reform is likely to involve approaches that consider teaching standards, assessment, curriculum and instruction, professional development and learning environments. Currently, it is not possible to find a school system that has instigated wide-reaching and multi-faceted reforms across all areas, although this is likely to change due to the growing interest in the importance of taking a broader view of the skills young people need for success in and outside school.

4. Assessing and evaluating skills

Measuring any academic skill can be a complex task, and without doubt the assessment and evaluation of key skills is a 'major challenge' (Voogt and Roblin, 2012, p. 312). While decades of debate and substantial research has been invested in how best to measure student skills in literacy and numeracy, the theory and measurement of other skills is still very much 'in its infancy' (Whitehurst, 2016). Care, Scoular & Griffin describe the new frontier:

'Historically, the assessment of cognitive and social competencies and attributes has relied on different approaches. The cognitive has been predominately based on correct versus incorrect answers, whereas the social has relied on self-report estimates. The emergence of interest in skills that are no longer defined uniquely within one of the spheres provokes query about whether they can be assessed in a common way' (Care et al., 2016, p. 262).

While there has been significant attention paid to the development of frameworks and typologies of skills, much less attention has been given to the measurement and evaluation of them. Whitehurst (2016) states that 'within the domain of soft skills there is nothing remotely close' to the level of specificity as that outlined within a literacy standard. 'Students' non-cognitive skills may well deserve a place at the heart of education as a complement to traditional measures of academic achievement on standardised tests, but they cannot assume this place without valid and reliable measures' (Egalite et al. 2016, p. 28).

Skills cannot be measured well without clear understanding and definition as a first step (Soland et al. 2013; Ananiadou and Claro, 2009). Educational concepts are constructs which 'lack inherent measurement properties independent of human definition' (Care & Vista, 2017). Engaging in meaningful assessment involves various stages of development— firstly defining what will be measured, secondly deciding on which competencies embody the construct, and then finally developing a system to 'define the magnitude of what is being measured' (Care & Vista, 2017). This takes time, especially with key skills for the 21st century, as their concepts and competencies overlap and permeate one another.

This chapter will outline the various methods of assessment and evaluation currently used to capture and measure key skills within educational contexts. These forms of assessment are:

- student self-rating
- direct assessment
- teacher judgement and reporting.

One view is that 'we can and we should measure students' non-cognitive skills, but we should do so in full recognition of the flaws in our measures' (West, 2016, p. 167). Duckworth and Yeagar (2015) concur and add that 'perfectly unbiased, unfakeable, and error-free measures are an ideal, not a reality'. The following discussion will cover the relative strengths of each type of assessment as well as their methodological limitations. It is important to weigh up each method to draw valid inferences about their capacity to evaluate key skills within the educational context and for what purpose (Wilson et al., 2012). Many of the systems featured in the previous chapter already engage with measurement and evaluation of key skills, and it is useful to consider here how they are doing so and for what purpose.

Self-rated measures

Self-rating is a common assessment measure when it comes to the measurement of skills. It is generally achieved through the use of a survey involving a questionnaire constructed and administered in a standardised format, employing multiple-choice items or open-ended prompts (Lai and Viering, 2012). Respondents typically respond to a bank of items or reflective questions within a survey, often employing Likert scaling, that aims to capture levels of capacity in skills, behaviours, attitudes and dispositions (Kautz et al., 2014; Lai and Viering, 2012). Responses to relevant items are often grouped into constructs that are then transformed into quantifiable measures or

scales. This is a typical format within psychological surveys (Kautz et al., 2014). There are many examples of surveys used this way within educational settings to capture self-rated assessments of skills. Three of the most cited are:

1. The *Big Five* personality trait inventory which is a 44-item questionnaire developed and empirically tested over decades with items that are contextually independent. Students rate themselves on a questionnaire, which defines statistically unique and dimensional (high and low) scales in openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism (Kautz et al., 2014).
2. The *Grit* scale developed by Duckworth consists of 8-12 questionnaire items designed to capture passion and perseverance (Duckworth et al., 2007). Researchers have reported that a high score on the grit scale captured in this way predicts later achievement more so than cognitive outcomes (Duckworth, 2016).
3. De Bono's *Six Hats Method* outlines six cognitive modes, where students are asked to rate their degree of perceived comfort with each of six cognitive modes via a self-assessment, which is typically administered as part of a classroom lesson (De Bono, 2000).

A key strength of self-reported measurement of skills is that it has been established that 'people are quite good at assessing their own character' (Reeves et al., 2014). The ease by which self-reported data collection can occur, especially using online platforms, is another key advantage. The format is 'easy to score, allows for many questions in a short amount of time, and, due in part to the large sample of items, tends to produce more-reliable scores than other formats' (Soland et al., 2013, p. 22). Finally, as opposed to other methods of evaluation, self-rated assessment is also relatively cheap to administer on a large-scale basis (Egalite et al., 2016).

While such methods can be used to measure skills, dispositions and engagement at an individual student level, and therefore potentially be employed diagnostically and for reporting on a student's skill level, the methods are also used for other purposes by some school systems, such as measuring school and system performance. For example, New South Wales currently uses *Tell Them From Me*, which is run annually with students and collects information aligned to constructs including interest and motivation/engagement, sense of belonging and positive relationships with peers and teachers (Centre for Education Statistics and Evaluation, 2016).

In terms of skills and measurement of school and system performance, the CORE districts in California administer student surveys for use in their school accountability and improvement framework to measure school and district performance in promoting skill development. The performance of schools in the CORE districts is calculated from student surveys constructed to measure four key skills—growth mindset, self-efficacy, self-management and social awareness. The assessment of skills this way is considered by the districts to be robust and reliable, with a full-scale field test showing that all measures based on student self-reported data correlated in the 'expected direction with other academic and behavioural outcomes' and there were acceptable levels of internal reliability (Krachman et al., 2016, p. 14; West, 2016; Transforming Education, 2016).

Student assessments based on self-rated methods form the basis of various large-scale international assessments. The OECD's PISA measures student attitudes, beliefs, motivation, aspirations and learning-related behaviour such as self-regulation, learning strategies and invested time (OECD, 2014). To-date, most of PISA's findings concerning student 21st century skills, dispositions and behaviours have been captured from student questionnaires, although moving into the future, the OECD intends to employ direct assessment tests of some skills (e.g. constructs such as perseverance) (OECD, 2017a). Projects such as the *International Study of City Youth* have also attempted to examine student skills through various developed scales of dispositions,

engagement, non-cognitive and cognitive skills collected via self-reported data, the results of which are standardised across participating cities (Lamb et al., 2015).

Limitations of self-rated approaches

One issue with the use of student questionnaires to capture capabilities is whether the items used to capture a specific skill actually measure the skill that they target. Do the sets of items frequently used to capture grit or perseverance (e.g. 'My interests change from year to year', 'I am a hard worker', 'New ideas and projects sometimes distract me from previous ones') provide a reliable and valid measure of grit? Related to this is whether or not higher or lower scores on a derived scale using such items reveal meaningful differences in skill levels. Preliminary findings in the Californian CORE Districts from an analysis using 2015 data showed that social and emotional learning skills captured using self-rated measures appeared to change with age and two of them—self efficacy and social awareness—declined markedly over grade or year-levels even though cognitive skills improved. Several reasons are possible, though it is not possible to rule out the possibility that the scales do not capture the enduring quality or construct reflected in the skill labels.

A further issue is whether or not surveys can be used effectively and in the same way to measure the same constructs across different ages, particularly among younger children. The experiences in the CORE districts is instructive in terms of the challenges in designing question items for specific grades. The survey trial established that the questionnaires were not fit for students younger than Grade 5, as the younger grades tended to pull down the correlations on certain scales possibly due to their inability to comprehend certain items (Transforming Education, 2016). Lai and Viering also identify that younger children are less likely to be able to complete a self-report survey as they may interpret their response to just-experienced events rather than 'summarise across a range of situations and content areas' (Lai and Viering, 2012, p. 34). Some work has been conducted specifically to address this issue leading to student surveys for younger age students (Grade 3-5 students) designed to evaluate concepts including self-control, persistence, mastery orientation, academic self-efficacy, and social competence. It is still unclear, however, how effectively the surveys can be used to compare results meaningfully with other grade levels (Child Trends, 2014).

The way students from different backgrounds respond to survey items can also be an issue with self-report questionnaires. Self-reported survey inventories are generally designed to be non-confrontational and continue to be a primary method by which attitude and skill assessments are captured. However, self-rated assessments are prone to measurement issues such as item interpretation, literacy demands on respondents, social desirability bias, cultural bias, and reference group bias (students comparing themselves to other students they know) (West et al., 2016, Duckworth & Yeager, 2015, Soland et al., 2013). Reference bias is when individuals interpret survey scales differently based on their own cultural background or the culture of the school (West, 2016). Social desirability bias occurs when students may feel a sense of social pressure or obligation to select an answer option to portray themselves more favourably.

Direct-assessment

The administration of a test or assessment task to demonstrate a student's mastery of a competency or key skills is sometimes called direct assessment. It is often portrayed as an objective measure as it uses problems or tasks to assess understanding, accuracy and reasoning and is generally scored independently of teachers, often by a computer program/algorithm or independent assessor. Many of the direct assessments of 21st century skills are relatively new, as typically they were previously measured by self-rating or rating by observers (Pellegrino and Hilton, 2012). In comparison to self-report inventories or teacher judgment, which both can capture a range of skills at the same time if required, direct assessments tend to focus on individual skills and do not generally capture

multiple skills or constructs at the one time.

Skills commonly measured at present via direct assessment include collaborative problem solving, complex problem solving and creativity, with some already being used within international assessments such as PISA (Geisinger, 2016). The *Assessment and Teaching of 21st Century Skills* project developed online tasks to assess collaborative problem solving, encompassing the constructs of critical thinking, problem solving, decision-making and collaboration (Care et al., 2016; Griffin et al., 2012). Online methods have also found their way into PISA. While in 2003 the approach was to measure problem solving via a paper-based method, computer-based measures of individual problem solving were used in 2012. In 2015, this was extended to the use of a computer-based collaborative problem solving assessment (OECD, 2014). Classically, the items used to measure problem solving involve simple question and answer approaches sometimes using multiple choice and sometimes open-ended written responses (essay format) and sometimes requiring an outline of steps showing justification and reasoning. Further development of online testing in PISA is expected to expand the direct measurement of broader skills with new item types, which include scenario-based questions, video clips of a specific situation, and interactive visual representations. The reason in part is to provide more precise and relevant measurement as well as find better ways of capturing mastery of particular skills (OECD, 2014).

These newer forms of direct assessment of skills are complex and designed to differ from the typical correct-incorrect dichotomy often found in more traditional skill tests (Vista and Care, 2017). Developing the technical capability to better assess skills directly is regarded as a new frontier of assessment, with particular interest in computerised adaptive technology (CAT) that has the potential to provide question/item branching based on student interest and/or ability. These new forms of assessment technologies also collect metadata, which could eventually be used in the analysis of student performance. The OECD is proposing to analyse in this way data within the computer-based questionnaires to provide information useful to non-cognitive outcomes (e.g. different strategies and solutions that students use to solve a mathematics problem). Another example of this method is the examination of log files, which may uncover 'the frequency, length and sequences of actions performed by students as they respond to items'; in other words, how students approach the task at hand (Herde et al., 2016, p. 275; De Bortoli and Macaskill, 2014, p. 10).

Digitally enabled classrooms and clearly developed IT systems are important to the cultivation and assessment of skills. Binkley et al. describe how technology-based assessment has 'the potential to provide unprecedented diagnostic information and support for the personalisation of the curriculum' (Binkley et al., 2012). The view of Wilson et al. (2012, p. 87) is that 'improved data handling tools and technology connectivity' will be able to 'give a more complete picture of student learning'. Though Care et al. (2016, p. 262) caution that 'our capacity to capture complex social and cognitive skills in an online environment is still in its infancy'. It is evident that many direct assessments used to capture skills are still prototypes, 'with little evidence to establish their validity' (Soland et al., 2013). Technology is not necessarily the 'silver bullet' when it comes to the assessment and evaluation of skills, and it is still a necessity that the foundations of assessment remain robust and well thought out (Wilson et al., 2012, p. 86).

Some researchers have compared direct assessments against self-report measures using the same groups of students in observational settings. Egalite et al. (2016) used three direct assessments. The first one measured persistence, whereby students were given a set of ten anagrams to unscramble. Students were instructed to take as much time as they wanted on the task, and the amount of time they took was recorded as the behavioural measure of persistence, as only four anagrams were solvable. The second direct measure concerned the ability of students to delay gratification, via a delayed payment choice. The third, conscientiousness, was measured by asking

students items on honesty and creativity within a survey, and tracked the occurrence when students would skip through the easy items or select 'don't know' (Egalite et al., 2016). The direct assessment was compared to student responses on a survey designed to measure grit. The researchers found that data collected via student self-report did not correlate to any direct-assessment, whereas student scores on the delayed payment and persistence direct assessment tasks were highly correlated. Although measurement errors were reported for all measures, the grit scale in particular was found to be problematic as students who exhibited high levels of persistence and delayed gratification, typically marked themselves lower on the self-reported grit items, which researchers attributed to social desirability bias. Zajenkowski & Stolarski looked at the various methods of measuring conscientiousness and found that the relationship between conscientiousness and cognitive ability is positive when conscientiousness is measured by observation but it is negative when measured with self-report (Zajenkowski & Stolarski, 2015).

This shows that the way a construct is measured has important implications for the interpretation of results and for the implications these may have for educational practice.

Limitations of direct-assessment approaches

Direct assessment's biggest methodological limitation (and also possibly its key strength) is its strong dependence on the adequate definition of what is to be measured. Therefore, a lot of time and investment is required with direct assessment, especially in the initial stages of development. Kautz et al. (2014, p. 7) describe how performance tasks typically depend on multiple skills, and not standardising any of the contributing skills and incentives may actually 'produce misleading estimates' (also see Heckman and Kautz, 2012).

The growing market in for-profit corporations developing direct assessments for jurisdictions and schools is seen by some as worrying (evident in recent Sydney Morning Herald article 4/7/2017, 'Private companies accessing student data fuels commercialisation fears'). Corporations may start to have ownership and control over how educational constructs are defined and measured, while access to them will be at a cost to the public sector.

A more pressing issue is that there are several types of skills, those that are sometimes referred to as traits or characteristics or social capabilities, such as grit, self-efficacy, conscientiousness, communication, and belonging, for which currently there are no direct assessments. These so-called 'softer' skills are difficult to measure using direct assessment and measurement remains reliant on self-reporting using psychological survey inventories. This may reflect the difficulty in defining and agreeing on the elements and dimensions of each of the broader skills. Direct assessment is more comfortably applied where the skills are closer to those traditionally recognised as 'cognitive' or 'scholastic'.

Teacher judgement and reporting

Teacher judgement and reporting is another key method of assessing and recording broad skills. It is often the primary source of information about student skill development and often regarded as a key part of the work that teachers do (Meissel et al., 2017). It is increasingly common for teachers to assess and evaluate students, not only in traditional subject areas but also on broad sets of skills, for end-of-term report cards (OECD, 2015). A clear strength of teacher judgment is its immediacy, as Pellegrino outlines 'in the classroom context, instructors use various forms of assessment to inform day-to-day and month-to-month decisions about next steps for instruction, to give students feedback about their progress, and to motivate students' (Pellegrino, 2014, p. 67). Teachers are directly in contact with students on a day to day basis and get to see students close up engaging with different materials, working in different contexts and on different tasks. This leaves teachers in a position to have a strong feel for the skill levels of students, not just in areas of content knowledge but in the application and display of the various sets of broad skills. Teachers can use their judgment to adapt

instruction to student need, while students can use the information to determine which skills they need to improve (Pellegrino, 2014).

Teacher judgements or assessments of skills can be used not only for individual student monitoring and reporting, but also at a system level through reporting that is uploaded centrally for school and system accountability purposes. The state of Victoria, for example, uploads teacher assessments of student progress in key subject areas from Preparatory through to Year 10 from every government school twice a year. Potentially, the assessments can be extended to include broader skills, such as communication skills, which are built into the curriculum framework, but this has yet to be operationalised.

Several school systems that have incorporated broader skills into their programs rely on teachers as the main source of measurement and assessment of skills. Teachers are in a position to collect evidence to support student assessment, which can counter the perceived subjectivity inherent in this form of measurement. Student work in the form of essays, projects, portfolios, reports, debates, role-playing or oral presentations, for example, can all show the development of broader skills (Strong et al., 2017, p. 38). In Finland, teachers are expected to monitor and assess student development of transversal competencies in their own subject. They have autonomy in designing assessment instruments and, therefore, there is no dominant model for assessing competencies in Finnish education. The assessment of key competencies outlined in the New Zealand curriculum is done by teachers in schools, with the expectation that they will develop their own approach via professional reflection and professional learning. A range of traditional (tests, essays, checklists) and less common (learning stories, journals, portfolios) assessment strategies have been proposed by the Ministry of Education (Hipkins, 2007) to assist teachers. An interesting approach is the use of learning stories at the primary school level (Davis et al., 2013), while the assessment of 'dispositional' attributes (e.g. motivation) rely on fairly simple instruments (e.g. self-reported checklists).

Some other jurisdictions have developed methods by which to standardise teacher judgement, such as Ontario's report card, which provides a common template for all teachers to use right across the system that includes an assessment of broad skills (Meissel et al., 2017, p. 57). The main pastoral primary teacher, and all subject teachers at secondary schools provide an assessment of each student's degree of responsibility, organisation, independent work, collaboration, initiative and self-regulation regularly through the year. To support their judgement, Ontario teachers are expected to 'obtain assessment information through a variety of means, which may include formal and informal observations, discussions, learning conversations, questioning, conferences, homework, tasks done in small groups, demonstrations, projects, portfolios, developmental continua, performances, peer and self-assessments, self-reflections, essays and tests' (Ontario Ministry of Education, 2010, p. 28).

New tools of assessment are also being developed to support teacher assessment of broad skills. Rubrics in particular are regarded as effective to 'help teachers teach as well as evaluate student work' (Strong et al., 2017, p. 63). Rubrics are designed to eliminate the subjectivity in scoring as each criteria is nuanced and clearly described for both the student and teacher to follow, as well as 'concrete and descriptive enough so that the teacher would make the same inferences about the performance if the assessment were given again' (Strong et al., 2017, p. 44). Practices such as teacher moderation can also improve teacher evaluation of skills. The professional conversations generated through moderation are useful and ultimately serve to produce more consistency in teacher judgements (Connolly et al., 2012).

A key strength of teacher judgement is that it can be targeted within teacher training and teacher professional development. Lucas's work in United Kingdom found that teachers favoured a formative approach to assessment of creativity, which emphasised the structured development of

creativity in learners and subsequently helped inform teaching (Lucas, 2016). The clear preference teachers have for formative assessment was reaffirmed by teachers in the CORE districts who wanted more training and support to connect data to research and instructional strategies, in order to better develop key skills (Krachman et al., 2016, p. 24). The possibility has been raised by teachers in the CORE districts to regularly assess student skills 'throughout the school year in a way that positively reinforces students who demonstrate growth in skills and provides more granular data for teachers to use in refining their practice' (Krachman et al., 2016, p. 24). Including key skills within teaching standards, such as in North Carolina, is designed to encourage teachers to have conversations about how to best integrate skills into their classrooms, to collect evidence and to reflect on this as part of their professional responsibility and development.

Rating reports, where teachers are asked to score students using a scale on a particular skill, have also been used in some studies (see Child Trends, 2014). Teacher reports were collected in the CORE districts and compared with students' own assessment of their skill levels. The results were then aligned to student outcomes such as grades, courses passed, attendance and suspensions. Findings suggest that student and teacher assessments were overlapping to an extent, but each also provided distinctive correlations with student outcomes, leading to the view that 'it may be useful to use both teacher and student reports in order to help triangulate students' skills with greater accuracy' (Transforming Education, 2016, p. 15). One identified limitation of teacher rating reports is that there can be a 'halo' effect, that is when a teacher is asked to judge a student across multiple dimensions they tend to score students the same across all skill areas, suggesting that the teacher judgment in one area influences their judgment on all other areas. This happens despite differences in skills that students themselves have judged using self-reported methods.

In recent years, Australia has developed a standards-driven curriculum and widespread assessment reform both across traditional subject areas as well as in areas concerning key skills (Connolly et al., 2012). Using the new Australian Curriculum framework, teachers assess students by aligning their performance or behaviours to descriptors that serve as indicators of progress towards the standard. Teachers judge each student's progress along the learning continuum as either 'at-level', 'below' or 'exceeded'. Standards have been defined for all subjects as well as all capabilities (personal and social capability, ethical understanding etc.) from Kindergarten to Year 10 (K-10). There are some practical challenges in this. One is that lessons are often structured by subject areas, which poses difficulties for deciding what subject/context the skill is assessed within and by which teacher.

In upper-secondary, broader skills are no longer an assessable construct within Australia as the system orientates itself towards high-stakes examinations and university selection. Skills are a key part of Vocational Education and Training (VET) units that students can choose to undertake while at school. VET teachers deliver a competency-based curriculum, and nearly all training packages include units including key skills. For example, Certificate II in Hospitality has two units, which are 'work effectively with others' and 'show social and cultural sensitivity' (New South Wales Education Standards Authority, 2017). Within VET, teachers need to evaluate whether a student has displayed these attributes or not and there is no assessment of the degree to which the student has demonstrated the competency.

Australia has made substantial progress in articulating broader skills within the national curriculum frameworks, thereby providing a good foundation to support better assessment and teacher judgement. Yet even with the Australian Curriculum framework or VET training packages, some researchers consider that the 'use of standards and criteria alone would not result in a consistency in teacher judgements' (Wyatt-Smith, Klenowski and Gunn, 2010 cited in Connolly et al., 2012). It is questionable whether teachers in fact use the given Australian curriculum framework or

VET competencies to assess purely in a criterion-referenced manner, as 'judgments are likely to be influenced by normative evaluations, such as how well each student is performing in relation to other students within the teacher's class' (Meissel et al., 2017, p. 49). It is also problematic that broader skills are largely forgotten within the formal academic curriculum in the upper secondary years.

Limitations of teacher judgement

The evidence concerning teacher judgement is less well formed than the evidence for other forms of measurement. The subjectivity inherent in teacher reporting is its major limitation, as 'the properties of teacher judgements and what informs these decisions remains relatively unexplored' (Miessel et al., 2017). Despite existing mechanisms and wide coverage across schools, system authorities have to this point tended to prefer what they perceive as more 'objective' measures of skills such as student self-report and direct assessment. 'Previous research has indicated that teacher judgements might be biased on the basis of student characteristics and influenced by classroom and school contexts' (Meissel et al., 2017). Research undertaken in New Zealand compared teacher judgments to student performance on standardised assessments. Their work found that teacher judgements for marginalised learners were lower than their score on standardised assessment, and classroom/school achievement were inversely related to teacher judgement as well – therefore the school's context impacts how teachers differentiate their students (Meissel et al., 2017). The same researchers also found that even when 'asked to make judgements against specific standards, [teachers'] judgements are at least partially norm-referenced' (Meissel et al., 2017, p. 57), meaning that teachers turn criterion-referenced assessment (at least partly) into norm-referenced assessment (i.e. comparing students to one another).

Lack of objectivity has been pointed to by some researchers as an issue. Teacher reporting, it has been contended, could express to an extent the relationship a teacher has with students and perhaps become clouded by bias, or a 'top-down, global evaluation' rather than a more accurate assessment of skill mastery or progress (Duckworth and Yeager, 2015). Duckworth and Yeagar (2015, p. 240) describe how 'teachers have the benefit of a non-egocentric perspective as well as experience with many other same-age students over the course of their careers. Nevertheless, end-of-year teacher reports may be coloured by first impressions and therefore underestimate change'. Cheng and Zamarro (2016) add a new dimension to this debate, which is the possibility that the levels of the key skills held by teachers impact their own ability to develop (and assess) the same skills in their students (Cheng and Zamarro, 2016). Looking specifically at conscientiousness, they established that teachers with high levels of conscientiousness were more effective at improving conscientiousness within their students, but they do not necessarily improve test scores (Cheng and Zamarro, 2016). The study suggests that the skills held by teachers are an important factor to consider – after all, can a teacher with poor communication skills be expected to significantly improve their students' communication skills?

Assessing and evaluating skills

It could be argued that an effective and accurate assessment strategy for skills might involve employing different forms of assessment where possible (Partnership for 21st Century Learning, 2009). Currently, schools and teachers employ a mix of methods of assessment of learner mastery of traditional academic skills and therefore the same approach could be adopted when it comes to other skills. A key question when it comes to choosing any form of assessment and evaluation is 'what will the measurement be used for?' There are many purposes that can be identified but four key ones are (1) monitoring student learning and progress (individually and collectively), (2) supporting instructional improvement, (3) monitoring system performance, and (4) setting priorities by signalling to teachers and parents which competencies are valued (Schwartz et al., 2011, cited in Soland et al.,

2013). Some assessment methods lend themselves more easily to some purposes rather than others. For instance, teacher judgement is more beneficial to instructional improvement as it is direct and immediate, while systems currently favour student self-report when considering broader skills, as it provides brevity at a relatively low-cost. Monitoring of system performance, particularly if done down to a school level, might require summative measures such as scores derived using direct assessments, teacher judgements or survey-derived self-report scale scores.

There is, according to Pellegrino and Hilton (2012, p. 149) 'a paucity of high-quality measures' for assessing key skills for the 21st century. Problems with the measurement of the skills are not limited to technical problems of measurement. There is a range of epistemological challenges stemming from the fact that measurements of skills aim at capturing latent constructs, making research in this area highly theory-dependent. The assessment and evaluation of skills in general requires additional work and development, especially as the importance of broader skills continues to grow within school systems.

One way to attempt to circumvent the limitations of each method of measurement is to use multiple measures of assessment that 'support triangulation of inferences' (Kautz et al., 2014). Different measures tap into different aspects of the construct and provide a fuller picture. A plurality of measurements is preferable, according to some working in the field (e.g. Duckworth and Yeager, 2015). Employing different measures when it comes to the key skills, varying dependent on the purpose of the assessment, could help in circumventing the methodological limitations associated with each method. Multiple measures of assessment might also help properly reflect the definitional complexity within the skills area (Kautz et al. 2014). Triangulation of the various forms of measures which are currently in use has been undertaken by various researchers (Egalite et al., 2016; Transforming Education, 2016; West et al., 2016; Child Trends, 2014). PISA analysis is increasingly comparing direct and self-reported measures related to broader skills. The OECD's current approach to improve subjective measurement is to collect student, teacher, parent and peer reporting (OECD, 2015, p. 37).

5. Conclusion

The goal of this report has been to contribute to the conversation around key skills for schooling in the 21st century. The scope was broad, ranging from a review of evidence for commonly discussed skills and capabilities to a study of the ways different education systems have sought to embed key skills into their schools and programs. The report also examined the crucial areas of assessment and evaluation of key skills for the 21st century.

Many education systems are responding to the challenge of fostering student acquisition of key skills in schools, with the expectation that developing the skills will lead to improved student learning across different areas of the curriculum. At the same time, the skills are also viewed and treated as learning outcomes in their own right, to the extent that they promote future success in life and work. Schools can play a significant role in helping students build a broad platform of skills by the time they leave school, equipping them with the tools they need to become engaged thinkers, resilient and resourceful learners, creative problem solvers and active members of their communities. One of the main challenges remains to create the conditions for a generalised acquisition of key skills for *all students*, across very diverse schools and classrooms.

There are a number of issues for school systems that emerge from current discussions and evidence on key skills, such as agreeing on the most critical skills to focus on, building cogent frameworks for thinking about the interrelationships of skills and learning, identifying the best methods for teaching the skills, and working out how the skills can be assessed and measured to monitor acquisition and progress at both a student and system level. Each of these issues presents particular challenges for school systems wanting to focus on promoting the development of key skills.

Five frameworks of key skills for the 21st century were outlined in Chapter two. The frameworks overlap to a certain extent, but it is also clear that what they are trying to explain (e.g. academic achievement, transferable learning, or student outcomes) heavily determines the structure and content of each framework. The frameworks represent a laudable effort to make sense of the complexity of student skills and dispositions, since research on specific skills studied in isolation has led to a problematic inflation in the number of key skills and at the same time a risk that different labels are being used for the same essential skill or capability. Further research, especially on the *causal influences* of the complex web of student skills on student outcomes, is needed to improve these frameworks.

This report discussed nine key skills which have received considerable attention from researchers, policy makers and practitioners:

1. critical thinking
2. creativity
3. metacognition
4. problem solving
5. collaboration
6. motivation
7. self-efficacy
8. conscientiousness
9. grit or perseverance.

The list is the result of a review of educational literature and research, as well as a study of international and jurisdictional frameworks for learning. The nine skills illustrate both the possibilities and challenges of thinking about a comprehensive range of skills for education in addition to traditional

content areas. The key skills listed were all found to be malleable to some extent, although they do not equally correlate with student outcomes. Finally, it is important to consider whether generic or context-specific conceptions of each skill are useful for educators. This means determining the transferability of skills across different subject areas, and whether individual key skills can be considered legitimate learning outcomes in their own right.

Various approaches have been adopted by jurisdictions to systematically embed key skills for the 21st century into their education systems. Chapter three presented seven jurisdictional case studies as exemplars, and one case study of a curriculum framework, the International Baccalaureate. The jurisdictions have placed considerable attention on incorporating key skills into their curricular frameworks and statements, largely adopting a cross-curricular approach whereby all teachers are expected to support the acquisition of key skills by students. However, it is less clear how these policy statements and aspirations have translated into daily classroom practice, and whether the focus on key skills has improved student outcomes. In these respects, this review demonstrates that a careful examination of the key skills and their use in different school systems raises as many questions as it answers.

In the take up of key skills by different systems, a common issue has been the assessment and evaluation of the skills. Unlike traditional measures of literacy and numeracy, the evidence base concerning measurement and evaluation of key skills is less well formed. Key skills are not adequately captured by cognitive test performance and academic scores. Three forms of assessment are currently used to monitor the acquisition of key skills: self-rated measures, direct-assessment and teacher judgement. Given the limitations of each form of assessment, a combination of these enhances the measurement of skills. Better assessment practices conducive to student learning are a crucial factor for the development of key skills within education systems. At the same time, the place and importance of key skills amongst a wider range of educational objectives, as well as the purpose of assessment, are determining factors for designing assessment tools and organising assessment practices. For instance, introducing high-stakes assessments of key skills as part of a school accountability mechanism is likely to be damaging to other educational objectives such as equality of opportunity.

Another question is whether or not there is a deep enough understanding of expected learning outcomes at different stages of learning and development for teachers to use and to support assessment. While we have considerable experience with how to teach and assess literacy and numeracy, that rich body of experience doesn't yet exist for things like 'creative thinking' or 'resilience' even though they aren't themselves new concepts. This is another challenge facing systems.

In the end, the question of key skills for schooling in the 21st century is part of a broader reflection on the roles and responsibilities of school systems. While our understanding of causal relationships between some of these 21st century skills and academic achievement is currently quite limited, the evidence is building that systems should consider focusing on these skills in addition to, and indeed through, a focus on rigorous content and broad and deep knowledge in core subject areas. At the same time, it should be acknowledged that identifying the 'right' skills for systems to focus on is complicated and that the evidence base for some is more developed than for others. There are no 'silver bullets' here. Given this, it is only through collective and ongoing, reflexive discussions that education systems and communities can determine which skills are *key* for schools to focus on in the 21st century.

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