

Draft White Paper 5

Policy frameworks for new assessments

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The Assessment and Teaching of 21st Century Skills project was created by Cisco, Intel and Microsoft and launched at the Learning and Technology World Forum 2009 in London. During 2009, the project operated with five Working Groups, each of which produced a White Paper. These papers will be fully edited into a volume that will be published electronically on the project website (www.atc21s.org). Print publication is also being considered.

As a report to the Learning and Technology World Forum 2010 in London, final drafts of the papers are collected together in this set and posted on the project website for Forum participants and others who can freely access them on the website. These drafts are not for formal citation. All persons registered on the project website for updates will be advised when the final publication has been posted on the site.

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Abstract

Many nations around the world have undertaken wide-ranging reforms of curriculum, instruction, and assessments with the intention of better preparing all children for the higher educational demands of life and work in the 21st century. While large-scale testing systems in some countries emphasize multiple-choice items that evaluate recall and recognition of discrete facts, there is growing use of more sophisticated approaches in many countries. These approaches include not only more analytical selected response items but also open-ended items and curriculum-embedded tasks that require students to analyze, apply knowledge, and communicate more extensively, both orally and in writing. A growing emphasis on project-based, inquiry-oriented learning has led to increasing prominence for school-based tasks in state and national systems, including research projects, science investigations, use of technology to access information and solve authentic problems, development of products, and presentations about these efforts.

This paper briefly describes the policy frameworks for assessment systems in Australia, Finland, Singapore and the United Kingdom, with special attention to identifying where assessment of 21st century skills has been or may be developed in assessment systems that report information at the national or state, as well as local, levels. Identifying the role of 21st century skills within these assessment systems serves two purposes. First, this process furthers knowledge about distinct approaches to the integration of 21st century skills in countries with different educational governance systems. Second, it provides information about how assessment systems work within the broader policy landscape of each country that determines student learning opportunities through the construction of policies governing teacher education and development, as well as curriculum, instruction, and assessment.

Policy frameworks for new assessments

Linda Darling-Hammond¹

Many nations around the world have undertaken wide-ranging reforms of curriculum, instruction, and assessments with the intention of better preparing all children for the higher educational demands of life and work in the 21st century. To varying degrees, curriculum guidance and assessment systems have begun to focus on a range of 21st century skills: the abilities to find and organize information to solve problems, frame and conduct investigations, analyze and synthesize data, apply learning to new situations, self-monitor and improve one's own learning and performance, communicate well in multiple forms, work in teams, and learn independently.

This interest is also increasingly captured in PISA assessments which attend explicitly to a number of these 21st century skills, going beyond the question posed by many contemporary standardized tests, "Did students learn what we taught them?" to ask, "What can students do with what they have learned?" (Stage, 2005). PISA defines literacy in mathematics, science, and reading as students' abilities to *apply* what they know to new problems and situations. TIMSS also tests the cognitive domains of applying and reasoning in most items in both 4th grade (60% of items) and 8th grade (65% of items). The IEA's test of reading, PIRLS, focuses on four processes of reading comprehension, with somewhat more weight given to making inferences and integrating ideas and information. This kind of higher-order learning is increasingly emphasized in many nations' assessment systems in addition to the international assessments.

While large-scale testing systems in some countries emphasize multiple-choice items that evaluate recall and recognition of discrete facts, there is growing use of more sophisticated approaches in many countries. These approaches include not only more analytical selected response items, but also open-ended items and curriculum-embedded tasks that require students to analyze, apply knowledge, and communicate more extensively, both orally and in writing. A growing emphasis on project-based, inquiry-oriented learning has led to increasing prominence for school-based tasks in state and national systems, including research projects, science investigations, use of technology to access information and solve authentic problems, development of products, and presentations about these efforts. These assessments, often incorporated into examination scores, influence the day-to-day work of teaching and learning, focusing it on the development of higher-order skills and use of knowledge to solve problems.

This paper briefly describes the policy frameworks for assessment systems in four ATC21S countries – Australia, Finland, Singapore, and the United Kingdom, with special attention to identifying where assessment of 21st century skills has been or may be developed in assessment systems that report information at the national or state, as well as local, levels. Identifying the role of 21st century skills within these assessment systems serves two purposes. First, this process furthers knowledge about distinct approaches to the integration of 21st century skills in countries with different educational governance systems. Second, it provides information about how assessment systems work within the broader policy landscape of each country that determines student learning opportunities through the construction of policies governing teacher education and development, as well as curriculum, instruction, and assessment. With the goal of ensuring that students have the necessary skills to productively contribute to contemporary societies, this paper

¹ This paper was prepared with assistance from Laura Wentworth and Frank Adamson at Stanford University and materials provided by Tan Lay Choo of the Singapore Examinations and Assessment Board, Shannon Quek and Horn Mun Cheah of the Singapore Ministry of Education; the Victoria Curriculum and Assessment Authority and Paul Herschell of Queensland Studies Authority of Australia; Pasi Sahlberg of Finland and the Finnish National Board of Education; the Council for Curriculum Examinations and Assessment in the United Kingdom; Michael Crowther of the Australian Government Department of Education; and Seamus Hegarty of the International Association for the Evaluation of Educational Achievement and formerly the National Foundation for Educational Research in England and Wales.

provides insights about how different education systems may evolve when supporting an increased focus on 21st century skills.

We review the goals and elements of assessment systems in these countries, and how they are implemented in both on-demand tests that occur at a relatively brief moment in time and classroom-based, curriculum-embedded assessments, that may occur over an extended period of time in which students not only respond to questions or prompts, but also construct knowledge products and demonstrate skills through more complex performances. Figure 2 seeks to illustrate where, in the context of assessment systems, one might expect to evaluate various kinds of abilities. The list of abilities, presented in White Paper 1, outlines ten kinds of competencies, each of which incorporates dimensions of knowledge, skills, and attitudes or values. The competencies include:

Ways of Thinking

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

Ways of Working

4. Communication
5. Collaboration (teamwork)

Tools for Working

6. Information literacy (includes research)
7. ICT literacy

Living in the World

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

As Figure 1 suggests, certain ways of thinking and use of tools may be at least partially evaluated with relatively short item on-demand tests, with more extended tasks required for more ambitious forms of problem solving, decision making, and demonstrations of literacy. As one moves from knowledge toward demonstrations of skills, as well as attitudes, values, and dispositions – and as one moves further toward examining creativity and innovation, and ways of working and living in the world – the need for more open-ended and extended opportunities to demonstrate abilities becomes more prominent. The most authentic, complex, and applied demonstrations of skills like unstructured inquiry and problem solving, learning to learn, creativity, communication, collaboration, citizenship, and personal and social responsibility must be examined in contexts that allow tackling larger-scale tasks over a longer period of time with more performance-based demonstrations of results than on-demand tests allow. Thus, classroom-based, curriculum-embedded assessments take on an important role in the evaluation of many, perhaps all, of the 21st century skills. (One could also imagine contexts in which these kinds of assessments would be based, not only in classrooms, but also in internships or other employment or life contexts.)

In what follows, we discuss the ways in which assessment systems in four nations provide various kinds of affordances for evaluating these 21st century skills. In the process, we note that, while smaller countries often have a system of national standards, sometimes accompanied by national tests, larger nations — like Australia, Canada, China, and the United States — have typically had state or provincial-level standards and assessment systems. In large countries, managing assessment at the state rather than national level, where it remains relatively close to the schools, has often been an important way of managing an integrated curriculum, teaching, learning, and assessment system. This approach enables strong teacher participation in the assessment process and allows curriculum-embedded assessments to be moderated to ensure consistency in scoring. Smaller nations, which are about the size of these states or provinces, have been able to support such integrated systems because of their more manageable size.

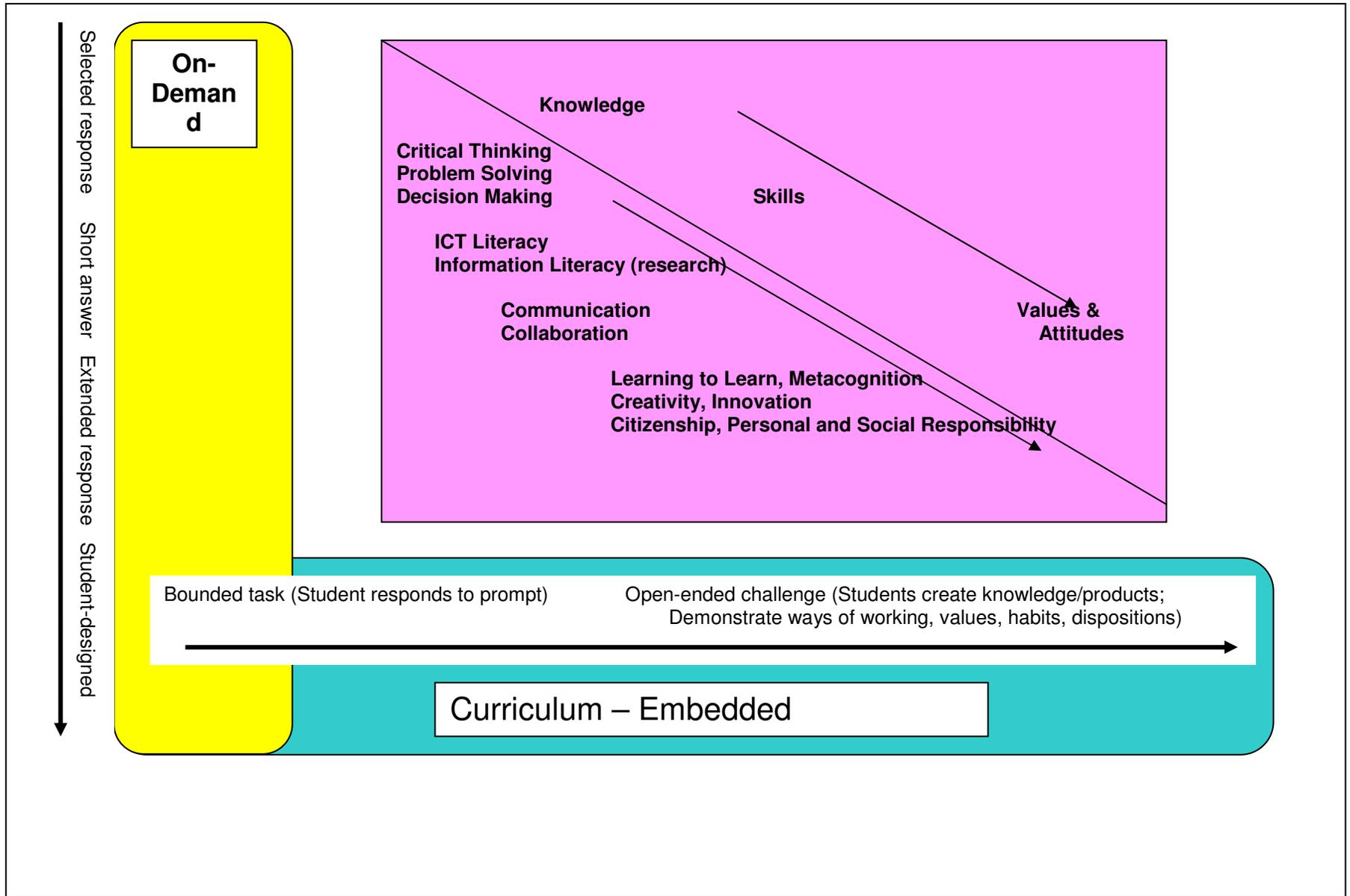


Figure 1: Contexts for assessing 21st century skills

Currently, governance arrangements are changing in two different directions. On the one hand, both Australia and the United States are attempting to develop national standards and to launch or revise national tests, while also maintaining state assessment systems. On the other hand, school-based assessments – long the norm in countries like Finland and states like Queensland and Victoria in Australia – are becoming increasingly important parts of the assessment systems in jurisdictions like Singapore, England, and Hong Kong, China.

Although this paper does not discuss the new assessment system in Hong Kong, it is perhaps worth noting here that the government's decision to replace the Hong Kong Certificate of Education Examinations with a new Hong Kong Diploma of Secondary Education places increased emphasis on school-based assessments. As outlined in Hong Kong's "Learning to Learn" reform plan, the goal of the reforms is to shape curriculum and instruction around critical thinking, problem-solving, self-management skills, and collaboration. A particular concern is the development of meta-cognitive skills, so students may identify their strengths and areas needing additional work (Education Bureau, September 2001, Chan, et al., 2008). The Hong Kong Education Examinations Authority explained the rationale for growing use of school-based assessments (SBA) in this way:

The primary rationale for SBA is to enhance the validity of the assessment, by including the assessment of outcomes that cannot be readily assessed within the context of a one-off public examination.... Obtaining assessments based on student performance over an extended period of time ... provides a more reliable assessment of each student..... Teachers know that SBA, which typically involves students in activities such as making oral presentations, developing a portfolio of work, undertaking fieldwork, carrying out an investigation, doing practical laboratory work or completing a design project, help students to acquire important skills, knowledge and work habits that cannot readily be assessed or promoted through paper-and-pencil testing. Not only are they outcomes that are essential to learning within the disciplines, they are also outcomes that are valued by tertiary institutions and by employers. Moreover, they are activities that students find meaningful and enjoyable (HKEAA, 2009).

In the nations discussed here, school-based assessments often complement centralized "on-demand" tests, constituting from 20% to 60% of the final examination score. Tasks are mapped to curriculum expectations or standards and are selected because they represent critical skills, topics, and concepts that cannot be measured in a few hours on an on-demand test. The tasks may be designed and scored locally, based on common specifications and evaluation criteria, or they may be designed or scored externally. Whether locally or centrally developed, administration of these tasks occurs at the classroom level, allowing students to engage in intellectually challenging work that taps many of the most ambitious 21st century skills, while allowing teachers to get immediately available, rich information about the learning process that can inform instruction, something that traditional standardized tests cannot do.

In addition, as teachers use and evaluate these tasks, they can become more knowledgeable about both the standards and how to teach to them, and about their students' learning needs. Thus, by improving the quality of teaching and learning, these forms of assessment may *develop* complex abilities as well as measuring them. (A summary of assessment system features for the four countries discussed in this paper is included in Table 1.)

Australia

Australia is a federation of six states and two territories. The prime responsibility for education is vested in the states and territories under the Australian constitution. In recent years, a more national approach to education has emerged. Currently, state and territory governments are responsible for developing policy, delivering services, monitoring and reviewing performance of individual schools and regulating schools so as to work towards national objectives and achievement of outcomes compatible with local circumstances and priorities.

Table 1: International examples of assessment systems

Country/ State	Description of Core System	What kinds of assessments are used?	Who designs and grades the assessments?
Australia	At the national level, a literacy and numeracy assessment is given at grades 3, 5, 7, and 9. Sample assessments occur in science, ICT literacy and civics and citizenship. States and localities manage their own assessment systems.	<i>National</i> -- Multiple-choice, short-answer, and extended written responses	<i>National</i> -- Designed, administered, and scored by the Curriculum Corporation with questions and prompts contributed by state education agencies.
Queensland, Australia	All additional assessments are school-based, developed by teachers based on the national curriculum guidelines and state syllabi On an optional basis, schools may draw on a bank of "Rich Tasks" from the New Basics project that can be administered across grade levels and scored at the local level, with moderation.	<i>School-based</i> -- Open-ended papers, projects, and inquiries -- Rich tasks are complex, interdisciplinary tasks requiring research, writing, and the development of multi-faceted products.	<i>School-based</i> -- Assessments are developed, administered and scored by teachers. Scoring is moderated by regional panels of teachers and professors that examine scored portfolios of student work representing each score point from each grade level from each school. A state panel also looks at specimens across schools as well. Based on these moderation processes, schools are given instructions to adjust grades for comparability. -- Rich-tasks are developed by teachers with assessment developers; they are accompanied by scoring rubrics and moderation processes by which the quality of student work and scoring can be evaluated.
Victoria, Australia	All additional assessments are school-based until 11 th and 12 th grades, when students choose to take exams in different subject areas as part of the Victorian Certificate of Education (VCE), used to provide information to universities and employers. The VCE exams have both external and school-based components. At least 50% of the total examination score is comprised of required classroom-based assignments and assessments given throughout the school year. Schools have access to an on-demand assessment system for students in Years 3-10 which includes computer adaptive literacy and numeracy tests that score students according to a statewide standards scale All students on entry to school and at end of Prep, Year 1 and 2 complete an online assessment of English (The English Online Interview). Also available for on-demand testing by teachers in primary school is the Mathematics	<i>State VCE</i> -- Multiple-choice (25%) and open-ended (75%) written, oral, and performance elements <i>School-based</i> -- Lab experiments, essay, research papers and presentations <i>On-entry, Prep-Year 2</i> -- Oral language, Phonemic awareness, Fluency, Reading, Comprehension, Writing, Spelling -- Mathematics online interview	The Victoria Curriculum and Assessment Authority (VCAA) establishes courses in a wide range of studies, oversees the development of the external examinations by teachers and university faculty, and ensures the quality of the school-assessed component of the VCE. Teachers score the open-ended items on the external exam and design and score the classroom-based assessments in response to syllabus guidelines. Online marking has been introduced for one examination and will be used for more examinations in the future. Online marking has been introduced due to efficiencies it provides as well as enhanced quality control of marking. The quality of the tasks assigned by teachers, the work done by students, and the appropriateness of the grades and feedback given to students, are audited through an inspection system; schools are given feedback on all of these elements. In addition, the VCAA uses statistical moderation based on the external exam scores to ensure that the same assessment

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	Online Interview, providing rich diagnostic information about individual student learning. The Mathematics Online Interview is used optionally by teachers of Prep to Year 2 students, with an estimated 70% of schools routinely using this assessment for Prep students.		standards are applied to students across schools. The Prep to Year 2 English Online Interview has been designed specifically to provide an indication of student achievement against the Victorian Essential Learning Standards (VELS). It is administered and marked by classroom teachers via an internet-based system.
Finland	Student performance is evaluated on a sample basis by the Finnish education authorities at the end of 2 nd and 9th grades to inform curriculum and school investments. All other assessments are designed and managed locally, based on the national curriculum.	<i>National</i> -- Problems and written tasks that ask students to apply their thinking <i>School-based</i> -- Papers, research tasks, & presentations	<i>National</i> -- Designed by teachers through the Finnish Ministry of Education. Graded by teachers. <i>School-based</i> -- Teachers design and grade tasks based on recommended assessment criteria and benchmarks for each subject and grade within the national core curriculum.
	A voluntary matriculation examination is taken by most students to provide information to colleges. Students choose which subjects they will sit for (usually at least four), with the test in the students' mother tongue being compulsory.	The tests use mostly open-ended questions to evaluate skills including problem solving, analysis, and writing	The exam is administered, organized and evaluated by The Matriculation Exam Board appointed by the Finnish Ministry of Education. Teachers grade the matriculation exams locally by using the official guidelines and samples of the grades are re-examined by professional raters hired by the Exam Board.
Singapore	External examinations are given at the end of primary school (grade 6) in mathematics, science, English, and mother tongue (Malay, Chinese, or Tamil). Results are used to guide course placements in secondary school. All other assessments are school-based.	<i>National</i> -- Short and long open-ended responses <i>School-based</i> -- Coursework, research projects, investigations	<i>National</i> -- The Singapore Education Assessment Board designs the assessments and manages the assessment system. <i>School-based</i> -- Designed and graded by the classroom teacher in response to the syllabus.
	After four years of secondary school, students take the GCE N- or O-level examinations. Students choose the elective subject areas in which they want to be examined. Exams have school-based components that comprise up to 20% of the final score. Results are used as information for postsecondary education. GCE A-level examinations may be taken after two years of tertiary education.	<i>National</i> -- Short and long open-ended responses and multiple-choice items <i>School-based</i> -- Research projects, laboratory investigations	<i>National</i> -- The Singapore Education Assessment Board manages the assessment system. The GCE examinations are developed by the Cambridge International Examinations Group. <i>School-based</i> -- Teachers develop, implement, and score projects and other products that complement the external examinations.
United Kingdom	National curriculum assessments are enacted primarily as guidance for school-based formative and progress assessments conducted by teachers. A mandatory set of assessments at ages 7 and 11 includes externally developed tasks and observation scales implemented by teachers. Teachers choose which tasks and tests	<i>National</i> -- Observation scales completed by teachers regarding pupils' work and performance on specific kinds of tasks; written, oral, and performance tasks & tests <i>School-based</i>	<i>National</i> -- The Qualifications and Curriculum Authority (QCA) manages develops the national assessments, which are implemented scored by teachers, and a range of guidance and supports for in-school assessment. <i>School-based</i> : Teachers evaluate student performance and work samples based on the national

	<p>to use and when to use them, within certain parameters. Assessments for primary school are designed and managed locally, based on the national curriculum and guidance provided through the Assessing Pupil Progress (APP) program.</p>	<p>-- Coursework, tests, projects, essays</p>	<p>curriculum and syllabi. Extensive guidance for documenting pupil performance and progress, with indicators showing relationships to national standards are provided through the Assessing Pupils' Progress project. Regional authorities support teacher training for assessment and in-school moderation.</p>
	<p>Most students take a set of exams at year 11 (age 16) to achieve their General Certificate of Secondary Education (GCSE). If they take advanced courses, they may later take A-level exams, which provide information to universities. Students choose the exams they will take based on their interests and areas of expertise. About 40-75% of the exam grade is based on externally developed tests & 25-60% is school-based.</p>	<p><i>National</i> -- Essays and open-ended problem solutions, oral language assessments <i>School-based</i> -- Coursework, tests, projects</p>	<p><i>National</i> -- External exams are designed and graded by examining groups serving different schools (e.g. Oxford Cambridge, Ed Excel, the Assessments and Qualifications Alliance). <i>School-based</i> -- Teachers develop and score school-based components based on the syllabus.</p>

The Australian Government provides support for schooling through general recurrent, capital and targeted programs, policy development, research and analysis of nationally significant education issues. A key priority for the Government is to provide leadership towards achieving a nationally consistent school system through common national testing in key subject areas and consistency in curriculum outcomes. While state and territory governments provide the majority of recurrent funding to government schools, the Australian Government is the primary funding source of the non-government schooling sector.

At the national level, in recognition that students need to be prepared for the higher educational demands of life and work in the 21st century the Australian Government, in partnership with state and territory governments, has embarked upon a series of national reforms in education. Key aspects of these reforms that are relevant to AT21CS are outlined below.

National Efforts

Assessment

The establishment of the Australian Curriculum, Assessment and Reporting Authority (ACARA) brings together the management of curriculum, assessment and reporting for the first time at the national level. This is intended to help streamline and simplify national education governance, which in turn is expected to help reduce duplication of resources and costs, and provide a central mechanism through which Australian governments can drive national priorities in education.

A new National Assessment Program (NAP), managed by ACARA, includes annual national literacy and numeracy assessments and triennial national sample assessments in science literacy, civics and citizenship and ICT literacy. Australia's participation in international assessments (PISA, TIMSS and PIRLS) is also included in this suite of NAP assessments but is managed separately. As part of its 2010 work program, ACARA will be undertaking a review of the NAP sample assessments, which may present an opportunity to incorporate AT21CS project outcomes.

The reading, language conventions, and numeracy NAP tests consist mostly of multiple-choice items (about 75% of items), with some short constructed responses where relevant. The writing test is a longer constructed response where students are required to write on a specified topic and genre. The NAP sample assessments, which are administered to a representative sample of students from each state and territory across school sectors, include tests in science literacy (NAPSL) at year 6, civics and citizenship (NAPCC) at years 6 and 10 and ICT Literacy (NAPICTL) at years 6 and 10. These assessments are conducted on rolling triennial basis. A selection of items from the sample tests, those not required for equating purposes, are available for schools that wish to use them to assess their students if they wish.

In addition to multiple choice and short answer items, the science literacy test includes a group practical task. Information from the group practical task is used by individual students to answer items; the practical task itself is not marked and collaboration is not specifically assessed. The ICT literacy test requires students to use computers, mostly online, as part of the assessment process. Students are required to put together pieces of work using simulated web information and specific computer programs such as a word processor, spreadsheet and presentation program.

The Australian Government is currently undertaking a project to evaluate the usefulness of existing information and communications (ICT)-based assessment tools and resources for national curriculum key learning areas. In addition, it is proposed that the research document ICT-based assessment tools and resources in the vocational education and training (VET) and higher education sectors, as well as similar tools and resources from selected overseas countries. This research will provide vital information to assist the Australian Government to maximize the opportunities to enrich teaching and learning with the use of ICT tools and resources. It is expected that this project will be informed by the work being undertaken as part of the AT21CS.

Curriculum

Currently, the education landscape across Australia is varied and complex. Each state and territory has its own curriculum, assessment and reporting arrangements in place that have been built over time and in response to local considerations. The national curriculum being developed by ACARA seeks to equip young Australians with the skills, knowledge and capabilities they need to engage with and prosper in society, compete in a globalized world, and thrive in the information-rich workplaces of the future.

ACARA recognizes that not all learning is contained in the learning areas into which the school curriculum has traditionally been divided.² Accordingly, the national curriculum includes ten general capabilities to be addressed across the curriculum, which aim to develop '21st century skills'. The general capabilities are: literacy; numeracy; information and communications technology (ICT); thinking skills; creativity; self-management; teamwork; intercultural understanding; ethical behavior; and social competence.

Teaching

The Smarter Schools Improving Teacher Quality National Partnership (TQNP)³ provides funding for reforms to attract, train, place, develop and retain quality teachers and school leaders. These reforms include implementing a standards-based National Teaching Professional Framework that will provide nationally consistent requirements and principles for accrediting teachers at the graduate, competent, highly accomplished and leading teacher levels and to inform enhanced professional learning and performance appraisal for teachers and school leaders throughout their careers. This Framework will also support nationally consistent teacher registration and improvements in the quality of teacher training through the accreditation of pre-service education courses. Other components of the TQNP include professional development and support initiatives to empower principals to be better able to manage their schools to meet the needs of their students, mechanisms to attract high-quality graduates to teaching, measures to improve teacher retention by rewarding quality teachers and school leaders and improving the quality of teacher workforce data.

In addition to the Framework, the Australian, State and Territory Education Ministers have agreed to establish the Australian Institute for Teaching and School Leadership (AITSL). AITSL will promote excellence in the profession of teaching and school leadership by:

- developing and overseeing a set of national standards for teaching and school leadership and implementing an agreed-upon system of national accreditation of teachers based on these standards; and
- promoting excellence and national leadership in the professional development of teachers and school leaders.

A priority function of AITSL is to advise on the delivery of world leading professional development and support that delivery, which will empower principals to better manage their schools to achieve improved student results.

Technology

Through a major Digital Education Revolution (DER) initiative, the Australian Government is providing \$2.2 billion over six years to:

- provide for new information and communication technology (ICT) equipment for all secondary schools with students in years 9 to 12 through the National Secondary School Computer Fund;
- support the deployment of high speed broadband connections to Australian schools;

² See ACARA, *The Shape of the Australian Curriculum*. Available <http://www.acara.edu.au/publications.html>

³ Further information at www.deewr.gov.au/Schooling/Programs/SmarterSchools/Pages/default.aspx

- collaborate with states and territories and Deans of Education to ensure new and continuing teachers have access to training in the use of ICT that enables them to enrich student learning;
- provide for online curriculum tools and resources that support the national curriculum and specialist subjects such as languages;
- enable parents to participate in their child's education through online learning and access;
- support mechanisms to provide vital assistance for schools in the deployment of ICT.

State assessment systems

In many states, school-based performance assessments targeting many of the 21st century skills are a longstanding part of the system. In some cases, states have also developed centralized assessments with performance components. Here we describe these approaches across states; then we look more in depth at exemplars of assessment tasks in two states: Queensland and Victoria. One of these states, Queensland, has a highly developed system of centrally-moderated local performance assessments, and the other, Victoria, which uses a blended model of centralized and school-based assessments, both of which use moderated scoring.

A number of states have developed assessment systems that provide opportunities for students to demonstrate approaches to problem solving and the construction of ideas and products. There are also some innovative approaches to supporting both the development of productive attitudes, values, and dispositions toward inquiry and innovation, and the quality of teaching.

For example, **the New South Wales Essential Secondary Science Assessment (ESSA)** program (conducted at Year 8) is a diagnostic test that contains several extended response tasks, along with multiple-choice items. It also contains an unscored 'survey' to assess students' values and attitudes related to science and science learning. (Additionally, a teacher survey and a parent survey are also conducted each year as part of the assessment program.) Another aspect of the test, fully developed but not yet mandatory, is an online practical component that simulates a science investigation. Students complete multiple-choice, short response, and an extended response task as they conduct their online investigation. The pencil-and-paper format of the test is expected to be replaced by a completely online test in 2011.

Teachers mark the three extended response tasks and the extended response task from the online practical component at marking centers. Results are reported to schools through the NSW DET School Measurement, Assessment and Reporting Toolkit (SMART), a powerful computer package that flexibly displays results and enables the manipulation of data by schools. Curriculum support materials related to test items are available online for participating schools.

In **Western Australia**, external assessments of Science and Society and the Environment occur at grades 5, 7, and 9. In addition, the Curriculum Council establishes courses and examinations in Years 11 and 12 across a wide range of disciplines and ensures the quality of the school-assessed component of the Western Australian Certificate of Education (WACE). (Similar systems are used in South Australia and Victoria.) External examinations are combined with school-based assessments that range from laboratory experiments, essays, research papers, presentations, demonstrations, and projects to school-based tests and examinations. State external assessments are mainly written examinations with some courses also having external practical examinations (eg oral for languages, instrumental solos for music, visual diaries for Visual Art to flight simulation for Aviation). In Years 11 and 12, the Curriculum Council uses statistical moderation based on the external exam scores to ensure that the same assessment standards are applied to students across schools.

In addition to a syllabus for teachers to refer to in developing teaching and learning programs, the Western Australian Department of Education also provides grade standards and student work exemplars to support teachers in making appropriate and consistent judgments about student achievement, along with diagnostic assessment and reporting tools.

Extensive databases are used during administration of tests and the inputting of reporting data. Online interactive programs based on the test data facilitate diagnostic assessment, moderation and evaluation of student, cohort, school, and system performance. Substantial scanning technology is used for population-based assessments, including full scanning of writing scripts with sophisticated on screen marking.

Similarly, in **the Australian Capital Territory (A.C.T.)**, where school-based assessment is the primary approach until grade 10, individual teachers design and grade tasks, based on school developed assessment criteria and curriculum documents. They are guided by the different stages of development outlined in the ACT Curriculum framework. Students are also involved in their own self-assessment against specific criteria. The assessment of student's use of ICT is embedded across all curriculum areas. It is also an integral part of administration, scoring, moderation, sharing of assessments and student work. A 'Myclasses' online resource is available for the sharing of assessment tasks amongst teachers.

In **South Australia**, interesting progress is being made in creating more comparable evaluation of school-based assessments. Through grade 10, all students are assessed through school assessments developed by teachers, and judgments are made against the outcomes in the South Australian Curriculum, Standards and Accountability (SACSA) Framework. Schools can enter the outcomes data into the SACSA Achievement System software. Curriculum Services of the Department of Education and Children's Services manage a Peer Review Moderation project to promote consistency across schools and to provide quality assurance for the data that are input into the SAS through a random sample of schools across subject areas. This project also intends to expand assessment of the SACSA Essential Learnings (identity, interdependence, thinking, futures and communication) Many schools have assessment programs that incorporate communication, collaboration, critical thinking, citizenship, ICT literacy and learning to learn.

At Grades 11-12, a variety of assessment instruments are used in school based assessments of the South Australia Certificate of Education (SACE). All Stage 1 subjects are assessed wholly using school based assessment. External assessment components apply to some Stage 2 subjects including written examinations, performance and practical examinations, studies, investigations and oral examinations. When the new SACE is introduced at Stage 2 in 2011 all subjects will have 70% school based and 30% external assessment components. It is intended that a student who completes the SACE will:

- be an active, confident participant in the learning process (confidence);
- take responsibility for his or her own learning and training;
- respond to challenging learning opportunities, pursue excellence, and achieve in a diverse range of learning and training situations;
- work and learn individually and with others in and beyond school to achieve personal or team goals (independence, collaboration, identity);
- apply logical, critical, and innovative thinking to a range of problems and ideas (thinking, enterprise, problem-solving, future);
- use language effectively to engage with the cultural and intellectual ideas of others (communication, literacy);
- select, integrate, and apply numerical and spatial concepts and techniques;
- be a competent, creative, and critical user of information and communication technologies (information technology);
- have the skills and capabilities required for effective local and global citizenship, including a concern for others (citizenship, interdependence, responsibility towards the environment, responsibility towards others);
- have positive attitudes towards further education and training, employment, and lifelong learning (lifelong learning).

With the introduction of the new SACE, five capabilities (communication, citizenship, personal development, work and learning) are embedded in all subjects. Some or all of the capabilities are

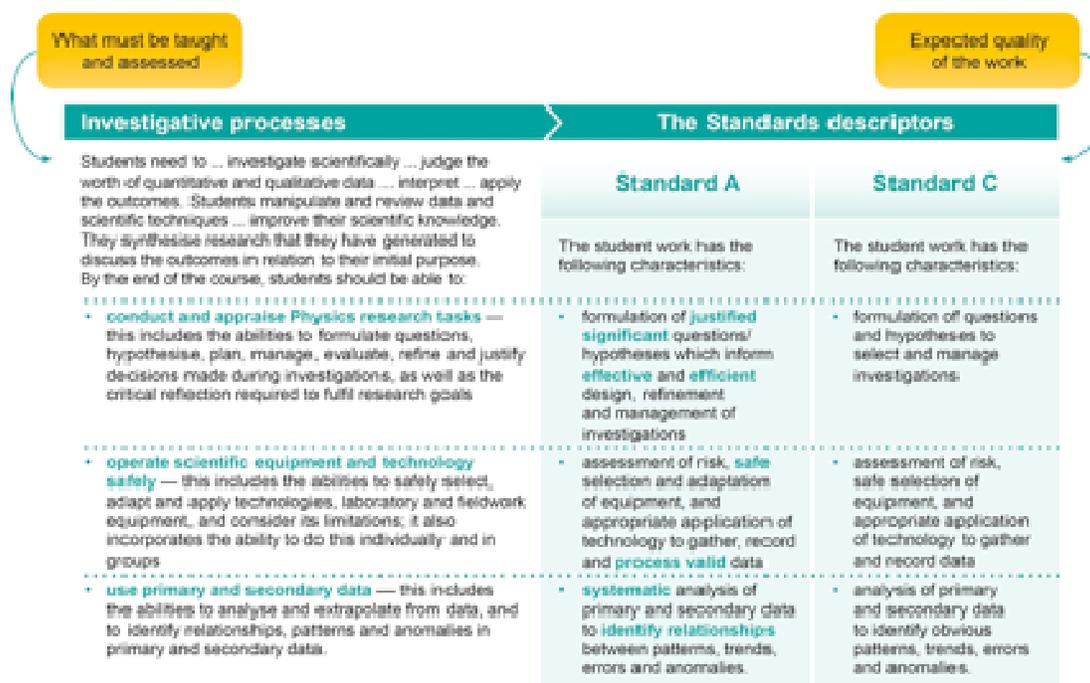


Figure 2: Excerpt from Queensland science standards

explicitly assessed. The introduction of the new SACE will also offer new opportunities for using technology, including e-Portfolios, e-Assessment and e-Moderation in addition to an enhanced management system.

Queensland. In Queensland, school-based assessment has been the norm for 40 years. Until the early 1970s, a centralized examination system controlled the curriculum. When it was eliminated, all assessments became school-based. These assessments are developed, administered and scored by teachers in relation to the national curriculum guidelines and state syllabi (also developed by teachers), and are moderated by panels that include teachers from other schools and professors from the tertiary education system. Recently, centrally-developed tasks and a 12th grade test have been added.

To create the standards used throughout the province, the central authority gathers groups of teachers and subject experts to write standards that specify different levels of achievement and describe the characteristics of student work at each level. In the excerpt from Queensland’s science standards shown in Figure 2, the left side describes the objectives or “Essential Learnings” that must be taught and assessed by teachers. The objectives convey the knowledge or skill expected at each standard. The standard descriptors to the right detail the expected characteristics and quality of the work. The teachers and experts also develop samples of work used as exemplars to show the different levels. These standards guide the assessments teachers develop and their scoring.

The syllabi seek to strike a balance between “informed prescription” and “informed professionalism.” They spell out a small number of key concepts and skills to be learned in each course, and the kinds of projects or activities (including minimum assessment requirements) students should be engaged in. Each school designs its program to fit the needs and experiences of its students, choosing specific texts and topics with this in mind. However, all schools evaluate student work using shared criteria, based on the course objectives and specific standards for an A, B, C, D, and E mark.

In Queensland science courses, students must complete an extended experimental investigation. The instructions for the task read:

Within this category, instruments are developed to investigate a hypothesis or to answer a practical research question. The focus is on planning the extended experimental investigation, problem solving and analysis of primary data generated through experimentation by the student. Experiments may be laboratory or field based. An extended experimental investigation may last from four weeks to the entirety of the unit of work. The outcome of an extended experimental investigation is a written scientific report. *Aspects of each of the three criteria should be evident in the investigation.* For monitoring, the discussion/conclusions/evaluation/recommendations of the report should be between 1500 and 2000 words.

To complete such an investigation the student must:

- develop a planned course of action
- clearly articulate the hypothesis or research question, providing a statement of purpose for the investigation
- provide descriptions of the experiment
- show evidence of modification or student design
- provide evidence of primary and secondary data collection and selection
- execute the experiment(s)
- analyze data
- discuss the outcomes of the experiment
- evaluate and justify conclusion(s)
- present relevant information in a scientific report.

Box 1: Extended experimental investigations

As the criteria from the physics syllabus in Box 1 indicate, in the category of *Knowledge and conceptual understanding*, work that meets an “A” standard demonstrates interpretation, comparison, and explanation of complex concepts, theories and principles, whereas work at an “E” standard is characterized by reproduction of isolated facts and application of simple, given algorithms. In this particular course, objectives also include *Investigative Processes*, and *Evaluating and Concluding*, with indicators spelled out for all of these objectives. The expectations of work quality are challenging, and include critical thinking, problem solving, decision making, research, and communication skills, as shown in the example in Box 1.

An example from a year 12 paper shows how a student investigated a problem entitled, “The Air Pocket.” The assessment starts with a picture, shown in Figure 3 of a vertical air jet from a straw producing a cavity on a water surface.

The student investigated the parameters that would affect the volume of the cavity, preparing a 32 page paper meeting the criteria described earlier, including evaluating the problem theoretically and empirically, presenting data through tables and charts, analyzing findings both by summarizing individual results and developing a regression to evaluate the combined effects of several variables on the volume of the cavity, and evaluating the results, along with the potential errors and additional research needed. Overall, the paper more closely resembles a research report from a scientific laboratory than a traditional high school physics test. The student concluded:

It was determined through initial theoretical research that the predominant influences on the cavity’s volume were air speed, diameter of nozzle/straw and distance between straw/nozzle and water. Upon testing the effects of changing an individual parameter with respect to volume, every possible variation was tried, such that eventually a complete set of values was obtained. To combine the different parameters into a single equation, a multiple regression was used; to determine both the constant factor and the powers to which each of the variables should be raised. The resultant r^2 value was 0.96 indicating an excellent fit for the data while the average

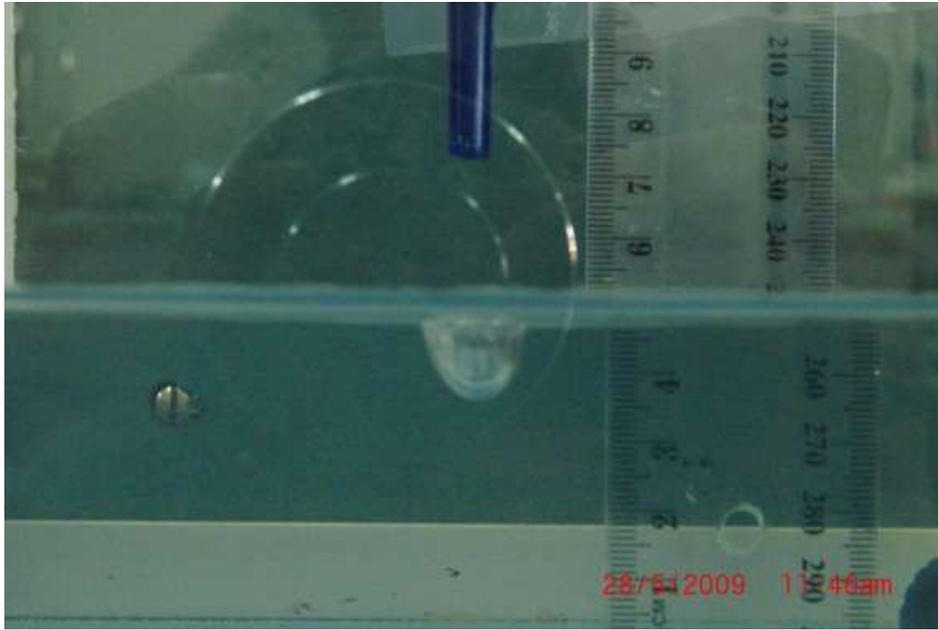


Figure 3: Picture for problem on an air pocket

percentage error was 1.59% and the median percentage error, 6.71%. ... [In future experiments], it would be suggested to do the experiments on a larger scale as this would virtually eliminate the effects of surface tension while cutting down unfounded accuracy in the model (the volume could be measured in cubic centimetres or cubic metres, resulting in a more realistic fit, with data that is not required to be impossibly precise. Finally, it would be suggested to trial the effects of the different orientation of the straw/nozzle, as tilting it would give a completely differently shaped cavity (due to the dispersion characteristics of air).

Thus, students go beyond their own empirical data and conclusions to reflect on the accuracy of their findings and means for improving their investigation. These kinds of extended responses are demanded in all of the subject areas, shaped by the core concepts and modes of inquiry of the disciplines. Student reflection is also a common element of the assessments. Consistent scoring of such intellectually ambitious work is made possible by internal and external moderation processes, and by the clear guidance of the syllabi and rubrics used to set standards for the work.

All of the 98,000 students in Queensland's 11th and 12th grades complete multiple assessments like these based on the national standards, the state syllabi, and the school's approved work plan. At the end of the year, teachers collect a portfolio of each student's work, which includes the specific assessment tasks, and grade it on a 5-point grading scale. To calibrate these grades, teachers put together a selection of portfolios from each grade level – one from each of the 5 score levels plus borderline cases -- and send these to a regional panel for moderation. A panel of five teachers re-scores the portfolios and confers about whether the grade is warranted, making a judgment on the spread. State review panels also look at a sample of student work from each district to insure that schools implement the standards across all districts. Based on this analysis, and at year 12, a standardized statewide test called the Queensland Core Skill (QCS) Test, the Queensland authority confirms the levels of achievement proposed by school programs and may adjust it if it does not calibrate to the standards.

At lower grade levels, the Queensland Studies Authority (QSA) has recently developed and piloted centrally devised Queensland Comparable Assessment Tasks (QCATs) for Years 4, 6 and 9 in the English, Mathematics and Science *Essential Learnings* and *Standards*. These tasks, available in an Assessment Bank, aim to provide authentic, performance-based assessments that can be used to

Instruction to Students: Your task is to design a space to store enough stackable chairs to seat all the staff and students in your school.

You will:

- follow a series of steps to help you design a suitable space
- use a research journal to record your ideas and rough working
- write a report on the process and solutions.

Questions

1. Develop mathematical models for each dimension of a stack of chairs, where the number of chairs is unknown.
2. To help you think about the practicalities of storing chairs, use your mathematical models to find:
 - a. the greatest number of chairs in one stack that can fit into a storage area with a 4 m high ceiling
 - b. the number of stacks that fit across a 3.2 m wide area if there are 10 chairs in each stack
 - c. the height of a stack, if all the chairs for the school are put into one stack.
3. Use the understanding of the practicalities of storing chairs you developed in Question 2 to find a practical storage area for the chairs.

To answer these questions, work through the steps set out on the following pages. As you work, record everything you do in your research journal.

Using a research journal

A research journal is a record of what you and your group do. Your research journal should include:

what you and your group do in each class session

- ideas
- questions
- plans
- difficulties faced
- how difficulties are managed
- data collected
- calculations
- mathematical language
- acknowledgment of any help you receive from friends, teachers or other people.

Your research journal should contain all the information you need to write your report. It will also help your teacher decide what you can do by yourself, and what you can do as part of a group.

Communicating your Findings

Write a report on your investigation. Your report should include:

- an introduction providing an overview of the scenario and the questions
- your solutions to the questions, using mathematical language, data, calculations, diagrams, graphs and phrases or sentences that provide enough information for a person to know what you are calculating without having to read the questions
- a conclusion, summarising:
 - your reflection on the practicalities of your solutions
 - any assumptions made or limitations to your answers
 - suggestions for improving the investigation or strategies used.

Box 2: Problem to design space for stackable chairs

evaluate learning and scored in moderated processes by teachers to develop comparability of reported results. The task in Box 2 for grade 9 mathematics illustrates the kind of problem-solving, critical thinking, collaboration, creativity, and communication evaluated by the tasks.

Aiming for even more applied, interdisciplinary work, Queensland developed a “Rich Tasks” approach to standards and assessment, which was introduced as a pilot in 2003. Part of the “New

Students must identify, explore and make judgments on a biotechnological process to which there are ethical dimensions. Students identify scientific techniques used as well as significant recent contributions to the field. They will also research frameworks of ethical principles for coming to terms with an identified ethical issue or question. Using this information they prepare pre-conference materials for an international conference that will feature selected speakers who are leading lights in their respective fields.

In order to do this students must choose and explore an area of biotechnology where there are ethical issues under consideration and undertake laboratory activities that help them understand some of the laboratory practices. This enables them to:

- A) Provide a written explanation of the fundamental technological differences in some of the techniques used, or of potential use, in this area (included in the pre-conference package for delegates who are not necessarily experts in this area).
- B) Consider the range of ethical issues raised in regard to this area's purposes and actions, and scientific techniques and principles and present a deep analysis of an ethical issue about which there is a debate in terms of an ethical framework.
- C) Select six real-life people who have made relevant contributions to this area and write a 150-200 word précis about each one indicating his/her contribution, as well as a letter of invitation to one of them.

This assessment measures research and analytic skills; laboratory practices; understanding biological and chemical structures and systems, nomenclature and notations; organizing, arranging, sifting through, and making sense of ideas; communicating using formal correspondence; précis writing with a purpose; understanding ethical issues and principles; time management, and much more.

Box 3: Summary description of task on science and ethics

Basics" project, this effort has created extended, multi-disciplinary tasks that are developed centrally and used locally when teachers determine the time is right and they can be integrated with locally-oriented curriculum (Queensland Government, 2001). These are "specific activities that students undertake that have real-world value and use, and through which students are able to display their grasp and use of important ideas and skills." Rich Tasks are defined as:

A culminating performance or demonstration or product that is purposeful and models a life role. It presents substantive, real problems to solve and engages learners in forms of pragmatic social action that have real value in the world. The problems require identification, analysis and resolution, and require students to analyze, theorize and engage intellectually with the world. As well as having this connectedness to the world beyond the classroom, the tasks are also rich in their application: they represent an educational outcome of demonstrable and substantial intellectual and educational value. And, to be truly rich, a task must be transdisciplinary. Transdisciplinary learnings draw upon practices and skills across disciplines while retaining the integrity of each individual discipline.

One task description is summarized in Box 3. A bank of these tasks now exists across grade levels, along with scoring rubrics, and moderation processes by which the quality of the tasks, the student work, and the scoring can be evaluated. Studies have found stronger student engagement in schools using the Rich Tasks. On traditional tests, the "New Basics" students scored about the same as students in the traditional program, and they scored notably better on assessments designed to gauge higher order thinking.

Victoria. In Victoria, as in many other Australian states, a mixed system of centralized and decentralized assessment combines these kinds of school-based assessment practices with a set of state exams guided by the Victoria Essential Learning Standards (VELS). Considerable attention is given to teachers' abilities to assess the VELs. The Standards define what students should know

and be able to do at each level so that units of work based on activities described in the learning focus statements are assessable against the expected standards. An emphasis on real-world tasks supports transfer in learning. Assessment maps are provided within each domain to assist teachers in assessing all the standards. These are a collection student work samples for each domain, each of which is annotated to describe attributes of the student's work and its relationship with specific elements of the standards as well as progression points illustrating development within each level. Teachers are advised that:

Assessment of student achievement against the standards requires a mix of summative assessment to determine what the student has achieved and formative assessment to inform the next stage of learning. This should be based on authentic assessment in which students are asked to perform real-world tasks demonstrating the application of essential knowledge and skill. Assessment must also evaluate knowledge, skills and behaviors in an integrated way, rather than treating each and every standard as discrete. This not only ensures a more efficient approach to student assessment that avoids unnecessary duplication of assessment tasks and subsequent reports, but also more clearly reflects how students actually learn and develops deep understanding in learners which can be transferred to new and different contexts (VCAA, 2009).

At the secondary level, the Victorian Certificate of Education (VCE) provides information that guides pathways to further study at the university, Technical and Further Education (TAFE) and to the world of work. Some students undertake a school-based apprenticeship or traineeship within the VCE. The Victoria Curriculum and Assessment Authority establishes courses in a wide range of studies, develops the external examinations and ensures the quality of the school-assessed component of the VCE.

VCAA conceptualizes assessment as “of,” “for,” and “as” learning. Teachers are involved in developing assessments, along with university faculty in the subject area, and all prior year assessments are public, in an attempt to make the standards and means of measuring them as transparent as possible. Before the external examinations are given to students, teachers and academics sit and take the exams themselves, as if they were students. The external subject-specific examinations, given in grades 11 and 12, include about 25% machine-scored items; the remaining items are open-ended, and are scored by the classroom teacher. The exams may include written, oral, and performance elements. Language examinations, for example, include on-demand oral tests and arts examinations include required performance components, such as dance and musical performances.

The VCE exams often push toward applications of knowledge in problem solving contexts requiring evaluation and innovative thinking. For example, the Design and Technology exam poses several design challenges to which students have to respond along many dimensions – with respect to materials, engineering features, safety, reliability, and aesthetic considerations – while resolving design dilemmas and justifying their decisions.

In the on-demand portion of the English exam, which is comprised of several essays that test aspects of analysis and communications skills, students must analyze aspects of literature they have read, respond to critical interpretations of texts with their own analyses and ideas; and develop and explain their thinking about a topic after reading several source materials that provide differing kinds of information and points of view. In one such task, students are asked to analyze whether parents and government laws seek to “overprotect” citizens from potential harm. (See Box 4).

In addition to the on-demand tests, at least 50% of the total examination score is comprised of classroom-based tasks that are given throughout the school year. Teachers design these required assignments and assessments – lab experiments and investigations on central topics as well as research papers and presentations – in response to syllabus expectations. These required classroom tasks ensure that students are getting the kind of learning opportunities which prepare them for the assessments they will later take, that they are getting feedback they need to improve,

Part 1

Analysis of language use: Complete the following task. In a coherently constructed piece of prose, analyse the ways in which language is used to present a point of view in **both** opinion pieces found on pages 14 and 15.

Part 2

Presentation of a point of view: Complete **one** of the following tasks. Draw on the material provided on pages 13 -17 as you think appropriate.

a. You are to speak at a public forum. Your topic is “Are we overprotected?” Write a **speech** expressing your point of view on this topic.

OR

b. The daily newspaper is conducting an essay competition. The topic is “Are we overprotected?” Write your **essay** for this competition.

OR

c. You have read the two articles in the daily newspaper (reproduced on pages 14 and 15). Write a **letter to the editor** of the newspaper expressing your view on whether we are overprotected.

TASK MATERIAL

Parenting styles have changed over the years and much has been written about the best way to bring up children. Some experts advise new parents to implement a regime of strict control and rigid routine for their children’s own protection. Others argue for a more permissive, liberal style of parenting to encourage children to be independent and become more resilient adults. This pattern continues into adulthood. Laws intended to protect people could be seen to prevent them from taking personal responsibility for their own actions. The following material presents a range of viewpoints on this issue.

[The materials include opinion pieces about parenting and about societal regulations, as well as newspaper articles about accidents that have happened to children and adults who were both warned and protected and unwarned and unprotected. Data about various sources of injury are also provided in graphical form.]

Box 4: Year 12 English examination question, Victoria, Australia

and that they will be prepared to succeed not only on these very challenging tests but in college and in life, where they will have to apply knowledge in these ways.

An example from the Victoria biology test, shown in Box 5, describes a particular virus to students, asks them to design a drug to kill the virus and, in several pages, explain how the drug operate, and then to design an experiment to test the drug.

In preparation for this on-demand test, students taking Biology will have been assessed on six pieces of work during the school year covering specific outcomes in the syllabus. For example, they will have conducted “practical tasks” like using a microscope to study plant and animal cells by preparing slides of cells, staining them, and comparing them in a variety of ways, resulting in a written product with visual elements. They also will have conducted practical tasks on enzymes and membranes, and on the maintenance of stable internal environments for animals and plants. Finally, they will have completed and presented a research report on characteristics of pathogenic organisms and mechanisms by which organisms can defend against disease. These tasks, evaluated as part of the final examination score, link directly to the expectations that students will encounter on the external examination but go well beyond what that examination can measure in terms of how students can apply their knowledge.

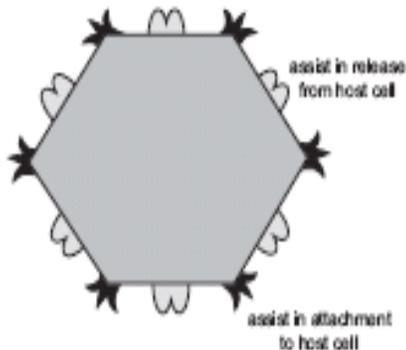
The tasks are graded according to criteria set out in the syllabus. The quality of the tasks assigned by teachers, the work done by students, and the appropriateness of the grades and feedback given to students are audited through an inspection system, and schools are given feedback on all of these elements. In addition, the VCAA uses statistical moderation to ensure that the same

assessment standards are applied to students across schools. The external exams are used as the basis for this moderation, which adjusts the level and spread of each school's assessments of its students to match the level and spread of the same students' collective scores on the common external test score. The system supports a rich curriculum and ambitious assessments for students with a comparable means for examining student learning outcomes.

When scientists design drugs against infectious agents, the term “designed drug” is often used.

A. Explain what is meant by this term. _____

Scientists aim to develop a drug against a particular virus that infects humans. The virus has a protein coat and different parts of the coat play different roles in the infective cycle. Some sites assist in the attachment of the virus to a host cell; others are important in the release from a host cell. The structure is represented in the following diagram:



The virus reproduces by attaching itself to the surface of a host cell and injecting its DNA into the host cell. The viral DNA then uses the components of host cell to reproduce its parts and hundreds of new viruses bud off from the host cell. Ultimately the host cell dies.

- B. Design a drug that will be effective against this virus. In your answer outline the important aspects you would need to consider. Outline how your drug would prevent continuation of the cycle of reproduction of the virus particle. Use diagrams in your answer. Space for diagrams is provided on the next page.
- C. Before a drug is used on humans, it is usually tested on animals. In this case, the virus under investigation also infects mice. Design an experiment, using mice, to test the effectiveness of the drug you have designed.

Box 5: High school biology examination question, Victoria, Australia

Finland

Finland has been much studied since it rapidly climbed to the top of the international rankings for both economic competitiveness and educational outcomes over the decade and a half. In 2006, it ranked first among the OECD nations on the PISA assessments in mathematics, science, and reading. Leaders in Finland attribute these gains to their intensive investments in teacher education and major overhaul of the curriculum and assessment system (Laukkanen, 2008; Buchberger & Buchberger, 2004). Prospective teachers are competitively selected from the pool of college graduates and receive a three-year graduate-level teacher preparation program, entirely free of charge and with a living stipend. Their master's degree program offers a dual focus on inquiry-

oriented teaching and teaching that meets the needs of diverse learners – and includes at least a full year of clinical experience in a model school associated with the university. Preparation includes a strong focus on how to use formative performance assessments in the service of student learning.

Policy makers decided that if they invested in very skillful teachers, they could allow local schools more autonomy to decide what and how to teach — a reaction against the highly centralized system they sought to overhaul. Finland's national core curriculum is a much leaner document, reduced from hundreds of pages of highly specific prescriptions to descriptions of a small number of skills and core concepts each year. (For example, about 10 pages describe the full set of math standards for all grades.) This guides teachers in collectively developing local curricula and assessments that encourage students to be active learners who can find, analyze, and use information to solve problems in novel situations.

There are no external standardized tests used to rank students or schools. Finland's leaders point to the use of school-based, student-centered, open-ended tasks embedded in the curriculum as an important reason for the nation's extraordinary success on international examinations (Lavonen, 2008; Finnish National Board of Education, 2007). Finnish education authorities periodically evaluate school-level samples of student performance, generally at the end of the 2nd and 9th grades, to inform curriculum and school investments. All other assessments are designed and managed locally. The national core curriculum provides teachers with recommended assessment criteria for specific grades in each subject and in the overall final assessment of student progress each year (Finnish National Board of Education, June 2008). Local schools and teacher then use those guidelines to craft a more detailed curriculum and set of learning outcomes at each school as well as approaches to assessing benchmarks in the curriculum (Finnish National Board of Education, June 2008). Teachers are treated as “pedagogical experts” who have extensive decision-making authority in the areas of curriculum and assessment as in other areas of school policy and management (Finnish National Board of Education, April 2008).

According to the Finnish National Board of Education (June 2008), the main purpose of assessing students is to guide and encourage students' own reflection and self-assessment. Consequently, on-going feedback from the teacher is very important. Teachers give students formative and summative reports both through verbal feedback and on a numerical scale based on students' level of performance in relation to the objectives of the curriculum. All Finnish schools use a grading scale of 4–10, where 5 is “adequate” and 10 is “excellent.” The recommended assessment criteria are shaped around the grade of 8 or “good.” Teachers' reports must be based on multiple forms of assessment, not only exams. Schools are responsible for giving basic education certificates for completing the different milestones of comprehensive school up to 9th grade and additional classes prior to university (European Commission, 2007/2008).

Most Finnish students take a set of voluntary matriculation examinations that provide information for university admissions based on students' abilities to apply problem solving, analytic and writing skills. University and high school faculty members construct the examinations – which are composed of open-ended essays and problem solutions – under the guidance of the Matriculation Exam Board, which is appointed by the Finnish Ministry of Education to organize, manage, and administer the exam (The Finnish Matriculation Examination, 2008). The Board members (about forty in number) are faculty and curriculum experts in the subject areas tested, nominated by universities and the National Board of Education. More than 300 associate members – also typically high school and college faculty – help develop and review the tests. High school teachers grade the matriculation exams locally using official guidelines, and samples of the grades are re-examined by professional raters hired by the Board (Kaftandjieva & Takala, 2002).

Students take at least four exams, with the test in the students' mother tongue (Finnish, Swedish, or Saami) being compulsory. These tests have a textual skills section, that evaluates students' analytic skills and linguistic expression, and an essay that focuses on the development of thinking, linguistic expression and coherency. They then choose three other tests from among the following: the test in the second national language, a foreign language test, the mathematics test, and one or more tests

from the general studies battery of tests in the sciences and humanities (e.g. religion, ethics, philosophy, psychology, history, social studies, physics, chemistry, biology, geography, and health education). The tests also incorporate questions that cross disciplinary boundaries.

The Finnish system assumes that all students aiming for college (who comprise a majority of will be at least bi-lingual and many will be tri-lingual. The language tests evaluate listening and reading comprehension as well as writing in the language in question.

In addition to choices of which tests to take, students make choices of which items to answer within the exams. In the general battery, they are generally given a set of questions or prompts from which they must respond to six or eight of their choice. On the mathematics test, there are 15 or so problems from which they must choose 10 to answer. Problems require critical thinking and modeling, as well as straightforward problem-solving.

For example, the Basic mathematics exam poses this problem:

A solution of salt and water contains 25 per cent salt. Diluted solutions are obtained by adding water. How much water must be added to one kilogram of the original solution in order to obtain a 10 per cent solution? Work out a graphic representation which gives the amount of water to be added in order to get a solution with 2–25 % of salt. The amount of water (in kilograms) to be added to one kilogram of the original solution must be on the horizontal axis; the salt content of the new solution as a percentage must be on the vertical axis.

And the Advanced mathematics exam poses this one:

In a society the growth of the standard of living is inversely proportional to the standard of living already gained, i.e. the higher the standard of living is, the less willingness there is to raise it further. Form a differential-equation-based model describing the standard of living and solve it. Does the standard of living rise forever? Is the rate of change increasing or decreasing? Does the standard of living approach some constant level?

Assessment is used in Finland to cultivate students' active learning skills by posing complex problems and helping students address these problems. For example, in a Finnish classroom, it is rare to see a teacher standing at the front of a classroom lecturing students for fifty minutes. Instead, teachers are likely to be coaching students who are working on hands-on tasks that are often self-managed. A description of a Finnish school (Korpela, 2004) illustrates how students may be engaged in active, self-directed learning, rotating through workshops or gathering information, asking questions of their teacher, and working with other students in small groups. They may be focusing on completing independent or group projects or writing articles for their own magazine. The cultivation of independence and active learning allows students to focus on broad knowledge with emphasis on skills like analytical thinking, problem solving, and metacognitive skills that develop students' thinking (Lavonen, 2008).

Although not part of the mandatory national assessment system, one assessment project of some potential interest to ATC21S is the "Learning to Learn" project launched in the mid-1990s as a partnership between the Finnish National Board of Education, the Centre for Educational Assessment at the University of Helsinki, and the City of Helsinki Education Department. Reports through 2002 describe the results of several studies of 6th, 9th, and upper secondary school students using cognitive and affective measures administered as paper and pencil test items and attitudinal surveys (Hautamaki et al., 2002; Hautamaki & Kupiainen, 2002). The project developed an elaborated framework for conceptualizing "learning to learn," defining it in the summary report as:

... the adaptive and voluntary mastery of learning action. After initial task acceptance, learning action is seen to be maintained through affective and cognitive self-regulation. Learning-to-learn can then be defined as the readiness and willingness to adapt to a novel task. It consists

of a complex system of cognitive competencies and self- and context-related beliefs. Readiness, or cognitive competence, refers both to the knowledge of relevant facts and to the use of thinking and reasoning; i.e., to the retrieval of the already learnt and to the application of general procedures to adapt to new situations. The cognitive component of learning-to-learn is also referred to as *mastery of reasoning*. It is related to Piaget's reflective abstraction, and the scaling of the indicator is criterion-referenced in relation to the mastery of formal operational schemata. This distinguishes it from classical measures of intelligence, as concrete and formal operations can be shown to be malleable and thus teachable. The affective component of learning-to-learn is seen to consist of several relatively independent subsystems, comprising both self- and context-related beliefs. Among these, learning motivation, action-control beliefs, school-subject-related beliefs, task acceptance, socio-moral commitment, self-evaluation, and the experienced support of significant others are seen to be central when learning-to-learn is assessed at school level (Hautamäki & Kupiainen, 2002, pp. 3-4).

That report noted both the interest generated by this conceptual framework (for a full discussion, see Hautamaki et al., 2002), along with some concerns about the assessment formats, in particular the use of paper-and-pencil, multiple-choice items in collecting data. The researcher observed that, "The 'real' learning situations in later life are not in a ready paper-and-pencil form," (Hautamaki & Kupiainen, 2002, p. 22) and suggested that further work on open-ended prompts and real-life tasks (coming nearer to a work-sample approach) would be more ideal if cost considerations could be overcome.

Singapore

Greater emphasis on school-based assessment integrated into large-scale testing systems has more recently occurred in Singapore. Singapore's education system has been a source of intense interest for policy analysts since its students took first place in the TIMSS (Trends in International Mathematics and Science Study) assessments in mathematics and science in 1995, 1999 and 2003. These rankings are based on strong achievement for all of the country's students, including the Malay and Tamil minorities, who have been rapidly closing what was once a yawning achievement gap (Dixon, 2005). About 90% of Singapore's students scored above the international median on the TIMSS tests. This accomplishment is even more remarkable given that fewer than half of Singapore's students routinely speak English, the language of the test, at home. Most speak one of the other four official national languages of the country – Mandarin, Malay, or Tamil – and some speak one of several dozen other languages or dialects.

Intensive investment and reform over thirty years have transformed the Singaporean education system, broadening access and increasing equality while orchestrating a system that includes a complex system of private, "autonomous," and public schools, some of them inherited from the colonial era, all of which receive government subsidies. These schools are intentionally diverse in many ways, as local schools are urged to innovate, but purposefully common in instructional expectations and supports, using a common national curriculum for core subjects.

Since the prime minister introduced the "thinking schools, learning nation" initiative in 1997, Singapore's explicit focus in its reforms of curriculum, assessment, and teaching has been to develop a creative and critical thinking culture within schools, by explicitly teaching and assessing these skills for students – and by creating an inquiry culture among teachers as well, who are supported to conduct action research on their teaching and to continually revise their teaching strategies in response to what they learn. This initiative was married to commitments to integrating technology into all aspects of education – a mission nearly fully accomplished a decade later – and to dramatically opening up college and university admissions.

Higher education is now available to virtually all Singaporeans. Based on their interests, labor force needs, and the results of their grades, O-level exams, and other accomplishments, students pursue one of three pathways after 10th grade when secondary school ends: about 25% attend Junior College for two years, followed by university, which leads to professional paths such as teaching,

science, engineering, medicine, law, and the civil service; about 60% attend a polytechnic college for 3 years, after which about half go on to the university while the others go into jobs in technical and engineering fields; and the remainder – about 15% – attend an Institute of Technical Education for two years, and some then continue onto college or university. Virtually everyone finishes one of these pathways.

Historically, the schools have operated a modified British-style system. Students sit for national exams administered by the Singapore Examinations and Assessment Board (SEAB). At the end of Year 6 (age 12), students take the Primary School Leaving Examinations (PSLE). These are open-ended written and oral examinations in four core subject areas: mathematics, science, English and a “mother tongue” language, which are administered and scored by teachers in moderated scoring sessions. The exams in the English and native languages include four components – two written essays of at least 150 words, listening comprehension, language comprehension, and an oral exam that requires students to engage in a conversation on a set topic for 15 minutes. Two examiners observe the candidates and grade the oral proficiency of the student. In math, students have to demonstrate the steps in solving a problem.

Students then take the General Certificate of Examinations Normal or Ordinary Level (GCE N/O-Level) at the end of year 10 (age 16). The GCE N- and O-level examinations are based on common course syllabi that outline what is to be taught; they require short and long open-ended responses and essays across a wide range of content areas from which students choose the ones in which they want to be examined. Although the results are used to guide postsecondary admissions, and are not used to determine graduation from high school, they exert substantial influence on the high school curriculum. Recent reforms are changing the curriculum and assessment system to make it more explicitly focused on creativity and independent problem solving. Many courses included applied examination elements that allow students to demonstrate how they can solve problems in performance tasks.

For example, the examination score for the Computer Applications course at the N-level includes a paper and pencil component (30%), a practical component (35%), and a specific set of course-embedded tasks (35%) to be scored using common criteria by teachers. The practical examination tests students' ability to use both word processing and spreadsheet software for a series of tasks. The course-embedded project requires students to design a database, website, or product using technology. At the O-level, the Computer Applications exam requires a school-based project (25%) that takes place over a 14-week period. Students must identify a problem they want to tackle, design a technology-based solution, implement the solution, design and implement a testing strategy to evaluate the solution, document their strategy and the results of their testing, and evaluate the success and limitations of the overall solution strategy. These examination elements are scored by teachers using common criteria with internal and external moderation of scores for comparability.

Students attending Junior College (grades 11 and 12) en route to university take the GCE Advanced Level (A-Level) exams at the end of year 12 (age 18). A new 'A' level curriculum and examination system was introduced in 2002. The new exams are meant to encourage multi-disciplinary learning by requiring that students “select and draw together knowledge and skills they have learned from across different subject areas, and apply them to tackle new and unfamiliar areas or problems” (Singapore Examinations and Assessment Board, 2006, p. 2).

The A-level curricular framework includes Core Content Areas in which students take courses and associated exams: humanities, mathematics and sciences, and languages. It also includes Life Skills – emphasizing leadership, enrichment, and service to others – and Knowledge Skills, evaluated through a general paper, project work, and a course in knowledge and inquiry. A typical A-level student is evaluated in three compulsory subjects – a general paper, project work, and a native language assessment -- along with four content subjects.

The newer areas of Life Skills and Knowledge Skills are intended to develop the more advanced thinking skills thought to be underrepresented in the traditional content-based curriculum and examinations system. They represent the goals of reforms launched in 1997 as part of the “thinking schools, learning nation” initiative, which created a number of changes:

Syllabi, examinations and university admission criteria were changed to encourage thinking out of the box and risk-taking. Students are now more engaged in project work and higher order thinking questions to encourage creativity, independent, and inter-dependent learning (Ng, 2008, p. 6).

The content courses are also evolving to include more critical thinking, inquiry and investigation, along with mastery of content. A number of the high school content tests are accompanied by school-based tasks, such as research projects and experiments designed and conducted by students. Each of the science courses now includes a component called the “School-based Science Practical Assessment” (SPA). These school-based components, managed and scored by teachers according to specifications provided by the Examinations Board, count for up to 20% of the examination grade. Scoring is both internally and externally moderated. The goal is for students to be able to:

1. Follow a detailed set or sequence of instructions and use techniques, apparatus and materials safely and effectively;
2. Make and record observations, measurements, methods and techniques with precision and accuracy;
3. Interpret and evaluate observations and experimental data; and
4. Identify a problem, design and plan investigations, evaluate methods and techniques, and suggest possible improvements in the design.

The projects can be submitted to the university as part of the application, and universities are encouraged to examine evidence about student accomplishments beyond examination scores. Below we describe some of these innovations in the examination system.

Innovative features of the examination system

Project Work

Project Work (PW) is an **interdisciplinary subject** that is compulsory for all pre-university students. There is dedicated curriculum time for students to carry out their project tasks over an extended period. As an interdisciplinary subject, it breaks away from the compartmentalization of knowledge and skills to focus on interdisciplinary outcomes by requiring students to draw knowledge and apply skills from across different subject domains. The goals for this experience are embedded in the requirements for the task and its assessment, which are centrally set by the Singapore Examinations and Assessment Board. The tasks are designed to be sufficiently broad to allow students to carry out a project that they are interested in while meeting the task requirements:

- **It must foster collaborative learning through group work.** Together as a group randomly formed by the teacher, students brainstorm and evaluate each others’ ideas, agree on the project that the group will undertake and decide on how the work should be allocated amongst themselves.
- **Every student must make an oral presentation:** Individually and together as a group, each student makes an oral presentation of his / her group project in the presence of an audience
- Both product and process are assessed: There are 3 components for assessment:
 - the **Written Report** which shows evidence of the group’s ability to generate, analyze and evaluate ideas for the project

- the **Oral Presentation** in which each individual group member is assessed on his/her fluency and clarity of speech, awareness of audience as well as response to questions. The group as a whole is also assessed in terms of the effectiveness of the overall presentation;
- the **Group Project File** in which each individual group member submits three documents related to 'snaphsots' of the processes involved in carrying out the project. These documents show the individual student's ability to generate, analyze and evaluate (i) preliminary ideas for a project (ii) a piece of research material gathered for the chosen project and (iii) insights and reflections on the project.

In carrying out the PW assessment task, students are intended to acquire self-directed inquiry skills as they propose their own topic, plan their timelines, allocate individual areas of work, interact with teammates of different abilities and personalities, gather and evaluate primary and secondary research material. These PW processes reflect life skills and competencies such as knowledge application, collaboration, communication and independent learning, which prepare students for the future workplace.

About 12,000 students complete this task annually. Assessment is school-based and criterion-referenced. While task setting, conditions, assessment criteria, achievement standards and marking processes are externally specified by SEAB, the assessment of all three components of PW is carried out by classroom teachers, using a set of assessment criteria provided by the board. All schools are given exemplar material that illustrates the expected marking standards. The Board provides training for assessors and internal moderators. Like all other assessments, the grading is both internally and externally moderated.

Knowledge and inquiry

Knowledge and Inquiry is a Humanities subject that seeks to develop in students:

- **An understanding of the nature and construction of knowledge:** Students are expected to show that they have read widely and have understood and can apply the concepts involved. They are expected to demonstrate skill in selecting relevant material with which to tackle the assessment tasks.
- **Critical Thinking:** Students are expected to demonstrate skills of critical thinking. They are expected to analyze different kinds of arguments and information, identify and evaluate assumptions and points of view, verify claims and provide reasoned and supported arguments of their own.
- **Communication Skills:** Students are expected to communicate their ideas and arguments clearly and coherently in good English. They are expected to structure their arguments, and select an appropriate style of presentation, to communicate responses which are fully relevant to the questions asked and demonstrate clear ability to engage with different aspects of these questions.

There are three assessment components:

- **Essay:** This paper gives candidates the opportunity to demonstrate their ability to apply the concepts they have learned in their study of the nature and construction of knowledge. It covers the theoretical aspects of areas of exploration identified in the syllabus and the questions set will require candidates to draw on knowledge they have gained during their study of the following key questions:
 - Why ask questions?
 - What is knowledge?

- How is knowledge constructed?
 - What makes knowledge valid?
 - How is knowledge affected by society?
 - How should knowledge be used?
- **Critical Thinking:** This paper requires students to critically analyze different kinds of arguments and information presented in the Material, identify and evaluate assumptions and points of view, and verify claims, and to provide reasoned and supported arguments. Students must use language appropriately and effectively to communicate a clear and well-structured argument.
 - **Independent Study:** The Independent study component allows students to demonstrate their understanding of the nature and construction of knowledge as it relates to their chosen area of study, apply this understanding in addressing the specific context, select appropriate material and show that they have engaged in relevant reading during the course of their research by presenting a literature review and applying what they have read to support the arguments they present. Students must use language appropriately and effectively to communicate a clear and well-structured argument. At the end of the 6 months of independent research study, they submit an extended essay of 2,500 to 3,000 words.

The kinds of more intellectually challenging school-based assessment in the high school examinations are also encouraged in the earlier grades as well. In the curriculum and assessment guidelines that accompany the national standards, teachers are encouraged to engage in continual assessment in the classroom, using a variety of assessment modes, such as classroom observations, oral communication, written assignments and tests, and practical and investigative tasks. The Ministry has developed a number of curriculum and assessment supports for teachers. For example, SAIL (Strategies for Active and Independent Learning) aims to support more learner-centered project work in classrooms, and provides assessment rubrics to clarify learning expectations. All schools have received training for using these tools.

The Ministry's 2004 Assessment Guides for both primary and lower secondary mathematics contain resources, tools and ideas to help teachers incorporate strategies such as mathematical investigations, journal writing, classroom observation, self-assessment and portfolio assessment into the classroom. Emphasis is placed on the assessment of problem solving and on meta-cognition, the self-regulation of learning that will enable students to internalize standards and become independent learners (Kaur, 2005). The Institute of Education has held a variety of workshops to support learning about the new assessments and integrated the new strategies into teacher development programs.

United Kingdom

The move toward more school-based assessment has also occurred in various ways in the United Kingdom, which has, for more than a century, had some influence on examination systems in English-speaking countries around the world. Assessments have typically been open-ended essay and constructed-response examinations, but the nature of the tasks and of the administration have been changing over the last two decades to include more school-based tasks and projects.

England

England's assessment system is managed at the national level by an organization called the Qualifications and Curriculum Authority (QCA). Schools teach and assess students using a national curriculum, which includes syllabi for specific courses. Teachers assess pupils' progress continuously and assemble evidence for external reporting in the national data system at ages 7, 11, and 14 (Key Stages 1, 2, and 3). This evidence is based on classroom-based assignments,

observations, and tasks, the results of which are evaluated in terms of indicators of performance outlined in learning progressions for each of several dimensions of learning within each subject area.

At key stage 1, ages six to seven, student progress is evaluated based on classroom evidence and results from centrally-developed open-ended tests and tasks in English and mathematics. These tests and tasks are marked by teachers and moderated within the school and by external moderators. At key stage 2, ages eight through eleven, student progress is evaluated based on teachers' summary judgments and results from open-ended tests in English, mathematics, and science. These tests are externally marked and the results reported on a national level. At key stage 3, England recently abolished external tests and now relies on teacher assessments to report achievement levels in all subjects. Teacher judgments are moderated and results are reported on a national level.

The Assessing Pupils' Progress program that guides this work is described by the QCA in this way:

APP is the new structured approach to teacher assessment, developed by QCA in partnership with the National Strategies, which equips teachers to make judgments on pupils' progress. It helps teachers to fine-tune their understanding of learners' needs and to tailor their planning and teaching accordingly, by enabling them to: use diagnostic information about pupils' strengths and weaknesses to improve teaching, learning and pupils' progress; make reliable judgments related to national standards drawing on a wide range of evidence; and track pupils' progress.

The APP subject materials for teachers include assessment guidelines for assessing pupils' work in relation to national curriculum levels. These provide a simple recording format providing assessment criteria for each of the assessment focuses in the subject, and standards files, which are annotated collections of pupils' day-to-day work that exemplify national standards at different levels. These help teachers reach consistent and reliable judgments about national curriculum levels (Qualifications and Curriculum Authority, 2009, p. 1.)

Some nationally developed tasks are designed and distributed to schools to support teacher assessment. At Key Stage 2 (age 11), a set of these tasks and tests must be used to evaluate students, in combination with the other evidence teachers assemble from the classroom. In other years, the use of the tasks is optional. As described by the QCA: "The tasks are designed to support teacher assessment. They can be used to indicate what pupils are able to do and inform future learning and teaching strategies. Individual tasks can be used to provide a basis for discussion by teachers and pupils on what has been achieved and to identify the next steps. They can support day-to-day assessment and generate outcomes which can contribute to the breadth of evidence which is used as the basis for periodic and transitional assessment."

At key stage 4, ages fifteen to sixteen, the national qualification framework includes multiple pathways for students and consequently multiple measures of student achievement. There are four pathways based on students' aspirations after graduation: apprenticeship, diploma, the General Certificate of Secondary Education (GCSE), and the A-Level examinations. Some students go on to a Further Education college to take vocationally related courses. They usually take the National Vocational Qualification using the apprenticeship model.

Most students take the GCSE, a two-year course of study evaluated by assessments both within and at the end of courses or unit. Students may take as many single-subject or combined-subject assessments as they like, and they choose which ones they will take based on their interests and areas of expertise. The exams involve constructed response items and structured, extended classroom-based tasks which comprise from 25 to 60% of the final examination score. England is currently piloting new tasks for the GCSE with an increased emphasis on functional skills like problem solving, team building, and communication as well as personal learning and thinking skills across subjects. These new tasks, called "controlled assessments" are either designed by the

Table 2: Examples of assessment tasks in English GCSE

Unit and Assessment	Tasks
<i>Reading literacy texts</i> Controlled assessment (coursework) 40 marks	Responses to three texts from choice of tasks and texts. Candidates must show an understanding of texts in their social, cultural and historical context
<i>Imaginative Writing</i> Controlled assessment (coursework) 40 marks	Two linked continuous writing responses from a choice of Text Development or Media
<i>Speaking and Listening</i> Controlled assessment (coursework) 40 marks	Three activities: a drama-focused activity; a group activity; an individual extended contribution. One activity must be a real-life context in and beyond the classroom
<i>Information and Ideas</i> Written examination 80 marks (40 per section)	Non-Fiction and Media: Responses to unseen authentic passages Writing information and Ideas: One continuous writing response – choice from 2 options

awarding body and marked by teachers or designed by teachers and marked by the awarding body. Either way teachers determine the timing of controlled assessments.

These classroom-based assessments comprise 25% of the total examination score in subjects like business studies, classical civilization, English literature, geography, history, humanities, or statistics, and 60% of the total examination score in subject areas such as applied business, music and dance, design and technology, drama, engineering, English, English Language, expressive arts, health and social care, home economics, ICT, manufacturing, media studies, and modern foreign languages. Examples of classroom-based tasks in English are given in Table 2, in mathematics in and in Interactive Computer Technology (ICT) in Box 6.

Litchfield Promotions works with over 40 bands and artists to promote their music and put on performances in England. The number of bands they have on their books is gradually expanding. Litchfield Promotions needs to be sure that each performance will make enough money to cover all the staffing costs and overheads as well as make a profit. Many people need to be paid: the bands; sound engineers; and, lighting technicians. There is also the cost of hiring the venue. Litchfield Promotions needs to create an ICT solution to ensure that they have all necessary information and that it is kept up to date. Their solution will show income, outgoings and profit

Candidates will need to: 1) Work with others to plan and carry out research to investigate how similar companies have produced a solution. The company does not necessarily have to work with bands and artists or be a promotions company. 2) Clearly record and display your findings. 3) Recommend a solution that will address the requirements of the task. 4) Produce a design brief, incorporating timescales, purpose and target audience.

Produce a solution, ensuring that the following are addressed: 1) It can be modified to be used in a variety of situations. 2) It has a friendly user interface. 3) It is suitable for the target audience. 4) It has been fully tested. You will need to: 1) incorporate a range of: software features, macros, modeling, and validation checks - used appropriately. 2) Obtain user feedback. 3) Identify areas that require improvement, recommending improvement, with justification. 4) Present information as an integrated document. 5) Evaluate your own and others' work.

Box 6: Example of controlled assessment tasks in interactive computer technology

A City council attempted to reduce traffic congestion by introducing a congestion charge. The charge was set for 4 pounds for the first year and was then increased by 2 pounds each year. For each of the first eight years, the council recorded the average number of vehicles entering the city center per day. The results are shown in the table:

Charge (Pounds), x	4	6	8	10	12	14	16	18
Average number of vehicles per day, y million	2.4	2.5	2.2	2.3	2.2	1.8	1.7	1.5

1. Calculate the product moment correlation coefficient for these data.
2. Explain why x is the independent variable.
3. Calculate the equation of the regression line of y on x .
- 4a Use your equation to estimate the average number of vehicles, which will enter the city center per day when the congestion charge is raised to 20 pounds.
- 4b Comment on the reliability of your estimate.
- 5 The council wishes to estimate the congestion charge required to reduce the average number of vehicles entering the city per day to 1.0 million. Assuming that a reliable estimate can be made by extrapolation, state whether they should use the regression line of y on x or the regression line of x on y . Give a reason for your answer.

Box 7: English A-Level question from a probability and statistics examination

During key stage 4, most students take five or more GCSE exams. Their performance determines the level of the diploma they receive, and whether they will go on to Advanced Studies that are later evaluated by A-level exams that qualify students for university admissions. England has 45 areas for A-level exams. The exam questions require extended answers aimed at assessing deeper levels of understanding and applications of knowledge to real-world problems, as illustrated in the example in Box 7.

Most of the exams take the form of essay questions. The mathematics exams include questions that ask students to show their reasoning behind their answers. Foreign language exams require oral presentations. The 'A' Level exam in English literature asks students to show their skills and knowledge in four sections: poetry, drama, prose, and general, analyzing works of literature they have read as part of their curriculum in terms of their meaning and interpretation as well as literary devices and writing strategies. Coursework accounts for 25 to 30% of the 'A' Level score, depending on the course. Students must now also complete an independently designed extended research project as part of the A-level assessments. Teachers mark assessments in a moderated process managed by the five examination agencies that organize sets of examinations.

While England has moved to include some school-based assessments in its increasingly performance-oriented assessment system, Scotland, Wales, and Northern Ireland have gone even further in revising their approaches to assessment.

Scotland

Scotland has a separate governing body for its educational system from the United Kingdom. Scotland uses a set of assessments called the Scottish Survey of Achievement administered in the third, fifth, and seventh years of primary school and standardized courses and benchmark exams in secondary school. The assessment tasks for the primary courses and general secondary courses are designed and marked by teachers and lecturers. Schools use external assessments for the intermediate and advanced secondary courses. The Scottish Qualifications Authority designs and scores those assessments which may take the form of an examinations, project work, or portfolios (Scottish Qualifications Authority, March 2004; The Scottish Government, 2008).

Wales

Wales recently separated from the system used in England and now has its own governing body for its educational system (Archer, 2006). Wales abolished national exams for children through age 14. Much like Finland, during the primary years, Welsh schools have a national school curriculum supported by teacher-created, administered, and scored assessments. During the secondary years, teachers create and manage all assessment of 14-year-old students, while students 16 years and older are encouraged to participate in the relevant GCSE exams and A Level courses and exams administered by the U.K.'s Qualifications and Curriculum Authority (Welsh Assembly Government, 2008a and 2008b). With these changes to its assessment system, Wales hopes to increase student engagement, engage students in more creative tasks, and reduce teaching to the test (Archer, 2006).

Northern Ireland

Northern Ireland is in the process of implementing an approach at all levels called "Assessment for Learning." This approach emphasizes locally developed, administered and scored assessments and focuses on five key actions:

5. *Sharing learning intentions* where students and teacher agree upon learning intentions to give them ownership over their learning.
6. *Sharing and negotiating success criteria* where students and teacher create the criteria for successful completion of a task together to help with self-assessment.
7. *Feedback* where teacher provide on-going feedback during formative assessment sessions.
8. *Effective questioning* where teachers introduce strategies like using open-ended questions and giving more thinking time so students will feel more confident thinking aloud and explaining their reasoning.
9. *How pupils reflect on their learning* where teachers provide students with strategies to think about what they have learned.

Northern Ireland does not require schools to externally assess students up through age 14, but it provides teachers with the option to give students end of Stage 3 assessments that are externally graded through the Northern Ireland Council for the Curriculum Examinations and Assessments (CCEA). These are largely open-ended assessments that evaluate how students reason, think, and problem solve. CCEA provides multiple assessments for Stage 4, according to which pathway a student chooses to follow including taking the GCSE exam and A level courses and exams from the U.K. system (i.e. whether towards university or a vocational degree) (Council for the Curriculum Examinations and Assessment, 2008a and b).

Conclusion

A variety of challenges confront nations seeking to integrate 21st century skills into standards, curriculum, assessment, and teaching. An examination of assessment policies and practices in these four nations suggests a range of potential opportunities for evaluating 21st century skills in both on-demand tests and curriculum-embedded assessments. The growing move to promote assessment *of*, *for* and *as* learning, rather than seeing testing as a separate disjointed element the education enterprise, may provide opportunities for strengthening the teaching and learning of 21st century skills, as well as their assessment.

The growing emphasis on school-based performance assessments in many countries appears to strengthen teaching where teachers learn more deeply about how to enact standards by participating in scoring and/or reviewing student work. It may also increase curriculum equity, as all students engage in more common activities and instructional supports as part of the required assessments. Some assessment policies also seek to use assessment to strengthen teaching by considering how to provide both feedback and "feedforward" information. They incorporate rich feedback to students, teachers, and schools about what has been learned, and they shape

students' future learning by offering opportunities for student and teacher reflection that supports learning-to-learn. Technology supports for these efforts are becoming increasingly sophisticated and should be shared across states and nations.

Given the critical importance of these initiatives to the teaching and acquisition of 21st century skills, the ATC21S project should facilitate countries' efforts to develop optimal policy strategies that integrate school-based assessments of ambitious intellectual performances with large-scale assessments that seek to measure problem solving, critical thinking, collaboration, and learning-to-learn in increasingly sophisticated ways.

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