Curriculum Planning in a Context of Change:  
A Literature Review.

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Executive Summary

This literature review has been undertaken for the Department of Education and Early Childhood Development (DEECD/the Department) of the Victorian Government as part of a broad ranging process, prompted by the transition to the Australian Curriculum, to review current practices and understanding around curriculum design and delivery, assessment and reporting practices. The literature review will inform the development of further work to be undertaken by the Department to support schools to make choices regarding curriculum design and planning with the implementation of the Australian Curriculum.

The project brief identified the following questions for the review:

- What is current best practice for schools in a range of different settings and contexts wishing to design a high quality standards-based curriculum and what are the indicators for success?
- What are the most important elements or acknowledged leading models and what makes these highly effective?
- What processes and practices are used in high performing systems overseas to support curriculum planning?
- What does curriculum planning look like in effective schools in the context of leadership, teacher capacity, school culture, student achievement and engagement, and accommodating learners’ needs, aspirations, interests and personal development?
- How do students benefit when schools provide them with opportunities to engage in the curriculum planning process?
- What role does data and assessment have in informing curriculum planning and design?
- How can curriculum design and planning reflect such elements as 21st century skills, student-centred pedagogy and personalised, self-paced learning?
- What is the role of ICT in developing, assessing and implementing curriculum?

The work was framed initially by a discussion of the changing curriculum context, both in Australia in the development of the Australian Curriculum, and also within the policy directions established by the Victorian Minister for Education and the Department of Education and Early Childhood Development.

The review is structured in sections corresponding to four key topics drawn from the questions above:

1. What is curriculum and what makes an effective curriculum?
2. Processes and practices in high performing countries.
3. Influences on the curriculum.
4. Focus on the learner.
Each section of the review concludes with a series of implications for school curriculum policy and practice drawn from the literature on that question. These implications are translated in this summary as characteristics of curriculum policy and practice for schools wishing to implement evidence informed practice based on the outcomes of this review. The characteristics can be seen as indicators that school policy and practice reflect the recommendations arising from the research.

**What is curriculum and what makes for effective curricula?**

Schools implementing the findings of this review would:

**Reflect a shared curriculum vision within the school culture**
- Curriculum planning and review includes consideration of overarching curriculum rationales, goals and structures to establish common understandings, beliefs and values which are explicit in school programs.
- There is evidence that forms of curriculum (ideal, formal, enacted, perceived etc.) are systematically compared to maximize the extent to which they support each other.

**Apply a systematic process of curriculum planning, monitoring and review**
- A process of professional dialogue and self-evaluation includes use of the list of features of effective curricula to evaluate school programs.
- A process of professional dialogue and self-evaluation applies curriculum mapping strategies to strengthen alignment of school programs.
- Processes of curriculum audit ensure that creative open-ended inquiry and student choice are included in curriculum plans.

**Have programs which prioritise deep learning**
- Unit and lesson plans include initial assessment of students’ prior knowledge and preconceptions and an estimate of the learning demand of concepts and tasks.
- Unit and lesson plans include models and frameworks which help students organize the concepts and information they need to use.
- Metacognition strategies are explicit elements of curriculum objectives, teaching and assessment.
- Programs and unit plans articulate core ideas of the subject domain and their connection with student interests and practices outside the school.
- Unit and lesson plans engage students in exploring rich information resources through questions related to an explicit conceptual framework.
- Programs and unit plans reflect a developmental progression of cognitive complexity within the subject domain.
- Program and unit planning are based on consideration of the logical, psychological, sociocultural, epistemological and pedagogical dimensions of subjects.
Develop C21 skills through general capabilities

- The process of developing subject programs integrates general capabilities into planning of objectives and learning activities from the outset, rather than as an add-on.
- Program and unit plans emphasise authentic application of core subjects to contemporary settings and issues to maximize the focus on general capabilities.
- Subject assessments are designed to include demonstration of general capabilities, which are explicit in assessment criteria and rubrics.
- Programs and units include an explicit and independent treatment of general capabilities within core subject teaching.

Implement processes of collaborative and distributed leadership

- Curriculum planning and review follow processes of collaborative and distributed leadership according to expertise and capacity.
- Curriculum teams develop procedures which enact principles of shared values, critically reflective inquiry and distributed leadership to develop policies and procedures which have a clear outcome related to student outcomes.
- School leaders and teams apply an explicit strategy for planning curriculum innovation, such as that recommended by Baines, Blatchford and Chowne (2007).
- Programs, units and lesson plans include provision for inclusive curriculum and teaching based on an agreed and consistent focus on social justice.

Processes and practices in high performing systems

Schools implementing the findings of this review would:

Enact successful practices from high performing school systems:

- Clear and well-focused curriculum documents are used as a base for collaborative planning.
- Program, unit and lesson plans are developed through a collaborative process.
- Collaborative professional self-development includes activities such as peer observation, demonstration lessons.
- There is collaboration with other schools on curriculum and teaching improvement, including consortia arrangements.
- School programs include cross-disciplinary project work which cut across discipline based subjects.
- Systems are in place for early detection of student learning problems and a flexible and immediate response.
- Programs and units incorporate active learning (including in whole class contexts), as well as diverse learning activities such as science experiments, excursions and student fairs.
- Policies and practices ensure high levels of expectations for all students.
Influences on the curriculum

Schools implementing the findings of this review would:

Include teachers’ concerns and professional learning needs in curriculum development
- Planning procedures incorporate strategies for addressing the beliefs and concerns which influence teachers’ response to innovations.
- There is provision for long term, continuing collaborative professional learning using a variety of strategies, with teacher input into the content and process of learning.
- Professional standards for teachers are used as a framework for identifying aspects of teacher capacity to be developed.

Develop a school environment which supports change
- The school implements models and strategies for developing a learning organization and a professional learning community.
- Student wellbeing is a priority in all decisions and procedures.
- Strategies and protocols are in place for engendering trust among members of the school community.
- Curriculum change processes use models for planning change, such as that proposed by Everard, Morris and Wilson (2004).
- Programs are in place to promote community engagement, especially parental engagement.
- Systems and support for networking are provided for all staff, especially online professional exchanges and interactions beyond the school.

Plan and review teaching practices to promote active learning and inquiry
- Recommendations from the literature are used as frameworks for self and peer evaluation as part of ongoing review of pedagogical practice.
- Programs, units and lessons include a balance of direct instruction and inquiry approaches as well as individual and community contexts for learning.
- A structured developmental approach to inquiry learning is integrated throughout the curriculum.
- Planning and teaching of learning skills include explicit development of student self-regulation.
- School organization and staff pedagogical beliefs and practices are reviewed to ensure high expectations for all students.
- Curriculum and teaching are reviewed for the extent of personalization of learning provided, and strategies to extend it are implemented, such as the use of technology, modularized content and diverse resources.

Implement assessment programs and practices informed by recent research
- Fine-grained formative assessments are used which match planned progressions in depth and breadth of learning.
- Teachers collaboratively develop assessment tasks with a focus on clarifying intended learning outcomes.
• Assessment programs and practices reflect Assessment for Learning strategies informed by the UK Assessment Reform Group (2002) and similar work.
• Assessment practice and professional learning reflect a commitment to productive feedback.
• Assessment programs provide frequent opportunities for performance assessment.
• Accountability processes are based on collegial systems which do not distract from deep learning outcomes and creativity.
• Systems and expertise are developed to integrate a wide range of data to inform decision-making.

Maximise the benefits of information and communication technology
• ICT products and facilities are continuously monitored and evaluated for ways to enhance curriculum, teaching, student engagement and teacher professional development.
• Programs are in place to monitor and take steps to remedy skill deficits and unequal access to technology among students.

Focus on the learner

Schools implementing the findings of this review would:

Implement policies and practices to maximize student motivation
• Recommendations from research are applied to curriculum and teaching to maximise motivation.
• Strategies are implemented to promote mastery rather than performance goals in teaching and learning.
• Strategies are in place to promote student confidence and combat potential stereotype threat.

Implement policies and practices to maximize student engagement
• Managerial, instructional and student-centred strategies are used to maximize student engagement.
• Strategies are in place to recognise and respond to students’ needs for relational and competence support and relevance (Pianta, Hamre and Allen 2012).
• Choice of challenging activities in curriculum, teaching and extracurricular activities are provided within a fair disciplinary environment.
• Programs are in place to develop students’ capacity for self-regulation.

Implement policies and practices to give voice to students’ expressed needs and interests
• Formal avenues exist for students to give voice to their interests, needs and concerns, and to have input into curriculum, teaching and assessment, including through the use of ICT and social media.
1. Background and context of the review

This literature review has been undertaken for the Department of Education and Early Childhood Development (DEECD/the Department) of the Victorian Government as part of a broad ranging process, prompted by the transition to the Australian Curriculum, to review current practices and understanding around curriculum design and delivery, assessment and reporting practices. The literature review will inform the development of further work to be undertaken by the Department to support schools to make choices regarding curriculum design and planning with the implementation of the Australian Curriculum.

In commissioning the review, the Department confirmed its commitment to a series of principles for curriculum design which have provided important signposts for this review:

- Designing a school curriculum for progressive learning opportunities should be informed by valid assessment data, be tailored to meet learners’ needs, aspirations and personal development, and provide multiple means of representation, action and expression, and engagement.
- Curriculum design should harness student’s positive attitudes, ideas and imaginative capacities to support them to be co-creators of their own learning and to ensure it is personally meaningful and relevant.
- Curriculum design should be reviewed, evaluated and modified through a collaborative process of reflection to develop a partnership where children and young people participate actively in their own learning, monitoring of progress and assessment for learning.
- Curriculum should be planned for success with clearly articulated learning intentions, coupled with effective feedback and monitoring, and evaluated in partnership with students and practitioners.
- Curriculum planning should maximise opportunities for collaboration and participation in learning between families and practitioners and should include students’ own views of their learning and engagement in assessment practices.

Within this broad educational vision, the Department has requested that the literature review consider what is current national and international best practice in curriculum design and planning and what indicators for success might be based on this research evidence. More specifically, the review was to address the following questions:

- What is current best practice for schools in a range of different settings and contexts wishing to design a high quality standards-based curriculum and what are the indicators for success?
- What are the most important elements or acknowledged leading models and what makes these highly effective?
- What processes and practices are used in high performing systems overseas to support curriculum planning?
• What does curriculum planning look like in effective schools in the context of:
  • leadership
  • teacher capacity
  • school culture
  • student achievement and engagement
  • accommodating learners’ needs, aspirations, interests and personal development?
• How do students benefit when schools provide them with opportunities to engage in the curriculum planning process?
• What role does data and assessment have in informing curriculum planning and design?
• How can curriculum design and planning reflect such elements as 21st century skills, student-centred pedagogy and personalised, self-paced learning?
• What is the role of ICT in developing, assessing and implementing curriculum?

The changing curriculum context

The Australian Curriculum
The major issue in the current curriculum context is the challenge presented by the Australian Curriculum. At one level, this could be seen as a matter of translating existing practices into a new curriculum framework. However, this modest approach would be a disservice to students because it would overlook the opportunities that this major initiative provides.

The Australian Curriculum aims to strengthen the educational experience and outcomes of all students. The Shape of the Australian Curriculum document (Australian Curriculum Assessment and Reporting Authority (ACARA) 2012) describes its rationale as being to promote equity, excellence, quality and transparency in education. Its motivation is that all young Australians will become successful learners, confident and creative individuals and active and informed citizens. It is driven by the need to address the intellectual, personal, social and educational needs of young Australians for successful future learning and community participation. The rationale canvasses a range of other personal, social and national imperatives which the curriculum is intended to address, including the important place of Aboriginal and Torres Strait Islander students and cultures.

It is within this broad ranging set of aspirations that the curriculum attempts to clarify what will be taught and what and how well students will learn. In doing so it claims to provide for ‘rigorous, in-depth study, preferring depth to breadth wherever a choice needs to be made...’ (ACARA 2012: 10). These goals are translated into a three dimensional design of discipline-based learning areas, general capabilities and contemporary cross-curriculum priorities.

These arguments and the resulting design are grand and abstract, as is typical of curriculum statements at this overarching level. They offer an ambitious vision...
based on principles derived from the values of our culture and our hopes for our children. As with any statement of values, much needs to be resolved before this document could become a guide to practice, but this process of clarification must be done. Without it there is the risk that subjects and skills become goals in their own right, devoid of the higher principles which justify their part in the curriculum, provide their ultimate goals and should guide their teaching.

In Victoria, not all school communities work with documents such as the Shape paper; they are thought too far removed from the realities of the work that schools do. However, it will be shown later in this document that a strong need for successful curriculum development is a shared set of values and a clear sense of purpose. One step on the way to achieving this within any school community would be to consider the implications of the rationale for the Australian Curriculum and how it is and might be made concrete in the activities of teaching and learning in the school.

The three dimensions of the Australian Curriculum are much more specific to school practice. The obvious challenge is to integrate them in productive ways so that all are achieved. The Australian Curriculum is not entirely successful in this, since the integration of the general capabilities in particular is far from ideal. This is in part a consequence of history, in that the subject curricula in English, Mathematics, Science and History were developed before the capabilities were fleshed out in any substantial way. The result is that the current versions of subjects note connections to general capabilities and cross-curriculum priorities, but they are often either tenuous or trivial (Gilbert 2012). For instance, the study of beliefs, values and practices of ancient Romans is said to contribute to intercultural understanding, personal and social competence, critical and creative thinking and ethical behaviour! In mathematics, using tatami mats as a unit for calculating area is said to be an instance of the cross-curriculum priority of Asia and Australia’s Engagement with Asia.

The Australian Curriculum specification of general capabilities describes them as ‘an integrated and interconnected set of knowledge, skills, behaviours and dispositions’ (ACARA 2012b), but the example above suggests that this integration may be superficial and even illusory. A key challenge for schools is to compensate for whatever gaps or inconsistencies might occur. Again this is an intellectual and practical challenge which will require considerable thought and effort. However, the value of the capabilities and priorities, and their embodiment of much of the curriculum’s rationale, makes this an important task.

The discipline-based learning area descriptions are generally impressive collections of potentially valuable learning. Again they attempt to provide a clear and cohesive framework for planning. At one level, the documents appear to do this well, since the framework of strands, descriptions and achievement standards seem well aligned. Of course, beneath the apparent clarity and consensus of the subject descriptions lie traditions of debate about the nature and purpose of the subjects represented. This is a perennial feature of the school curriculum as it is of the disciplines themselves. While it can be seen as a sign of
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diverse and dynamic scholarship, it can also be a cause of confusion and cross purposes.

In the context of the Australian Curriculum, these debates have been identified in the English and history curricula (Macken-Horarik 2011; Gilbert 2011). Aubusson (2011:241) reports experts’ assessments of the Australian science curriculum, describing it as ‘a compromise curriculum’ about which there was ‘considerable variation’ in the experts’ ‘perceptions of the goodness of the curriculum’. In mathematics, Sullivan (2011: 4) describes an international debate between ‘the functionally relevant perspective and that of mathematical rigour and ‘the strongly held views of those on both sides’.

In short, curricula are typically worthy but imperfect attempts to resolve perennial educational dilemmas. Curriculum authorities tend to downplay these inconvenient realities, but this neglect is itself an obstacle to successful curriculum change if it assumes that curricula are more coherent and unified than they actually are.

The structure used to describe the learning areas in the Australian Curriculum is quite complex, which can be a source of richness when the various inputs are combined in imaginative, productive and engaging ways. It can also contribute to a lack of cohesion within years if the various strands, sub-strands, elaborations, descriptions, general capabilities, cross-curriculum priorities and achievement standards prove difficult to combine. To integrate these various inputs into a meaningful set of learnings will involve much thought, imagination and careful planning.

The curriculum in Australian schools is at an historic moment when the idea of a national curriculum has reached a stage of development not seen before. It is motivated by powerful arguments in its rationale, and the three dimensional framework offers considerable promise if it can be translated into successful outcomes for students. However, it is in the nature of curriculum that the move from conception and documentation to development and implementation in practice is difficult, in part because the documents themselves can never be perfect, and also because the range of influences on the curriculum in practice is immense. This review is a contribution to understanding these problems in order to assist in the process.

Current directions in the Department of Education and Early Childhood Development

The Victorian Minister for Education (Dixon 2011) has presented a vision of the state as a learning community within a knowledge economy. Reviewing previous reform efforts which strengthened the power of schools, developed leadership and teachers’ capacity and focused on school improvement, the current priority is described as being ‘underpinned by professional trust and support’ with ‘a clear articulation of expectations, responsibilities and relationships’ (p. 7). The aim is for a compact between education authorities and schools which will establish expectations for priority activities, including curriculum planning, local accountability and systemic leadership, and clear core requirements, so that
schools can then determine the best strategies to drive improvement in student outcomes.

More directly related to curriculum matters are the five key reform areas the Minister identifies (Dixon 2011: 11):

1. supporting improved **student outcomes** – this is our goal
2. creating **order and inclusion in schools** – the foundation for all our work
3. **school innovation** – which is a critical driver of systemic excellence
4. **school partnerships** – a critical facilitator for improvement
5. **internationalising education** – the context for our work now and into the future.

The first of these addresses issues of curriculum quite directly, where mention is made of a wide range of desired outcomes including academic skills, leadership and decision-making, responsibility to community, health and wellbeing, creativity and problem-solving and intercultural and language abilities. There are clear links here to the Australian Curriculum’s general capabilities. A three phase model is proposed beginning with the Foundation years, leading in years 11 and 12 to specialized pathways including independent research projects and extension studies. This is to be combined with a flexible set of assessment tools, including online tools, to be available to teachers ‘on demand’.

The process through which improvement is to occur includes the promotion of innovative work and the ‘self-generation of ideas’ (Dixon 2011: 20), with Departmental support for teachers to trial new approaches, test ideas with colleagues and enhance peer-to-peer accountability. School partnerships with other schools and sectors, parents, business and industry and the community are part of the strategy, with particular emphasis on students learning in the community, and on networking among schools.

These initiatives have implications for teacher professional learning and school leadership which are elaborated in the DEECD discussion paper *New Directions for School Leadership and the Teaching Profession* (DEECD 2012). The paper highlights the value of practitioner-led research, classroom observation and professional collaboration as strategies to support curriculum planning and design. It is interesting to note the convergence between these strategies and practice in high performing countries discussed later in this review.

The range of initiatives proposed in the Minister’s *Learning Community* document is considerable, but in its focus on trust, twenty-first century skills, flexible assessment and school networking and teacher collaboration, there are important parallels with current thinking world-wide. The remainder of this review considers these matters among others.
2. What is curriculum and what makes for effective curricula?

Popular understanding, and the standard dictionary definition, is that the term ‘curriculum’ refers to a course of study, usually described in a document specifying the content of what is to be learned. As a process, curriculum entails the development of students’ knowledge, understanding, skills and attitudes to satisfy social, personal, cultural, environmental and economic goals. It exists within a triadic relationship between curriculum content, instructional practices and assessment. A broader perspective sees curriculum as a system:

   a socio-historical construction which is expressed through general systems of knowledge characterization and hierarchy; these systems are in turn translated and transformed into legislative and administrative regulations, academic achievement standards, textbooks and teaching aids, and the practice of teaching and learning in classrooms and schools (Moreno 2006: 195).

This process is less directly linear than Moreno’s description implies, as curriculum specifications result from a process of conception and revision in which they are constantly interpreted and reinterpreted. Any sophisticated understanding of curriculum must address this semiotic and indeterminate dimension of the curriculum. Consequently, curriculum statements are not seamless, univocal or transparent. Typically, they represent an assembly of ideas drawn from a range of sources, some well established, others novel or emerging, not all of which will necessarily be compatible. They are classic examples of documents written by committees. The curriculum is a site of contestation, and any curriculum will usually reflect diverse and even competing views and priorities of those who have created them.

These observations have important implications for whole school curriculum development and change, for to the extent that curricula lack clarity or coherence, it is left to teachers to provide the focus and the consistency that makes for successful learning. The process of curriculum change has tended to view the teacher’s role in successful curriculum implementation as one of compliance and simple adherence to a given prescription. This is a serious oversimplification of the process, and any approach to curriculum which begins from this premise is likely to fail. As Luttenberg, van Veen and Imants (2011: 19) point out:

   Coherence is not a ‘given’ at the start of a reform process but, rather, achieved by those involved in the process – including teachers, school leaders and other stakeholders.... Both reform and continuity are created by the teacher’s daily search for coherence, the communities of teachers working in schools, and the opportunities and obstacles that they encounter in their attempts to go forward.

It is common to recognise various forms of the curriculum, distinguished by their place in the curriculum development process, or the perspective from which the
curriculum is viewed. A typical set of curriculum forms includes (van den Akker and Voogt 1994; Ross 2000):

- **The ideal curriculum** includes the purposes and intentions which motivate the development of any curriculum by policy makers and curriculum developers.

- **The formal intended curriculum** is the most common idea of curriculum, and comprises the formal statements of rationales, aims, intended outcomes, lists of content or concepts to be known, or competencies or skills to be mastered in programs of study and demonstrated in assessment.

- **The informal intended curriculum** consists of learnings which are openly promoted by the school, but which are not part of the formal curriculum, such as morals, values, work habits and the like. These may be organised as pastoral or personal and social development programs and may include both curricular and extra-curricular components.

- **The hidden curriculum** refers to the knowledge, beliefs, values or practices which are implicit in the practice or culture of a school or program and learned by its participants, but which are not explicitly derived from the stated aims of the formal or informal curriculum. For instance, students may learn ways of relating to others as they interact with teachers and peers. They may learn to view knowledge in particular ways when they engage in assessment, and they may come to see themselves as particular kinds of people by the way they are treated by teachers and school authorities.

- **The enacted curriculum** refers to the experiences designed and provided by an educational institution or program in order to enact the intended curriculum. The idea of the enacted curriculum recognises that when stated intentions are put into practice, they will be interpreted, prioritised, selected and augmented in various ways by those who implement them.

- **The perceived or experienced curriculum** reflects the interpretations of the curriculum by those engaged with it. This is a salutary notion as it reminds us that what teachers and schools regard as their priorities and emphases in curriculum may not match how these aspects are experienced or perceived by others, such as students and parents. This recognises, for instance, the long held distinction between what is taught and what is learned.

The last two aspects of curriculum raise the question of the distinction between curriculum and teaching or pedagogy. If teaching strategies create activities in classrooms, then they are primarily what produce students’ experiences, and therefore largely coincide with the enacted curriculum. Such activities have usually been classified as part of teaching, the ‘how’ of education rather than the ‘what’ of curriculum. However, since these activities are intended to be the embodiment of the curriculum in practice, it is not useful to distinguish them from the curriculum itself in some means-end fashion. While it possible to define good pedagogy in certain ways and argue that the curriculum should be designed to realize it (Ladwig 2009), this does nothing to resolve the problems which
occur when the two concepts are separated in planning and practice.

It is worth noting here that many of the controversies over how particular subjects should be taught, such as the debates in mathematics mentioned by Sullivan (2011) or those over the relative merits of phonics and whole language approaches to reading, are often at least partly debates about curriculum priorities: for instance between everyday numeracy and mastery of the discipline of mathematics, or between decoding and the inferential elaboration of meaning in texts (though it is not suggested that either term in these pairs is incompatible with the other).

Another implication of this view is to limit the extent to which any curriculum outcome can be achieved through different learning activities. For instance, it is a tenet of the outcomes based approach to curriculum (Spady 1993), and of the current promotion of differentiation in learning experiences to cater for student diversity, that the same intended outcome can be achieved through a number of learning activities. This is clearly true in many respects, as when concepts are illustrated in a range of different cases or instances and with a range of media. However, there are clear limits to these possibilities, which, if exceeded, mean that the learning activity embodies something other than the intended curriculum outcome. For instance, in the case of concept development, learning definitions or following routine algorithms is no substitute for applying concepts in novel problem solving situations. In this sense the curriculum intent must be the chief arbiter of relevant and successful pedagogy.

The view taken here is that the practices of teaching and learning are the embodiment of the curriculum, and that while the distinction between curriculum and teaching is viable at a surface level, neither concept can be properly understood in isolation. While it is clearly possible to study a curriculum specification without looking at its implementation, and while it is possible to describe and analyse teaching activities without a concern for their curriculum context, neither of these activities is very helpful in improving educational outcomes.

**Features of effective curricula**

While what students experience is a combination of curriculum intent and teaching strategy, the formal intended curriculum can nonetheless be judged in its own right, and curriculum research has sought to identify the characteristics of effective curriculum specifications. In recent times, this examination has been applied to the currently widespread curriculum approach, the standards based curriculum. A range of criteria has been identified for evaluating standards schema, and any curriculum from the system to the school level will profit from considering them (Linn, Baker and Dunbar, 1991; Krathwohl, 2002; Payne, 2003; Cizek, Bunch and Koons, 2004; Klieme et al., 2006). These various statements can be reduced to the following key features of an effective curriculum:

- Clarity and focus (comprehensibility, explicitness, identifies salient features of student work)
• Reasonable expectations (feasible, appropriate to accepted practice and for relevant sub-groups)
• Quality of learning (includes deep learning, core aspects of learning domain, balance of knowledge, process and other elements)
• Cumulativity (targeting cumulative development and systematically integrated learning over time)
• Consistency of language, terminology and interpretation within and across learning areas and year levels
• Differentiation (distinguishing level of demand across performance levels and progression across year levels).

A key challenge for whole school curriculum change is to construct teaching and assessment plans which reflect these qualities.

Considerable attention has been devoted in curriculum research and evaluation to issues of fidelity of implementation, the extent to which the intended curriculum is accurately reflected in school curriculum plans. A related concept (though in some sources used interchangeably with fidelity) is that of curriculum alignment, promoted on the premise that effective curricula are those where the intended curriculum is most faithfully and consistently carried through into (aligned with) teaching and learning activities and assessment (Edvantia 2005; Pellegrino 2006; Nasstrom and Henriksson 2008; Squires 2009; Looney 2011).

Curriculum alignment is established through a process of monitoring and planning to ensure continuity of emphasis through the stages of curriculum construction, teaching and assessment. There is good evidence that alignment of such elements as curriculum content, textbooks and assessment produces higher achievement as measured on curriculum related tests (Edvantia 2005).

An influential procedure for analysing the alignment of assessment with curriculum standards (Webb, 1999) used four broad criteria to frame the analysis: categorical concurrence (the extent to which teaching and assessments match the thinking processes and content categories of the curriculum); depth of knowledge consistency (ensuring that teaching and assessment represent the highest levels of cognitive demand in the intended curriculum); range of knowledge correspondence (focusing on the scope of intended learnings); and balance of representation (comparing the emphasis given to curriculum objectives).

Karvonen, Wakeman and Flowers (2006: 4) point out that ‘accurate inferences about student achievement and growth over time can only be made when there is alignment between the standards (expectations) and assessments. From this perspective, alignment has both content and consequential validity implications’. They argue that students experiencing an aligned curriculum will be advantaged over those who do not, so that students are entitled to have their curriculum and teaching accurately aligned to the ideal and intended curricula.
An important part of ensuring curriculum alignment is the process of curriculum mapping, the documentation of what is happening in classrooms so that questions of fidelity and alignment can be considered.

A second strategy is designing down (what is sometimes called ‘backward mapping’, not to be confused with curriculum mapping described above). This process begins with the question ‘What do I want students to be able to do to demonstrate that they have achieved the intended learnings of the curriculum?’ Once this is clarified in terms of student performance, it makes clear to all concerned what the focus of planning needs to be. In effect, it means putting the demonstration of student learning (and therefore planned assessment tasks) upfront, and planning teaching and learning activities and resources which will provide students with the ability to demonstrate these learnings. This placement ensures that pedagogy will support the learning outcomes and the assessment of them.

When combined with curriculum mapping, designing down builds coherence by requiring that teachers understand the scope and sequence of student demonstrated learning outcomes across all levels and programs, not just at the level they teach (Drake 2007).

Caveats need to be entered on the role of alignment in ensuring curriculum effectiveness. Ensuring alignment is not simply an exercise in compliance. Pellegrino (2006) points out that while insufficient alignment fails to achieve the benefits mentioned above, too much alignment can stifle creativity and responsiveness in planning. Looney (2011: 3) suggests that ‘rather than thinking of alignment literally, as a lining up of the various elements and actors across systems, it may be more appropriate to approach it as a matter of balance and coherence’. She also points to the importance of a ‘vital’ social aspect of alignment, ‘the social capital in systems, including shared values, motives and efforts’ where ‘institutions and actors work together to define challenges and to consider alternative courses of action’ (Looney 2011: 17).

A final and perhaps the greatest danger is that the somewhat bureaucratic approach to curriculum accountability and auditing, implied by the literature on curriculum alignment and mapping, can create a conformist ethos which might constrain the potential for deep and rich learning. It is worth remembering here the exhortations of Lawrence Stenhouse, a pioneer of curriculum research, who argued that, rather than aiming for convergence on the replication of prespecified atomistic learning outcomes, more open-ended demonstrations of learning should be the ultimate aim. Stenhouse (1975: 82) sees education as an induction into a ‘thinking system’ and ‘a structure to sustain creative thought and provide frameworks for judgement’. It follows that:

*Education as induction into knowledge is successful to the extent that it makes the behavioural outcomes of the students unpredictable.*

In any area of knowledge or art the most important product in terms of student performance is the essay – in the broadest sense of that word, that is, a trial piece or endeavour....
An essay should be individual and creative and not an attempt to meet a prespecification. It takes account of the indeterminacy in knowledge which arises because the structures of knowledge are not mere classification and retrieval systems but constitute a raw material for thinking. [Emphasis in original.]

Genuine mastery of a subject is not limited to adhering to conventions or replicating routines, though these will be important resources for progress in learning. The ultimate goal of education is more open ended. This can create problems for a concept of curriculum quality dominated by criteria of conformity to centralized and uniform specification. A resolution to this dilemma is that the scrutiny implied by the need for fidelity and alignment should be an occasion, not for prescriptive narrowing to centralized dictate, but for professional dialogue and self-evaluation aimed at deeper understanding of the meanings and possibilities of curriculum.

Curriculum as culture

Just as the ideal and intended curricula are selections from the culture, so too the process of curriculum design and development at the school level is a cultural process. It follows that curriculum design and development in any school will be influenced by the culture of that school, its extant beliefs, values and relationships, and the meanings attributed to them by those involved. An important line of research has analysed the various connections between curriculum change and school culture.

Successful curriculum change requires initiative and commitment on the part of teachers and others in the school. Priestley, Biesta and Robinson (2012: 14), in their work on the implementation of Scotland’s Curriculum for Excellence, observed the importance of relationships in the degree of agency teachers demonstrated in their implementation of the new curriculum:

Our data suggest that even where individual teachers have extensive experience and strong aspirations for their work ... this can be stymied in situations where collaborative work is limited and difficult.... We conclude, then, with the suggestion that if teachers are to become agents of change – as is strongly supported by contemporary curricular policy – then school managers should carefully consider the relational conditions through which teachers achieve agency, bearing in mind that a collaborative culture to strengthen agency is to a large extent dependent upon the nature and scope of relationships within the school.

Knapp, Copland and Talbert (2003) draw on research on instructional leadership, reform and renewal, and education in high-poverty, high-diversity settings to develop a set of reflective tools to guide self-assessment, planning and professional development. They proffer the tools as a framework for building ‘a coherent, collaborative system that supports powerful, equitable learning for all students’ (2003: 6). The elements of the framework are values which become the
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foundation for school improvement, and are instructive in illustrating the key dimensions of a school culture on which successful curriculum change depends on, according to Knapp, Copland and Talbert (2003: 16):

- Ambitious standards for student learning. A high level of understanding and skills in critical areas of learning is essential.
- Belief in human capacity. Students and professionals can meet ambitious learning standards if they have effective instruction and support.
- Commitment to equity. Achievement gaps among students who differ by class, race, ethnicity, and language must be narrowed and ultimately eliminated.
- Belief in professional support, trust and responsibility. Teachers and administrators must share responsibility and hold one another accountable for improving educational quality and equity in an environment of trust.
- Commitment to inquiry. Using evidence to evaluate and change practice is essential to continuous improvement of teaching and learning.

Another approach is proffered by Marzano, Frontier and Livingston (2011), who suggest activities by which teachers can evaluate their teaching to make their practice ‘deliberate’, and incorporate their insights into a professional growth plan.

Weston and Bain (2009) found that attempts at curriculum change typically overestimate the extent to which stakeholders have a common understanding of change. They argue that the linear and rational needs analysis approach needs to be combined with an appreciation of the loosely coupled informal culture of schools. A reconciliation of these two approaches must assist stakeholders to ‘undertake a realistic analysis of their circumstances; learn about themselves in ways that inform commitment to change; and build a school-level schema that reflects commitment and support for the desired changes’ (Weston and Bain 2009: 159). In this view, the process of change must be integrated with a process of self-understanding which builds the school’s capacity for improvement.

**Subjects and deep knowledge**

The Australian Curriculum aims to provide students with deep knowledge of subject domains, through ‘rigorous, in-depth study, preferring depth to breadth wherever a choice needs to be made...’ (ACARA 2012: 10). This reflects growing recognition among curriculum experts and researchers that deep knowledge best empowers learners to apply what they have learned beyond the confines of the context in which it is learned.

This raises the question of just what deep knowledge is, and how it can be identified and promoted within the subjects of the curriculum. Given that the subjects of the curriculum are included because they are thought to develop distinctive understandings and skills, what qualifies as deep learning will also be distinctive, though there are features of deep learning that are evident across fields.
The priority given to deep learning is justified by arguments like the following, taken from a widely influential publication from the US National Research Council (2005: 15) edited by Donovan and Bransford.

An important point that emerges from the expert-novice literature is the need to emphasize connected knowledge that is organized around the foundational ideas of a discipline. Research on expertise shows that it is the organization of knowledge that underlies experts’ abilities to understand and solve problems.

It is these foundational ideas that give disciplines their explanatory power, and therefore they are an essential part of learning any subject. This leads to three fundamental principles of learning which are important for teaching:

- Students’ have preconceptions about topics and concepts, and will find new concepts difficult to accommodate unless their initial understanding is not engaged.
- To be competent in an area of inquiry requires a deep foundation in factual knowledge within the context of a conceptual framework, which is organised in such a way that it facilitates retrieval and application.
- A metacognitive approach to teaching can help students take control of their learning through identifying goals and monitoring their progress in achieving them.

These principles have been applied in Marzano’s Dimensions of Learning model of the learning process (Marzano 2011), which includes steps which focus explicitly on assisting students to integrate new knowledge into their existing knowledge, extending and refining knowledge through application, and using knowledge in decision-making, problem solving and other forms of inquiry.

The US National Research Council Committee on a Conceptual Framework for New K-12 Science Education Standards (National Research Council 2011a) presents a three dimensional curriculum framework for achieving deep learning of the core ideas of science. First, the curriculum incorporates the major practices that scientists use to investigate and build models and theories about the world and a key set of practices that engineers use as they design and build systems. The second dimension comprises crosscutting concepts with applicability across science disciplines. Third are the core ideas in the science disciplines and the relationships among science, engineering, and technology.

These core ideas should have broad significance across multiple sciences or engineering disciplines or be a key organizing principle of a single discipline. They provide tools for understanding or investigating more complex ideas and solving problems, and should relate to the interests and life experiences of students, or be connected to societal or personal concerns that require scientific or technological knowledge. Core ideas should be made accessible to younger students but be broad enough to sustain continued investigation over years.

All three dimensions must be woven together so that when exploring particular
disciplinary ideas from dimension 3, students will do so by engaging in practices in dimension 1 and should be helped to make connections to the crosscutting concepts in dimension 2.

It is important to note here that the emphasis on deep learning and core ideas is not a self-contained immersion in a single subject, but highlights concepts which cut across disciplines and applies these concepts and the core ideas in real life settings. Depth is defined by the potential power of application and explanation across settings and problems, not by the exclusivity of its focus. Depth is more an approach to knowledge rather than an advanced level of understanding or skill, so that it is possible to speak about deep learning at the youngest of ages.

An important issue in curriculum debate is the relation between the factual information associated with a subject domain, and the conceptual framework through which its explanations are constructed. Donovan and Bransford (National Research Council 2005: 6) see this relationship as a two way street in that factual knowledge must be placed in a conceptual framework to be well understood. While concepts are given meaning by multiple representations that are rich in factual detail: ‘Competent performance is built on neither factual nor conceptual understanding alone; the concepts take on meaning in the knowledge rich contexts in which they are applied’.

An important consequence of this is that the popular view that facts need to be taught before understanding, application or inquiry ignores the connections among these aspects of knowledge. Information is only made meaningful when it is organised within some conceptual framework. Its significance is apparent only when it is related to questions which give facts their relevance and importance. Questions, or inquiry, arise from some initial analysis of situations or actions. In disciplined knowledge, these analyses are drawn from the explanatory frameworks such as those discussed here. In all these ways, information, concepts and inquiry should be regarded as interdependent elements of learning.

One attempt to identify the cognitive structures implicit in deep understanding is the framework developed by Baxter and Glaser (1998: 38) to articulate the properties of knowledge which represent cognitive complexity in science assessment (Figure 1). The idea is that learning involves moving from a fragmented structure to a meaningfully organised one along four dimensions of scientific understanding, and this describes progress in cognition.

<table>
<thead>
<tr>
<th>Cognitive activity</th>
<th>Structure of knowledge</th>
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<tr>
<td></td>
<td>Fragmented ←------Meaningfully organised</td>
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<tr>
<td>Problem representation</td>
<td>Surface features and shallow understanding</td>
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<tr>
<td>Strategy use</td>
<td>Problem solving by</td>
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undirected trial and error | goal oriented
---|---
Self Monitoring | Minimal and sporadic | Ongoing and flexible
Explanation | Single statement of fact or description of superficial factors | Principled and coherent

**Figure 1: Cognitive activity and structure of knowledge (Baxter and Glaser 1998: 38)**

The first dimension is problem representation where the move is from a focus on surface features and shallow understanding to underlying principles and concepts. The second dimension describes how students go about solving problems, moving from undirected trial and error to efficient, informative and goal-oriented strategies. Student self-monitoring of progress can move from a minimal and sporadic process to an ongoing and flexible monitoring. Finally, explanation moves from single statements of fact or description of superficial factors to principled and coherent explanations.

While constructed for application to science, this framework identifies general features of deep knowledge which might be more widely applicable.

It is important to remember that arguments for deep learning in subject domains require examination in terms of the context of the school. For instance, in his discussion of physics, Deng (2007, 2011) draws distinctions between the psychological (an important school focus) and the logical (the focus of the academic discipline) dimensions of the subject to argue that knowing the key ideas of physics within the practice of the research discipline is not sufficient, since the school context introduces other important considerations. Similar arguments could be made for the curriculum in general. Consequently, in teaching school subjects, planning needs to recognize:

- the *logical* dimension of a subject which ‘entails knowing the concepts and principles that secondary-school students are supposed to know about particular topics in the school science curriculum’ (Deng 2007: 521);
- the *psychological* dimension which concerns how concepts ‘can be developed out of the interest, experience, and prior knowledge of students; and which ‘entails the use of examples, questions, and models that are within the realm of students’ experience and knowledge’ (p. 522); and
- the *sociocultural* dimension which ‘concerns how the subject matter of a school science subject relates to, and interacts with, society, culture, and technology’ (p. 525).
- the *epistemological* dimension, including how knowledge is produced and confirmed in the relevant discipline or field.
- the *pedagogical* dimension, how concepts and principles can be represented and reformulated for teaching and learning.
This analysis reminds us that disciplines are practices related to particular contexts and purposes. The practice of science, for instance, varies across applied science in professions like medicine, its application in industrial processing, its invention in cutting edge public and private research laboratories, and its teaching in schools and universities. The curriculum selects from this range of possibilities for the particular purposes of schooling.

Core concepts and ideas appropriate for curriculum planning are not ready made, but need to be constructed according to the purposes of the curriculum and the context in which they are to be taught. In some areas of the curriculum, there will be a strong though seldom complete consensus about major ideas. Mathematics is a likely case. However in some areas, key ideas for curriculum planning are not readily available and need to be constructed for the purpose, as has been the case in history (Gilbert 2011).

Given their importance as key outcomes of any curriculum, ensuring that these key ideas or dimensions are emphasised and successfully developed is a key priority in effective curriculum development. The history of curriculum change suggests that giving priority to these underlying structures is not a simple matter, as it requires that we go beyond the surface of topics and information. However, content topics and information can often become the dominant emphasis because they are so easy to identify.

Deng’s (2007) schema of the multidimensional structure of school subjects explains the complex processes of curriculum planning. It is the daily practice of teachers to construct schemes of work with these dimensions in mind, and to translate annual programs into more specific units, lessons and activities. An illustration of this practice in action is the European tradition of didaktik (Westbury, Hopmann and Riquart 2000), which has institutionalized a reflective practice of teaching in which the rationales for curriculum and teaching are central to the planning process. Implicit in this is that every teacher becomes a reflective educational theorist.

One attempt to articulate this approach to planning is the following series of questions which teachers ask when conducting Didaktik analysis during unit and lesson preparation, with respect to a particular topic, concept, issue, or theme in the curriculum (Klafki 2000: 152). (See also Deng 2011.) Underlying the questions are a clear educational philosophy and a concern for the formative potential of the subject matter:

1. Exemplary value: What wider or general sense or reality does this content exemplify and open up to the learner? What basic phenomena or fundamental principle, what law, criterion, problem, method, technique, or attitude can be grasped by dealing with this content as an “example”?
2. Contemporary meaning: What significance does the content in question, or the experience, knowledge, ability, or skill, to be acquired through this topic, already possess in the minds of the children in my class? What significance should it have from a pedagogical point of view?
3. Future meaning: What constitutes the topic’s significance for the children’s future?

4. Content structure: How is the content structured (which has been placed in a specifically pedagogical perspective by questions 1, 2 and 3)?

5. Pedagogical representations: What are the special cases, phenomena, situations, experiments, persons, elements of aesthetic experience, and so forth, in terms of which the structure of the content in question can become interesting, stimulating, approachable, conceivable, or vivid for children of the stage of development of this class?
   a) What facts, phenomena, situations, experiments, controversies, intuitions, are appropriate to induce the child to ask questions directed at the essence and structure of the content in question?
   b) What pictures, hints, situations, observations, accounts, experiments, models, etc., are appropriate in helping children to answer as independently as possible, their questions directed at the essentials of the matter?
   c) What situations and tasks are appropriate for helping students grasp the principle of the content by means of the example of an elementary “case”, and to apply and practice it so that it will be of real benefit to them?

Deep knowledge is not about accepting an artificial consensus about intellectual work, or applying routine procedures to produce predictable ends. Both conventional ideas and routine techniques will be important parts of learning, but they will be given depth only if they are framed by an approach which engages students in the thoughtful recognition that solutions of complex problems are tentative and never complete. Using deep knowledge to address problems is more like participating in a conversation than solving Sudoku, recommending a participation perspective on knowledge rather than an acquisition perspective (Leach and Scott 2008).

Research on concept development and deep learning has typically been in the context of particular subjects, and it is not possible to address these here. However, some studies illustrate important aspects of such research which might be applied more generally, and which illustrate the kind of analysis which teachers can apply to curricula in their chosen subjects.

Leach and Scott (2008: 650), for instance, call for a change to traditional ways of thinking about deep learning. They remind us that the Piagetian tradition would see science teaching ‘as a process of supporting learners in personal construction of knowledge based on experience of natural phenomena, rather than a guided introduction to ideas that already exist within a community’. In contrast, Leach and Scott prefer a communication approach to learning science, which they see as participating and interacting within a learning community. Similar reasoning would apply in other subjects. Ellis (2007: 448) criticizes a similar assumption about the kind of knowledge teachers need, an assumption which he describes as ‘peculiarly individualistic and linear and treats subject knowledge as fixed and easily codifiable’.
Leach and Scott (2008) suggest that a key influence on the difficulty students face in learning is the extent of difference between the disciplinary concept and everyday understanding, which they label ‘learning demand’. For instance, concept learning in some aspects of physics tends to be difficult because it seems counterintuitive. A parallel might be anachronistic explanation in history, since a goal of history as a discipline is to see things as they might have been seen in the past rather than as we see them now. Such a perspective is seldom taken in everyday situations. Clarifying the ‘learning demand’ in teaching a particular skill or concept will be a useful strategy in planning for deep learning. From ideas like learning demand and the communication approach, it is possible to develop a model for designing lessons to develop conceptual understanding (Ametller, Leach and Scott 2007).

The dominance of core subjects in the curriculum gives them a heavy responsibility for the quality and relevance of the outcomes of schooling. Research recommends a greater emphasis on deep learning as the key to success if subjects are to offer students understandings and skills they can apply to everyday situations, employment and lifelong learning. Any curriculum development process needs to make this task its key focus.

**Twenty-first Century Skills**

Recent curriculum discussion has promoted the importance of what have been called twenty-first century skills (C21 skills), a set of prescriptions of what students need to learn in order to function effectively in a learning society and a knowledge economy.

Economic growth depends on a synergy between new knowledge and human capital. Hence, countries that have achieved substantial economic growth are those in which large increases in the provision of education and training have been accompanied by advances in knowledge. The information-based role of education in developing twenty-first century skills in an information or knowledge economy has become indisputable. (Griffin, Care and McGaw 2012: 4)

Analyses of emerging global economic, social and technological change point to the need for a more dynamic, instrumental and engaged curriculum than the traditional subject based curriculum has generally provided (Cisco 2010). The degree of change advocated in the literature varies, but a typical view is that by Binkley et al. (2012) who argue that ‘new standards for what students should be able to do must replace the basic skills and knowledge expectations of the past. To meet this challenge, schools must be transformed in ways that will enable students to acquire the sophisticated thinking, flexible problem solving, and collaboration and communication skills they will need to be successful in work and life’. The result is a variety of frameworks attempting to identify the skills and to guide these changes (Dede 2010), though there is a large degree of commonality among them (Voogt and Roblin, 2012).
Kay and Greenhill (2011) note that student outcomes for C21 skills comprise a blend of specific skills, content knowledge, expertise and literacies (see Table 1). Achieving them requires support systems of core subjects and themes, standards and assessments, curriculum and instruction, professional development and learning environments. Core subjects proposed are a conventional range of learning areas (though with a greater emphasis on social sciences, including economics, geography, history and government and civics), and a number of interdisciplinary themes: global awareness; financial economic, business and entrepreneurial literacy; civic literacy; and health literacy.

In discussing core subjects, Kay and Greenhill (2011: 52) advocate deep learning in concert with the widely influential work of Donovan and Bransford (National Research Council 2005). They reject the view that content and skills are mutually exclusive, and ‘stress the importance of developing deep mastery in the core subjects, as long as those subjects are being mastered alongside an explicit emphasis on 21st century skills’. This involves engaging students with real-life data, tools and experts and allowing for multiple measures of mastery.

The recommendations from Kay and Greenhill (2011) provide a comprehensive framework of learnings implied by analyses of the demands of a learning society and knowledge economy. However, in recommending core subjects, interdisciplinary themes and C21 skills, the framework does not solve the question of how a curriculum might be designed to accommodate this range. To say that core knowledge needs to be developed ‘alongside’ skills does not help to clarify the implications that each side of this dichotomy might have for the other.

This is an important question, since what Kay and Greenhill (2011) refer to as the ‘content vs skill’ debate is not so simply resolved. Given that the most common means of addressing C21 skills is to incorporate them into a subject based curriculum, much more work needs to be done before such an integration can succeed, as the earlier discussion of the Australian general capabilities reveals (Gilbert 2012).

Scardamalia et al. (2012) address this question in discussing the relationship between C21 skills and deep knowledge. In response to questions as to whether there is anything new in the kinds of learning promoted by C21 skills advocates, Scardamalia et al. (2012: 251) suggest that the knowledge economy and its links with innovation require that people work creatively with knowledge to an extent not equaled before, as previously application of knowledge has been the chief priority. Consequently, it is this knowledge building process that C21 skills need to focus on, so that processes of collective responsibility for knowledge advancement can take hold ... That is how idea improvement, leading to deep disciplinary knowledge, gets to the center of the enterprise, with twenty-first century skills inseparable and serving as enablers.
<table>
<thead>
<tr>
<th>Kay and Greenhill (2011)</th>
<th>Binkley et al. (2012)</th>
<th>ACARA (2012b)</th>
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<tbody>
<tr>
<td><strong>Life and Career Skills</strong></td>
<td><strong>Ways of Thinking</strong></td>
<td>Literacy</td>
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<tr>
<td><strong>Information, Media and Technology Skills</strong></td>
<td>1. Creativity and innovation</td>
<td>Numeracy</td>
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<tr>
<td><strong>Learning and Innovation Skills</strong>, including:</td>
<td>2. Critical thinking, problem solving, decision making</td>
<td>ICT capability</td>
</tr>
<tr>
<td>Creativity and innovation</td>
<td>3. Learning to learn, Metacognition</td>
<td>Critical and creative thinking</td>
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<tr>
<td>Think creatively</td>
<td></td>
<td>Personal and social capability</td>
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<td>Work creatively with others</td>
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<td>Ethical behaviour</td>
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<td>Critical thinking and problem solving</td>
<td><strong>Ways of Working</strong></td>
<td>Intercultural understanding</td>
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<td>Reason effectively</td>
<td>4. Communication</td>
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<tr>
<td>Use systems thinking</td>
<td>5. Collaboration (teamwork)</td>
<td></td>
</tr>
<tr>
<td>Make judgments and decisions</td>
<td><strong>Tools for Working</strong></td>
<td></td>
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<tr>
<td>Solve problems</td>
<td>6. Information literacy</td>
<td></td>
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<tr>
<td>Communication and collaboration</td>
<td>7. ICT literacy</td>
<td></td>
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<tr>
<td>Communicate clearly</td>
<td><strong>Living in the World</strong></td>
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<tr>
<td>Collaborate with others</td>
<td>8. Citizenship – local and global</td>
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<td></td>
<td>9. Life and career</td>
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<td></td>
<td>10. Personal and social responsibility – including cultural awareness and competence</td>
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While Scardamalia et al. (2012) are not referring specifically to schools in this statement, the analysis is nonetheless useful, as it offers interesting possibilities for combining a deep learning approach to the subjects of the curriculum with the development of authentic C21 skills. For if these skills derive their power and significance from their relevance to contemporary social, economic, political and environmental change, then they can be seen as offering a link between these issues and the traditional knowledge domains of the core curriculum. In other words, by emphasizing an authentic problem-solving approach to contemporary issues, the incorporation of the C21 skills into core curriculum domains will become necessary.

It is also important to note that skills such as critical thinking need to be taught explicitly. In a meta-analysis of the teaching of critical thinking, Abrami et al. (2008) found that a mixed method, where critical thinking was taught as an independent strand within a specific content course had the largest effect, whereas an immersion method, where critical thinking is regarded as a by-product of instruction, had the smallest effect. Whether critical thinking is taught separately from content or embedded within it seemed less important than whether the objectives and teaching explicitly focused on critical thinking. These effects were enhanced if there was purpose-built professional development for teachers. The authors concluded (Abrami et al. 2008: 1121) that ‘These findings make it clear that improvements in students’ CT skills and dispositions cannot be a matter of implicit expectation’.

Much attention has been given to the assessment of C21 skills. In fact, the literature seems to give more attention to ways of assessing them than of teaching them. Acknowledging that C21 skills are ‘not yet well understood’, Griffin, Care and McGaw (2012: 14), nonetheless seem to envisage that change will be driven by large scale assessment. Strangely, they also acknowledge that, while experience with such testing has shown that it can influence teaching, it does not necessarily increase student learning. Binkley et al. (2012) in the same collection go further to point out that the research on the negative consequences for teaching and learning of high-stakes testing indicates that such forms of assessment are not appropriate for the kinds of learning implied by the C21 skills they identify (see Table 1). Rather, they advocate formative, largely performance-based assessment aligned with C21 goals which incorporate adaptability and unpredictability and which make students’ thinking visible. They offer a lengthy discussion illustrating a range of ICT and other tools on which to base assessment schemes and strategies for assessing the C21 skills in their framework. Scardamalia et al. (2012) suggest the need to integrate assessment, analysis and feedback of C21 skills within the context of assessment tasks in the subject curriculum.

**Curriculum and leadership**

The literature on school leadership has until the last decade or so been dominated by a concern for principal leadership, and this remains the key focus of the literature. However, increasing attention has been given to the relations
between principal and staff, and in particular the increased engagement of staff in decision-making (Goddard and Miller 2010). The result has been a strong shift to considerations of collaborative leadership as an approach to school improvement and change, and the introduction of the corresponding concept of distributed leadership (Hallinger 2007; Hallinger and Heck 2010a; Kochan and Reed 2005; Louis et al. 2010). All this has important implications for curriculum decision-making and development.

Collaborative leadership
Research provides clear evidence that collaborative leadership can positively affect student learning through building the school’s capacity for academic improvement (Hallinger and Heck 2010a, 2010b; Harris, Leithwood, Day, Sammons and Hopkins 2007). In a study of 192 US elementary schools over a four year period, Hallinger and Heck, (2010a: 654) found ‘significant direct effects of collaborative leadership on change in the schools’ academic capacity and indirect effects on rates of growth in student reading achievement’.

Leithwood and Mascall (2008) studied the impact of collective, or shared, leadership on key teacher variables and student achievement in English primary and secondary schools. Collective leadership explained a significant proportion of variation in student achievement across schools, as higher-achieving schools awarded more leadership influence to all school members and other stakeholders, especially to school teams, parents, and students.

Looney (2011) cites a large-scale longitudinal study in the United States which found that collective leadership (the extent of influence organisational actors and other stakeholders exert on decisions) at both the school and district levels was associated with stronger impacts on student achievement. At the school level, collective leadership focused on instructional improvement had a significant impact on teachers’ working relationships, and on student achievement.

By virtue of its potential for engaging a range of staff in initiating the change process, collaborative leadership is the most relevant approach for developing curriculum leadership throughout a school, and consequently warrants close consideration as a model for developing leaders of curriculum change. Its most well developed form in recent times is distributed leadership.

Distributed leadership
In their review of the literature on DL, Bennett, Wise, and Woods (2003) identify three distinctive elements of the concept:

- DL is an emergent property of a group or network of interacting individuals in which the outcome is greater than the sum of the parts;
- DL suggests openness of the boundaries of leadership so that any or all members can play some leadership role;
- DL recognizes that expertise and valuable ideas and capabilities can be found in individuals spread throughout the organisation. DL picks up on a range of developments in leadership and school change, including
teamwork, collaboration, collective responsibility and flexible application of expertise.

In her study of DL in schools, Harris (2008) identified common principles underlying DL in practice in a series of case studies. The cases gave rise to eight characteristics of distributed leadership:

- Vision is a unifying force when clearly articulated and shared.
- Leaders have expert rather than formal authority, which shifts according to need and task.
- Collaborative teams are formed for specific purposes, with fluid membership.
- Communities of practice emerge and maintain their affiliation long after the collaborative activities of the task are completed, often to brainstorm future needs and further possible collaborations.
- Individuals perceive themselves as stakeholders, and are willing and able to assume leadership positions when needed.
- Organizational goals are disaggregated to be distributed to the teams best able to achieve the tasks.
- Distributed roles and tasks take place at different times, places and under widely varying conditions.
- Enquiry is central to organisational change, renewal and innovation with the ultimate goal of DL being knowledge creation and organizational improvement (Harris 2008).

Without limiting the potential here, typical roles for teacher leaders include: resource provider; instructional specialist; curriculum specialist; classroom supporter (e.g. co-teaching, coaching); professional learning facilitator; mentor; contributor to school leadership; data coach; catalyst for change; and modelling continual learning and improvement (Harrison and Killion 2007).

While the literature on teacher leadership includes important elements of curriculum leadership, the notion of curriculum leadership needs further clarification in its own right.

Curriculum leadership
The earliest work to address aspects of curriculum leadership was based on the idea of instructional leadership (Robinson 2010). However, this was not an adequate base for curriculum leadership, for two reasons. First, instructional leadership tends to take the curriculum as given, so that it focuses on implementation at the classroom level rather than the prior and more fundamental task of developing school programs which emphasise deep learning, inclusive and authentic learning experiences and coherently aligned learning and assessment programs. Second, like most of the early literature, much of the instructional leadership literature was aimed at the principal. Nonetheless, the work on instructional leadership is very relevant to the role of curriculum leader.
A typical statement of instructional leadership comes from Brundrett and Rhodes (2010: 60) who state that:

Instructional leaders talk to teachers about teaching, encourage collaboration between teachers, empower teachers to make decisions, and encourage professional growth, teacher leadership, autonomy and self-efficacy ... Successful instructional leaders are able to encourage those conditions that can constitute a professional learning community of students and teachers.

Noting that the move to distributed leadership has spread the obligations for curriculum leadership beyond the principal, Brundrett and Rhodes (2010) identify characteristics of a school faculty or department culture which would encourage continuous improvement. It follows that curriculum leaders should contribute to the development of teams and departments which have these characteristics, including:

- Shared values, beliefs and moral purpose linked to a focus on learning and learners.
- Involvement in collaborative and critically reflective enquiry and evaluation.
- Leadership from different people on different tasks.
- Good interpersonal relationships.
- A sense of direction linked to a sense of achievement.
- Having clear departmental policies and procedures ... that are developed from a clear overall improvement plan.

In a review of research into subject leaders, middle managers, department heads and curriculum coordinators, Bennett et al. (2003: 3) identified a number of consistent points, which are interesting for the insight they provide into the somewhat ambiguous position of middle leaders. They found that:

- Middle leaders play a crucial role in developing the nature and quality of pupils' learning experience, but this is strongly influenced by the circumstances in which they work.
- There is a strong rhetoric of collegiality in how middle leaders describe the culture of their responsibility areas, and how they discharge their responsibilities. However, this is sometimes more aspired to than real.
- Middle leaders are reluctant to monitor their colleagues' work, especially by observing them in the classroom, which is seen as a challenge to professional norms of equality and privacy, and sometimes as an abrogation of trust. Subject leaders who introduced classroom observation did so as a collaborative learning activity for the entire department rather than as a management tool for the subject leader.
- Subject leaders' authority comes not from their position but their competence as teachers and their subject knowledge. However, high professional competence did not necessarily imply the perceived right to advise other teachers on practice.
- Subject knowledge provides an important part of professional identity for
both subject leaders and their colleagues. This can make the subject department either a major barrier or a strong impetus to large-scale change.

- Senior staff look to middle leaders to become involved in the wider whole-school context, but many are reluctant to do so, preferring to see themselves as departmental advocates. This is exacerbated by the tendency of secondary schools, in particular, to operate within hierarchical structures, which act as a constraint on the degree to which subject leaders can act collegially.

Baines, Blatchford, and Chowne (2007: 4) describe the process followed by schools in the UK engaged in developing innovative curriculum. They identified five components of leading curriculum innovation, with associated questions, which could act as a guide for curriculum leaders planning curriculum change:

2. Stimulating innovations – What do leaders do to stimulate interest and engagement? A question of trust, values and vision.
3. Developing strategy for innovation – What is the strategy to ensure that innovation is led and implemented effectively? A question of capacity, sustainability and evaluation.
4. Implementing innovation – How is the innovation led and its leaders supported? A question of vision into practice.
5. Evaluating the impact of innovation – How will we know whether the innovation has made a difference to the outcomes we value? A question of moral purpose.

Significant attention has been given recently to the need for curriculum and teaching to be evidence informed. While the use of classroom assessment for learning is a basic professional competence for teachers, the role of curriculum leader extends beyond this to take an overall perspective of assessment across the school and to integrate this information with data from other sources, including large scale testing. Leadership in the development and use of school assessment data to inform curriculum innovation and improvement has been addressed in a number of recent research studies and guides for practice (Alliance for Excellent Education 2010; Boyle and Charles 2010; National Comprehensive Center for Teacher Quality 2010). (See also the later discussion on assessment in this review.)

While large scale testing is controversial by virtue of the high stakes accountability often attached to it, there remains potential in such data to improve learning if the necessary interpretation, planning and application abilities are applied to it, a role for leadership (Hamilton et al. 2009; Ikemoto and Marsh 2007; Knapp, Copland and Swinnerton 2007). The use of data goes beyond the assessment of classroom learning. For instance, Sanders (2008) illustrates the use of data to inform links between schools and their communities. There is also an important role for curriculum leaders to evaluate
and apply the findings of educational research (General Teaching Council for England 2006; Levin 2010).

**Curriculum leadership and social justice**

Curriculum change is routinely closely connected to a social and political context. Essential to the moral dimension of educational policy and practice, and especially to curriculum change, are considerations of social justice (Fitzgerald 2009; Gunter, 2006), and a substantial literature confirms the importance of leadership in the creation of socially just educational outcomes.

Muijs et al. (2010, p. 142) point out that social justice implies a number of leadership tasks beyond the standard notion of the effective school, including:

- Enabling the school to respond to students from diverse backgrounds;
- Connecting school culture to students' home and community cultures;
- Promoting the overall personal and social development of students and enhancing their life skills and life chances, as well as promoting their academic development;
- Reconciling the social inclusion agenda with the standards agenda;
- Managing complex relationships with communities, community agencies, and employers.

Much of the focus of leadership for social justice is on the beliefs and values of leaders and their colleagues, confirming the general literature on leading change. Brown (2006) notes the particular challenges in achieving this, which arise from the tendency among some leaders to see their role as largely technical, a tendency which Jean-Marie, Normore and Brooks (2009) also note, linking it to the origins of educational leadership in an administrative tradition. Brown (2006) suggests a range of strategies for preparing leaders for leadership for social justice, as do McKenzie et al. (2008).

Hynds (2010) reports a study of resistance to social justice initiatives from teachers and the community, and the need for leaders to be prepared to deal with resistance. This is not straightforward, as Kose and Lim (2010) demonstrate in their study of the impact of professional learning programs on teachers’ beliefs about social justice and education. While results indicated positive changes in beliefs to a more just orientation, negative results also occurred, leading the authors to recommend a more concerted approach to professional learning of this kind. Similarly, Lumby (2006) found ambivalence among leaders in their understandings of and commitment to social justice. These studies identify a likely need for leadership development in this area.

A range of evaluations and reports describe strategies for promoting a social justice orientation in leadership (Capper et al. 2006; Theoharis 2007, 2010; Raffo and Gunter 2008; Ross and Berger 2009; Muijs et al. 2010; Shields 2010; Niesche and Keddie 2011).

Of special significance in the Australian context is the need for leadership to address the situation of Indigenous students. While much of value can be drawn
from the general leadership research, and studies on leadership for social justice in particular, there remains a range of considerations of distinct relevance to Indigenous education, and a significant literature which has addressed them.

The education of Indigenous students must respond to the research on culturally responsive schooling (Castagno and Brayboy 2008; D'Arbon et al. 2009; Frawley et al. 2010), and take a broad approach to education and its links with community development in general. Of particular importance is the need for leaders and teachers to develop cross-cultural competence and the capacities that comprise it (Gorringe and Spillman 2008). More general recommendations for leadership for Indigenous student outcomes have also been recommended (Mulford 2011), including by Indigenous school leaders themselves (Hughes, Matthews and Khan 2007).

Other students have special needs as a result of a range of factors affecting learning, and school leaders play a significant role in ensuring an inclusive approach to curriculum and teaching (Ainscow 2005; Bays and Crockett 2007; York-Barr et al. 2005). Consideration of students with special needs must be a high priority of curriculum leaders, and is an important component of professional learning for such a role.

Implications for curriculum planning, development and change

A series of overlapping implications arise from the research discussed here, and the convergence of some of the elements of recommended action should assist in developing programs to achieve them. Some key implications are:

Generating a shared curriculum vision within school cultures
- Promote reflective consideration of overarching curriculum rationales, goals and structures to clarify links to school programs and establish common understandings, beliefs and values.
- Consider the various forms of curriculum (ideal, formal, enacted, perceived etc.) to maximize the extent to which they support each other.

Planning and monitoring
- As part of a process of professional dialogue and self-evaluation, use the list of features of effective curricula to evaluate school programs.
- As part of a process of professional dialogue and self-evaluation, apply categories such as those proposed by Webb (1999) in curriculum mapping strategies to strengthen alignment of school programs.
- Ensure that curriculum audit processes do not reduce opportunities for creative open-ended inquiry and student choice in learning.

Subjects and deep learning
- Plan from an evidence based knowledge of students’ prior knowledge and preconceptions and an estimate of the learning demand of concepts and tasks.
- Devise models and frameworks which help students organize the concepts and information they need to use.
• Incorporate metacognition strategies as explicit elements of curriculum objectives, teaching and assessment.
• Identify the core ideas of the subject domain and their connection with student interests and practices outside the school.
• Engage students in exploring rich information resources through questions related to an explicit conceptual framework.
• Use models such as that proposed by Baxter and Glaser (1998) to describe and track increasing cognitive complexity within the subject domain.
• Consider in planning the dimensions of the school subject identified by Deng (2007).

Developing C21 skills through general capabilities
• Integrate general capabilities into planning from the outset, rather than as an add-on.
• Emphasise authentic application of core subjects to contemporary settings and issues to maximize the focus on general capabilities.
• Ensure that subject assessments are designed to demonstrate general capabilities, and explicitly include them in assessment criteria and rubrics.
• Incorporate an explicit and independent treatment of general capabilities within core subject teaching.

Leadership
• Develop capacity for and promote distributed leadership according to expertise and capacity.
• Develop team cultures along the recommendations of Brundrett and Rhodes (2010).
• Use an explicit strategy to plan curriculum innovation, such as that recommended by Baines, Blatchford and Chowne (2007).
• Ensure a consistent focus on social justice is central to the process of curriculum innovation.
3. Processes and practices in high performing systems

The increasing dominance of the OECD Programme for International Student Assessment (PISA) (Organisation for Economic Co-operation and Development 2010) as a measure of relative quality in education systems has produced a plethora of observations and debates about what makes a high-performing school system. From a policy perspective, some caution needs to be taken in how performance on PISA is interpreted. One obvious reason is that PISA is not the only international test on which comparisons can be made, and countries’ performances vary with the nature of the test. For instance, rankings of countries on PISA and TIMMS (Trends in International Mathematics and Science Study) are in many cases quite different (Clifton 2011).

From a curriculum perspective, it is important to know just what is being tested if data are to be used to judge curriculum effectiveness; it is also relevant that such tests do not assess all aspects of the curriculum. For instance, Askew et al. (2010: 45) in commenting on mathematics performance on TIMMS, state that:

High attainment in international comparisons does not imply high attainment in problem solving. TIMSS results may be largely attributable to proficiency in computation and solving relatively predictable and routine problems. When solving non-routine problems, differences between nations appear to be less pronounced.

The point here is that close examination of what is being tested should be a prerequisite for any action taken in the name of international comparisons of performance. Nonetheless, these qualifications aside, PISA in particular is a well established tool for comparing important outcomes of schooling and provides a wealth of information on skills, knowledge and attitudes relevant to policy and practice (Thomson 2010). Consequently, it is relevant to ask what lessons there may be in these discussions on international performance comparisons for curriculum design and development.

In her foreword to the collection Surpassing Shanghai: An agenda for American education built on the world’s leading systems (Tucker 2011), Linda Darling-Hammond (2011: ix) summarises the key elements of high-performing countries as:

- equitable funding with additional resources for needy students,
- competitive payment of teachers,
- high-quality government funded teacher preparation, mentoring and professional development,
- provision of time for collaborative planning and professional development ‘typically 15-25 hours per week’,
- a curriculum organised around problem-solving and critical thinking skills,
- careful but rare student testing with ‘measures that require analysis, communication and defense of ideas’.
Darling-Hammond (2011: x) concludes that ‘high-performing states and nations are focused on building coherent systems of teaching and learning, focused on meaningful goals and supported with universally available, strategic resources’. This is clearly so, but for present purposes, this review will focus only on those issues which relate to curriculum and which are amenable to direct influence at the school level. In Darling-Hammond’s list above, this would include the last three points but not the first three.

It must be said that the formal intended curriculum is not often put forward as a key feature of high performance, though the processes for ensuring high quality in the enacted curriculum are more widely remarked on. For instance, the 2007 McKinsey report (Barber and Mourshed 2007), which prompted so much attention, expressly excluded consideration of curriculum and pedagogy. The second McKinsey report contained a wider range of considerations, but again the focus was primarily on the system level (Mourshed, Chijioke and Barber 2010). Research in particular systems, however, does suggest an important role for the curriculum, especially as it encourages, enables and supports particular kinds of teaching practice.

There are clear dangers in drawing simple conclusions about what international examples should be followed. First, there are very few things that all high performing systems do. The response to this is sometimes to identify strategies at such a high level of generality that they approach the obvious, as Alexander observes (2010) about the first McKinsey report’s recommendations for high quality teachers, high quality teacher education and high quality teaching (Barber and Mourshed 2007).

Second, any particular practice may not be simply transferable in isolation, but may be effective because of its connection to some other aspect of its original context. The contributors to Tucker’s (2011) collection give considerable weight to the cultural contexts of high performing countries, and other researchers have considered a wide range of possible factors. For instance, researchers have discussed the Chinese number system as a possible explanation for high performance in mathematics in China and the Chinese diaspora (Askew et al. 2010; Ng and Rao 2010). Others have pointed to a higher level of mathematical knowledge among Chinese children before they reach school (Ni, Chiu and Cheng 2010).

In Finland, Toom and Husu (2012: 46) suggest that the system has succeeded not only because of its education policies, organization and pedagogy, but also because of Finland’s ‘democratic and consensus-seeking ethos in political decision-making’. Sahlberg (2011: 133) comments that ‘One lesson from Finland is, therefore, that successful change and good educational performance often require improvements in social, employment, and economic sectors’. In seeking lessons from successful education systems, it is important, though perhaps difficult, to understand the complex and sometimes subtle aspects of their broader cultural contexts.

In commenting on this problem, Askew et al. (2010: 1) observe that:
study after study shows that countries ranked highly on international studies – Finland, Flemish Belgium, Singapore, Korea – do not have particularly innovative teaching approaches. Lest this observation be picked up as ammunition for arguing for a ‘back-to-basics’ style of teaching, we hasten to add that such traditional approaches only appear to succeed because of cultural conditions that support them, particularly through parental expectations and relatively homogeneous populations. And there are many countries that use traditional practices that come low in international rankings.

However, it should be remembered that these nations (Finland, Singapore, Korea) have come to attention because of their recent outstanding progress rather than long traditions of high achievement. It is clear that cultural factors are important, but it is not sufficient to say that these nations are all special cases because of some cultural uniqueness.

A further point is that some apparently distinctive features may prove to be an indicator of some other more specific or less obvious quality. For instance, having a centralized national curriculum is sometimes proposed as a causal factor in high performance. However, the problem here (and in many cases where particular practices are identified as models worth following) is that some countries with very centralized systems are not high-performers, France being a good example, and, equally, some high-performing countries do not have nationally centralized curricula, Canada being a classic case. What is more pertinent here is the nature of the curriculum rather than its centralized origin. Askew et al. (2010) make the same point about mathematics achievement and centralized testing, with high performing Finland lacking a centralized examination system, while high performing Singapore has a highly centralized assessment system.

In their study of 37 countries’ performance on TIMMS, Schmidt and Prawat (2006: 654) note that their evidence suggests that ‘national control of the curriculum is not necessarily associated with greater curricular coherence’ and that ‘the national location variable fails as an independent predictor of curriculum coherence at the classroom level’ (657). Rather, it was the curriculum’s authoritativeness, credibility and clear and specific guidance which were more salient.

It is interesting to note that countries at the top of the PISA rankings are themselves not wholly content with their educational provision. Many of them have clear plans to reform aspects of their systems, suggesting that high performance on tests at one point in time is no guarantee of continuing relevance or quality (Askew et al. 2010). Related to this is the fact that high performing countries do not think they have achieved all that is desirable in education. Performance on tests is one of many measures, and many high performing countries are looking to increase their emphasis on and improve outcomes in other aspects of education.
There is also a time lag that should be recognized. Performance on the 2009 PISA tests (the latest available) presumably reflects curriculum and teaching in the years preceding that, but this cannot be assumed to be an ideal model for schooling ten years later (Oates 2011). It follows from this that the success on tests may not be due to things being done in these countries now, but perhaps what they were doing five or ten years ago.

It is somewhat ironic that, while the education world is seeking to replicate the success of these systems, they themselves are in many respects looking to do things differently. For instance, citing global change and its implications for education, Singapore’s Minister for Education said in 2011 that

> We want to make our education system even more student-centric, and sharpen our focus in holistic education – centred on values and character development. We could call this Student-Centric, Values-Driven education. (Heng 2011)

Finally, it is worth acknowledging the warning from the second McKinsey report (Mourshed, Chijioke and Barber 2010: 24) that:

> What has confused much of the discussion about system improvement in the past is that each system’s journey is different: each school system starts from a different point, faces different expectations, and operates in a different social and political context. These differences have often led even the experts to give poor advice...

In light of these potential pitfalls, consideration of the performance of other countries needs to be undertaken with care and a healthy skepticism about their transferability. Nonetheless, at any level of experience, learning is valuable because it augments people’s ability to reflect on their own beliefs and practice, and this is no less so at the level of professional practice and educational systems and institutions than it is at the level of the individual. What follows is a consideration of what might be learned about curriculum practice from a selection of high performing countries.

**Shanghai**

Considerable research has focused on the performance of Asian countries on the Pacific Rim, following their performance in PISA and TIMMS, especially the recent stand out ranking of Shanghai. In discussing the case of Shanghai, Cheng (2011) points to the traditional role of education in social mobility and status, the history of civil service examinations and the veneration of reading as important aspects of the backdrop of Chinese education. Countering this, the disruptions of war and the cultural revolution make the performance of Shanghai even more remarkable.

Askew et al. (2010: 32) cite research which found ‘evidence of more use of formal and abstract strategies by Chinese pupils than by American counterparts’ in solving non-routine problems, which they hypothesized might result from the
fact that Chinese students are introduced to formal recording and algebra earlier than American students. This raises the important question of level of expectation and cognitive demand in the curriculum.

In discussing school practice, Cheng (2011) points to ‘a rather rigorous framework and system of teaching’, including subject-based teaching-study groups which hold lesson planning meetings on a weekly basis. Cheng gives an example of a typical senior Physics teacher who teaches 12-15 lessons per week in only that one subject, a situation which no doubt has great potential for specialized and intensive reflection and analysis of teaching. These subject meetings are also identified by Moursched, Chijioke and Barber (2010: 89) as a significant aspect of the Shanghai system, as are the weekly meetings among school subject heads and visits to other schools. Peer observation and demonstration lessons are common, including the use of video technology and observations across schools, with demonstrations being part of promotion expectations, along with inducting new teachers and publishing in journals. The interaction across schools is promoted through the establishment of consortia of schools, where strong and weak, old and new, public and private schools are grouped into clusters, with one strong school at the core. This collaboration of teachers within and across schools has been labeled ‘constructive conformity’ and interpreted as a distinctively Chinese version of creativity in teaching (OECD 2011: 94).

Examinations play an important role in the system, as do private tutorials and examination preparation classes, with an estimated 80% of students attending exam tutors. OECD (2011a: 382) reports that more than 20% of students attend after school maths lessons for more than four hours a week. Askew et al. (2010) also report the importance of this ‘shadow education’ in a number of Asian countries. Parental pressure for students to spend long hours at homework has prompted the local authorities to stipulate a maximum number of hours which schools are allowed to assign. Since Shanghai authorities were given local control over examinations, greater flexibility and diversity has occurred in the number of subjects and the nature of the examinations required for university entry.

A new curriculum in 2001 promoted the linking of disciplines to each other and to life beyond school, and a constructivist approach to learning, though not without some opposition. This has however led to changes to examinations requiring integrated papers which ‘cross disciplinary boundaries and require students to solve real-life problems’ (Cheng 2011: 33). This has coincided with provision for schools to develop their own curricula, which comprise three components: basic compulsory courses, elective courses, and extra-curricular independent inquiry projects. This process is supported by online curriculum resources, success stories and research papers.

Cheng (2011) identifies a number of lessons from the Shanghai experience. Of relevance to curriculum are clear, ambitious and widely supported goals; a willingness for self-criticism; and high priority to the study of learning. The last of these is characterized by an emphasis on scholarship on the sciences of learning and the translation of the results into grassroots practices.
Singapore

The history of Singapore as a nation is in itself an impressive success story, but its educational performance is quite remarkable. At independence from Malaysia in 1965, Singapore had multiple religious groups, no common language and no common curriculum (OECD 2011b). Yet by 1995 Singapore ranked among the highest performing nations on TIMMS; in 2009 PISA results, it ranked fifth in reading literacy, second in mathematical literacy and fourth in scientific literacy.

Mourshed, Chijioke and Barber (2010: 27) cite Singapore as a model of ‘a pedagogy in which teachers and school leaders work together to embed routines that nurture instructional and leadership excellence’. They describe its progress from a tightly controlled to a more decentralized system, with the more recent emphasis on schools having greater flexibility and responsibility for their students’ education.

This flexibility is nonetheless governed by strict accountability requirements, what Ng (2011: 467) has called ‘centralised decentralisation’. Schools set their own goals and assess them against specified criteria such as leadership, student-focused processes, and results in ‘holistic development of students’ (including academic results), staff well-being and engagement with parents and community (OECD 2011b: 176). It is also important to note that students are differentiated on the basis of an examination at the end of six years of primary school, with most attending a range of mainstream schools but some attending specialized schools for talented students or others with special needs.

There is considerable diversity in the types of school covering the 4-6 years of secondary education (OECD 2011b: 164). There is also separation of students into ability groups for subjects at secondary level, with most students in ‘express’ classes (around 60% of pupils) leading to a GCE O-level in four years, 25% in a ‘Normal’ (academic) course leading to O-level in five years (or an N-level in four years) and 15% in a ‘normal’ (technical) course leading to N-level (Askew et al. 2010). Between 20% and 25% of pupils continue to university, a relatively low number in Australian terms, but this needs to be seen in the light of a high quality vocational education sector.

While the very large achievement gaps between different cultural groups have been reduced from some decades ago, the OECD notes that Singapore has a long tail in its achievement distribution on TIMMS (OECD 2011b: 167). PISA results in reading show that Singapore has a greater difference between its 5th and 95th percentile scores than its peers at the top of the reading literacy table (320 points compared, for instance, with Shanghai on 262 points or Finland on 284 points – Australia’s range is 325 points) (Thomson et al. 2010: 52). In mathematics and science this range is even greater, and in both cases higher than the range in Australia. The range of achievement outcomes is a challenge which is being addressed by trying to increase the flexibility of the system so that students can move across streams, and to ensure that vocational and technical education are very well resourced.
A key feature of recent reforms has been the introduction of school clusters to create a peer-based forum for leadership development and the sharing of teaching and learning practices, leading to a Professional Learning Community approach to collaboration and peer review of classroom practice.

This focus on quality was encapsulated in the policy of 'Teach Less Learn More', in part as an attempt to engage students and enable more active learning (Ng 2011). One outcome of this is the reduction of content requirements to provide more time for teachers to plan and reflect on their work. There has also been a greater emphasis on 'soft skills' and in primary schools an enhancement of art, music and physical education.

The OECD (2011: 167) observes that a ‘remarkable feature of the Singapore education system is the value, attention and resources it devotes to lower level achievers, not just high achievers’. Testing of reading at first grade identifies students (12-14%) in need of special assistance, which is provided daily in small groups of 8-10 students. Learning support is also provided in mathematics. Sclafani (2008: 4) has commented on the strong commitment of teachers in this process:

If a student in a Singapore school is not successful, the teachers ask themselves what they can do differently to enable the child to succeed. The teacher work day typically starts at 7:00 am and ends after 5:00 pm, providing time for morning and afternoon tutorials for students encountering academic difficulties, teaching and planning periods, and supervision of co-curricular activities.

This needs to be balanced with the widespread 'shadow education' system of after school coaching and examination schools. The Asian Development Bank (2012) cites a 2008 news report that 97% of students were receiving tutoring.

Performance in mathematics and science is highly valued. There is some specialization of teaching in mathematics and science from upper primary grades, and teachers meet regularly to share their experiences. The approach to mathematics is explained in terms of developing 'maths sense' with a focus on understanding problems rather than arriving at one correct answer. Less material is covered, but in greater depth. The OECD notes that the level of mathematics required in the Primary School Leaving Examination is approximately two years ahead of that in most US schools. Science follows an inquiry approach, including projects on science in daily life and the environment. Co-curricular activities such as mathematics and science fairs, competitions and outdoor learning trails are used to generate interest, and government research agencies offer support and activities for schools (OECD 2011b: 169).

In summarizing key lessons which can be learned from Singapore, the OECD (2011b:172) identified vision and leadership, alignment of education to economic development, coherence of the education system, high quality teachers and principals, strong central authority, accountability, meritocratic values, the
adaption of proven practices from abroad. To this were added two more specifically curriculum related lessons:

- ‘clear goals, rigorous standards and high-stakes gateways’, reflected in the very high level of expectations set by its Primary School Leaving Examination and O- and A-levels, and a strong early foundation in core subjects of mathematics, science, and literacy in two languages, and
- curriculum, instruction and assessment to match the standards.

Finland

Finland is a conundrum, in that it reverses many of the strategies of Shanghai and Singapore. School days are shorter than in most countries, high stakes testing is absent up to the end of secondary school, homework is light, out of school tutoring and ‘exam schools’ are rare, and systematic streaming has been abolished. Compared with other top performing nations, Finland does not have a high range from top to bottom of student achievement. Competition is not a conspicuous driver of performance, as illustrated in the words of a counselor at the Finnish National Board of Education (Levine 2011): ‘In Finland, outperforming your neighbor isn’t very important. Everybody is average, but you want that average to be very high’.

Sahlberg (2011: 134) advises that ‘the Finnish experience shows that a consistent focus on equity and shared responsibility – not choice and competition – can lead to an education system in which all children learn better than they did before’.

Underlying the Finnish education system, with implications across a wide range of practices, is the commitment to public education, ‘to building a good publicly financed and locally governed basic school for every child’ (Sahlber 2011: 6). There is a strong commitment to success for all. In this connection it is worth noting that, while 2 percent of Finnish children are deemed to need assistance in special schools, and another 6 percent in special education classes (Schwartz and Mehta 2011), special education is not seen as a remedy only for the most serious learning difficulties. Of the remaining 90% attending comprehensive schools, more than one fifth were in part-time special education focusing on specific learning difficulties in speaking, reading, writing, mathematics etc. Sahlberg (2011) estimates that, by the end of compulsory education at age 16, up to half of Finnish students have received some special education support at some time in their schooling.

A series of Finnish studies of their country’s performance in science (Lavonen and Juuti 2012) suggest that success is a result of:

- A national level core curriculum and implementation process at the municipality level;
- Science teaching being subject-oriented in the primary and lower secondary levels, with teaching aimed to transmit the nature of science;
- Teachers being treated as autonomous and reflective academic experts.
There is in common across the three systems examined here a strong focus on the quality of entry to and preparation for teaching. In the case of Finland, this is often proffered as the single most important feature of Finnish education (Korkeamäki and Dreher 2011). One distinctive aspect is the fact that Finnish teacher education is research-based and all teachers are educated to master’s level, writing a Master’s thesis as part of their studies. During this preparation, universities emphasise the importance of teachers’ pedagogical thinking, personal practical theory, reflection, and inquiry orientation (Jyrhama and Maaranen 2012). In the words of Lavonen and Juuti (2012: 137):

they are educated to be autonomous and reflective academic experts and consequently the need for inspectors, national evaluation of learning materials or national assessment vanished.

There is evidence that this affects teachers’ approaches to their work. Jyrhama and Maaranen (2012) found that teachers reported cooperation with colleagues in sharing and developing ideas and providing peer support, including cooperation with partners outside the school (though not any actual research). In their analysis of teacher responses in interviews on their approach to teaching, Jyrhama and Maaranen (2012: 105) identified evidence of an inquiry approach to teaching, including:

- Collecting feedback and evaluating one’s own action
- Multiple methods in teaching
- Cooperating with teachers or other people in the school
- Active, societal and critical orientation in teaching
- Inquiry as a method in teaching.

The character of the school community was also important, with teachers identifying in particular a cooperative school culture, operational follow-up and supporting structures. This may be assisted by the relatively small size of Finnish schools, where the average size of comprehensive schools is 200 students, and in 2010 one quarter had fewer than 50 students, while only 6% had more than 500 (though school closure and rationalisation are increasing school size). In summarizing their research on school culture, Jyrhama and Maaranen (2012:111) conclude:

it seems that teachers’ inquiry-orientation is first and foremost an attitude towards one’s work. The focus is on the development of one’s self, as well as the development of the school community, alternative ways of working, reflection, dialogic, feedback etc.

An early instance of this was the Aquarium project established to support the implementation of the revised curriculum of 1994. Combining aspects of traditional community collaboration with internet connectivity, the project promoted collaborative engagement and evaluation of curricular developments. In 1997, over1000 projects operated in 700 schools. The project was terminated in 1999 by what Sahlberg (2011) describes as a political decision.
The Finnish curriculum does not specify work at each year level in great detail. A combination of general goals, subject specific aims, core contents and a summary of expectations of high levels of achievement are thought to suffice. The science curriculum, for instance, totals about 30 pages. The National Board of Education identifies three essential ideas underlying the curriculum (Vitikka, Krokfors and Hurmerinta 2012: 84):

- management by goals given in legislation and in the national core curriculum;
- autonomy of municipal authorities in providing and organizing education: local curriculum as a steering document at local level;
- utilization of teachers as valued experts who develop the school-based curriculum as a source for different approaches to schoolwork.

Vittika, Krokfors and Hurmerinta (2012: 88) observe that ‘The current curriculum encompasses both a strong idea of individuality and pedagogical freedom, and the need for equal basic education that requires a strong centrally controlled curriculum’. It is also a way of promulgating information about developments in pedagogy, providing ‘tools to build and renew pedagogical practices’ (p. 89).

Along with this, there is considerable responsibility at the school level for assessment, which is primarily implemented by teachers. The only universally applied external standardized test is at the end of upper-secondary school. Lavonen and Juit (2012) suggest that this allows teachers to reflect on teaching and learning in their classrooms, and to select different forms of assessment, such as student self-evaluation and formative and summative assessment of experimental work. The Finnish approach to assessment is based on a range of evidence, including classroom assessments, sample based standardized subject tests, and thematic reviews, all within a municipal framework of quality assurance practices. Sahlberg (2011: 89) notes the significance of school-based assessment in Finland, which is ‘embedded in teaching and learning processes and is thereby used to improve both teachers’ and students’ work in school’. He summarises the Finnish assessment system as follows:

Teachers are responsible for the overall assessment of their students, using a mix of diagnostic, formative, performance and summative assessments. The municipality’s responsibility is to plan and implement necessary evaluations within and of their schools, based on their own and nationally expressed needs. Thus, current education policies encourage cooperation between schools and try to protect schools from unhealthy competition.

This openness to school and teacher decision-making in the curriculum has led to a mixed response. In their study of the teaching of literacy in Finnish schools in years 1 and 2, Korkeamäki and Dreher (2011) outline the primary school language curriculum and its emphasis on active student participation in learning, both individually and socially. The curriculum recommends that students should
be guided into problem solving with their peers, and the learning environment should promote curiosity. However, the authors note that this is demanding of teachers in that it lacks detail and leaves much content to teacher determination. The result observed in their research was that many teaching practices were more teacher-directed whole group work than the curriculum would suggest, though this was typically followed by small group work. Similar results were found in a survey of students on their experience of science lessons, in which students reported that many science lessons seemed to be rather traditional (Lavonen and Juuti 2012).

On the other hand, Lavonen and Juuti (2012: 143) report that classroom experiments in science classes are more frequent than in other OECD countries. Class size is controlled to allow for experiments as a normal part of science lessons. Lavonen and Juuti describe these experiments as ‘guided or structured inquiry’, but in the process students learn important competencies relevant to PISA, such as identifying scientific issues, explaining scientific phenomena and drawing scientific conclusions. Finnish students report that in most lessons they are given opportunities to explain their ideas and express their opinions about topics, though overall traditional teacher-centred instruction also contributes to high level outcomes.

Lavonen and Juuti (2012) suggest that the reasons for high performance on PISA are in part because of the close match between the PISA test framework and the Finnish curriculum, as well as the time devoted to science (6 lesson hours per week, taught by a teacher with a Master’s degree in the field). Sahlberg (2011) also comments on this, adding that the subject knowledge of teachers is strong. In the case of mathematics, for instance, both mathematics and education departments are closely involved in the preparation of teachers, with 15% of primary teachers specializing in mathematics. In science, university studies are tailored to the needs of the national curriculum. The knowledge background of Finnish teachers is substantial, and it is closely aligned to the demands of the curriculum.

Another issue is the close monitoring of student progress, perhaps made possible by the lower class sizes. For instance, Oates (2010: 12) reports that ‘If a young pupil is absent from school, even for short periods, they gain immediate referral to specialists after they return, to ensure that they master any elements which may be essential to them and which they may have missed through their absence’. Student self-assessment is also noted as a common practice (Schwarz and Mehta 2011).

The Finnish National Board of Education encourages teachers to collaborate with each other in developing strategies for supporting pupils in their educational progress, taking into account pupils’ previous social and peer group relations, academic achievements, special needs, and/or the continuums in learning of different subject matters across the various transitions of schooling (Pyhalto, Pietarinen and Soini 2012). In upper-secondary levels, programs are modularized and there is considerable flexibility in the way students move through the curriculum.
Pyhalto, Pietarinen and Soini (2012: 96) investigate how Finnish comprehensive school teachers perceived their role in curriculum reform, on the assumption that:

to be active professional agents in the reforms, teachers need time to negotiate and construct meaningful and shared conceptions of the reforms' pedagogical implications and maps of how to reach established goals in the context of application ... building understanding and negotiating meaning across levels of the schooling system, teacher groups, pedagogical cultures, and coordinating efforts are essential for reforms to take root.

They found a balance in teachers' reports between autonomy and control (Pyhalto, Pietarinen and Soini 2012: 111): 'Teachers' work is to some extent controlled by governmental and communal level decision making bodies, but at the same time, they are autonomous experts in teaching their classes and subject areas'. Tirri (2012: 60) locates the Finnish approach to teaching in the German didactic tradition, in which knowledge is accepted as interpretive, related to values and application in daily life, and 'based on the idea that any given matter can represent many different meanings, and many different matters can open up any given meaning'. (See p. 16 of this review.) Tirri (p. 65) concludes that 'the core of school pedagogy can be found in the purposeful, holistic, normative and context-dependent nature of teaching'.

The significance of Finnish education for other systems is often questioned, given its small and relatively homogeneous population. To the question of how such a country could offer lessons to others, Adams (2011) offers an interesting response, arguing that the answer to this question 'lies next door':

Norway is also small ... and nearly as homogeneous ... but ... Teachers don't need master’s degrees; ... and in 2006, authorities implemented a national system of standardized testing. The need for talent in the classroom is now so great that the Norwegian government is spending $3.3 million on an ad campaign to attract people to teaching... Moreover, ... classes in Norway are typically too large and equipment too scarce to run science labs... Unsurprisingly, much as in 2000, 2003, and 2006, Norway in 2009 posted mediocre PISA scores, indicating that it is not necessarily size and homogeneity but, rather, policy choices that lead to a country’s educational success.

In their summary of research on international comparisons on mathematics learning, Askew et al. (2010: 45) conclude that both cultural and contextual factors are important in explaining high performing systems. The authors note that mathematics teaching in Pacific Rim countries ground the teaching of mathematical procedures in mathematical principles, whereas in England the two approaches are largely seen as mutually exclusive. Reviews such as these (see also Wang and Lin 2005) are instructive in revealing the precision, nuance and complexity of analysis required for decisions about curriculum and teaching. System level studies, with their tendency for grand generalization, preference for
administrative solutions and concern for policy makers as the preferred audience are much less useful as guides to curriculum practice.

Askew et al. (2010) also observe that while mathematical subject knowledge is important, effective teaching is also influenced by tacit values and expectations, such as beliefs about learners. Further, they conclude that summaries of lesson content and tasks do not reveal how teachers develop these tasks in practice, since what may look like a procedural task can be used to develop understanding, while a potentially open ended problem can be made procedural by the teacher’s directions and interventions. Underlying these observations is the clear message that teachers need considerable insight into the goals and priorities of the mathematics curriculum, as well as reflection on their own practice in relation to them.

**Implications for curriculum planning, development and change**

This section opened with a series of cautions about the extent to which overseas practice offers models which can be simply applied in a different context. This is further complicated here in the considerable differences across the three locations considered. It should be remembered that the present focus is on the curriculum, broadly defined, so that aspects of systems like teacher education or centralized leadership development are not discussed, though the quality of teachers and principals are clearly important. However, beyond this, some patterns do emerge, and are supported in other contexts as well.

Possible lessons from practices of high-performing countries

- clear curriculum documents as a base for collaborative planning.
- collaborative planning down to the level of weekly teaching plans.
- professional self-development through peer observation, demonstration lessons.
- working with other schools on curriculum and teaching improvement, including consortia arrangements.
- provision for cross-disciplinary project work.
- high priority to detecting student learning problems with a flexible and immediate response.
- active learning (including in whole class contexts), as well as diverse learning activities such as science experiments, excursions and student fairs.
- high levels of expectations for all students.
4. Influences on the curriculum

The teacher and the curriculum

The importance of the teacher in curriculum interpretation, implementation and reform is obvious (Elliott 1994). The teacher-led approach to curriculum innovation and development accepted that the curriculum that matters most is the one enacted by teachers and experienced by students. Recent research has highlighted the ways in which teachers' involvement in innovation involves personal, social and emotional responses to change which influence how they deal with it (Zembylas and Barker 2007). However, McCulloch (1998) points out that the early hopes for teacher led curriculum reform underestimated the constraints of their environments.

Research into curriculum change has sometimes seen teachers as something of an obstacle, a doubtful perspective if the research is intended to support teachers' engagement with curriculum change. More useful is research which looks to identify steps which would facilitate teachers dealing with curriculum change. Anderson (2004, p. 109) identifies three 'understandable' reasons for teachers' reluctance to change: a lack of awareness that change is needed; a lack of knowledge, particularly procedural knowledge, concerning how to change; and the belief that changes will not make any difference to them or their students.

Research has sought to understand the processes and influences associated with teachers’ responses to curriculum change. One approach has been labeled the Concerns-Based Adoption Model (Loucks-Horsley 1996). The model claims that people considering and experiencing change evolve in the kinds of questions they ask and how they deal with it. Early questions tend to be self-oriented: ‘What is it? How will it affect me?’ Later questions are more task-oriented: ‘How do I do it? How can I use these materials efficiently? How can I organize myself? Why is it taking so much time?’ Finally, if self and task concerns can be resolved, the individual can focus on impact by asking: ‘Is this change working for students? Is there something that will work even better?’ Working with curriculum change requires an appreciation of this sequence and the ability to respond to it.

A similar set of questions is posed by Ellsworth (2000), including questions about relative advantage (Is it better than what I’ve got now?), compatibility (Does it conflict with my values, practices or needs?), complexity (Is it too difficult to understand or use in authentic settings?), trialability (Can I try it out first, and can I go back to what I was doing if I don’t like it?) and observability (Can I watch someone else using it before I decide whether to adopt?)

Choppin (2011) refers to research on teachers' use of curriculum materials. Some teachers modify materials to their customary practice while others adhere to the materials more closely. Teachers have stable beliefs and practices with
respect to curriculum use, but their strategies may change as they become familiar with materials and can envisage the opportunities the materials provide to meet the teacher’s understanding of curriculum goals.

Teachers’ knowledge and beliefs have also been the subject of study, including beliefs about such things as the nature of subjects, how students learn, what students are capable of learning, and how change relates to their understandings and attitudes about institutional and curricular goals of the school and system in which they work. If teachers’ knowledge and beliefs are incompatible with reform goals, change will be limited. It is also possible for teachers to enter into the rationales and terminology of an innovation without actually changing practice. For instance, Woodbury and Gess-Newsome (2002, p. 771) observe that ‘Teachers’ assimilation of new ideas into the status quo of their practice engenders their reports of making change where none can be observed’. Roehrig, Kruse and Kern (2007) also highlight the importance of teachers’ beliefs about teaching and learning in curriculum implementation.

To the extent that curriculum change is justified and motivated by changes in goals and assumptions or by new research recommending some new direction or approach, there will be a need for professional learning. It is also the case that new research or changes in the policy or social or economic environment present new challenges and demand a continuing professional learning as a normal part of the work of teachers and school leaders. This review has highlighted just some of these new developments.

A review of research into professional learning (PL) (Gilbert 2011b) led to the following broad conclusions about the features, strategies and conditions of successful PL. Successful PL programs will connect to participants’ own felt needs, sometimes through performance management and career development as well as self-evaluation and school improvement. One of the strongest recommendations from research on PL is that it should involve the collective participation of teachers from the same classrooms or schools in professional learning, analysing data on the needs of their own setting. The significance of collegial collaborative learning in Shanghai and Singapore in particular, mentioned elsewhere in this review, are instances of this.

In their review of PL in the UK, McCormick et al. (2008, p. 6) have commented that ‘Enquiry is seen to be important and there is strong evidence of its importance in ensuring changes in practice’. Critical reflection is an important part of this, as is the need to establish clear shared understandings of purpose. Successful PL will include both theory and content and provide information about alternative practices.

Integrating innovations into normal practice is in most cases a long-term process, requiring continuing help in the cycle of resolving problems and dealing with new issues and problems that will inevitably arise. As Penuel et al. (2007, p. 928) point out ‘Professional development that is of longer duration and time span is more likely to contain the kinds of learning opportunities necessary for teachers to integrate new knowledge into practice’. This should include ‘follow-
up and support for further learning—including support from sources external to the school that can provide necessary resources and new perspectives’ (Meiers et al. 2005, p. 16).

Successful PL will be based on the best available evidence about the field which it is promoting, including the input of expert knowledge, but also modelling effective strategies through active learning. It will use a range of strategies, including discussing, coaching, mentoring, observing others/lesson study, networking, collaboration, modelling strategies, creating a learning community, action research, case discussions, critical friends groups, data teams/assessment development, examining student work, portfolios and professional learning communities/study groups. The importance of collaboration in these strategies is obvious.

Collaboration and professional learning have been combined to create the idea of a professional learning community. The concept envisages school as a place where learning occurs for all stakeholders, not just the students. It is an environment where discussion about professional practice is reflected upon, and ideas on how to improve, shared and discussed. On-going collaboration is an important aspect of building a professional learning community. It creates an interactive dynamic between teachers, administrators, parents and members of the local community. Also important in the creation of a professional learning community is improved organisational capacity. Part of this is the need for an organisational structure which promotes teacher leadership, which is viewed as a more sustainable way of keeping teachers engaged with their school environment.

Professional standards for teachers provide comprehensive guidance for teacher professional learning. The National Professional Standards for Teachers developed by the Australian Institute for Teaching and School Leadership describe a range of essential aspects of teacher expertise and are a useful framework for identifying the elements of teacher capacity to be developed.

The demands being placed on schooling to contribute to a wide range of social and economic policy agendas are increasing. More systematic accountability systems are being introduced, and schools and teachers are expected to monitor and implement a host of new programs, strategies, resources and relationships, such as those outlined in this review. These pressures increase expectations of teachers and make professional learning an essential component of successful curriculum change.

**School environment**

In envisaging the ideal learning environment for contemporary schooling, the Partnership for 21st Century Skills (2009: 5) describes ‘an aligned and synergistic system of systems’ that:

- Creates learning practices, human support and physical environments that will support the teaching and learning of 21st century skill outcomes;
• Supports professional learning communities that enable educators to collaborate, share best practices, and integrate 21st century skills into classroom practice;
• Enables students to learn in relevant, real world 21st century contexts (e.g., through project-based or other applied work);
• Allows equitable access to quality learning tools, technologies, and resources;
• Provides 21st century architectural and interior designs for group, team, and individual learning;
• Supports expanded community and international involvement in learning, both face-to-face and online.

This list goes some way to indicating the range of issues to be considered in any discussion of school environments. The present focus will be on those dimensions which relate most directly to curriculum planning and enactment.

Organisational cultures can be viewed in a number of ways (Connolly, James and Beales 2011), but the key issue for schools is to understand how school cultures affect learning. For this reason, the most important aspect of school culture is how students experience it, and the extent to which it encourages or obstructs their engagement. Smyth (2007) analysed interviews with 209 early school leavers and formed a typology of the ‘cultural geography’ of schools, archetypes of the conditions which students described, comprising categories of aggressive, passive or active. Aggressive environments were characterized by fear and resentment and not being treated with respect, hierarchical streamed curricula, authoritarian disciplinary policies, condescending pedagogy and lack of opportunity to express views and feelings. Active environments recognized student voice and agency, accepted difference, connected curriculum to students’ lives and cultures, were trusting, flexible and open to students’ views, negotiated content and assessment and accepted alternative paths to student destinations. The first consideration for the development of school environments must be the degree of actual and perceived support they provide to students.

There is a logic that suggests that schools should be learning environments for all those who inhabit them, hence the recommendations that schools become learning organisations (Stein and Coburn 2008). At one level, a manifestation of this is school self-evaluation, and there is some evidence that this practice is related to the quality of teaching and learning (Looney 2011). Of course, not all forms of self-evaluation will involve school communities in constructive ways, and collaboration is a necessary part of any successful approach (Thompson 2010).

For genuine self-evaluation to occur, there must be a strong sense of trust among participants, and trust has been found more generally to be an important feature of school environments. Of particular interest in this context is research on the role of trust in professional relationships in establishing successful school cultures and collaborative professional learning. A number of studies have shown the importance of trust in school change and improvement (Cosner 2009; Daly 2009; Forsyth 2008; Hoy, Gage and Tarter 2006; Tschannen-Moran 2009).
Bryk and Schneider (2002) studied curriculum improvement in over 400 Chicago elementary schools over a 10-year period. They found a link between the level of trust in a school and student learning, observing that ‘trust fosters a set of organizational conditions, some structural and others social-psychological, that make it more conducive for individuals to initiate and sustain the kinds of activities necessary to affect productivity improvements’ (p. 116).

They found that trust among educators lowers their sense of vulnerability in the face of ‘the new and uncertain tasks associated with reform’. It also facilitates problem solving, and ‘sustains an ethical imperative … to advance the best interests of children,’ and thus ‘constitutes a moral resource for school improvement’ (p. 34). Hoy and Tschannen-Moran, (2003) suggested that when teachers perceived greater levels of trust, they had a greater sense of efficacy. They also found a link between teachers’ trust of principals, colleagues and parents and their willingness to collaborate with them.

Looney (2001: 18) cites research evidence that ‘strong teacher-to-teacher trust, a shared focus on instruction and student learning and experience are associated with higher levels of student achievement’, noting the role of collaboration and trust in developing coherent strategies to address student needs. This is supported by research by Fielding et al. (2005) into factors influencing the transfer of good educational practice. The research identified four elements of practice transfer that were of special significance, all relating to teachers learning with and from each other over periods of time. Most important was that teacher learning is a social process sustained by relationships and trust.

Levin and Fullan (2008: 296) point out the importance of culture as the basis for capacity building within the school, which requires ‘learning in context ... creating cultures where learning in context is endemic’. They endorse Elmore’s observation that:

Culture do not change by mandate; they change by the specific displacement of existing norms, structures, and processes by others; the process of cultural change depends fundamentally on modeling the new values and behavior that you expect to displace the existing ones. (Elmore 2004: 11)

Cultures are unique, and there is no simple set of prescriptions that will work universally (Day et al. 2009). Cultures need to construct solutions and associated practices appropriate to their context, as long as this does not become an excuse to avoid change. Nonetheless, general models are a valuable starting point, and Everard, Morris and Wilson (2004) nominate a process for school change which draws on the traditions of action research. The steps in the process are:

- diagnosis or reconnaissance in which the decision to change is made
- determining the future – deciding what is to happen
- characterising the present
- identifying the gaps between future and present and the work to be done
- managing the transition from present to future
• evaluating and monitoring the change

School cultures do not operate in isolation, but must connect in positive ways with their surrounding contexts. Lonsdale and Anderson (2012: 4) point to consistent research findings that strong school-community engagement can bring a range of benefits to students, teachers, schools and the wider community. ‘For these benefits to occur, school-community partners need to have a shared vision, work in genuinely collaborative ways, and monitor the progress and effectiveness of their partnership activities’. While this is a broader notion than parental involvement, the research on the importance of parental involvement to student achievement makes it a necessarily strong priority (Desforges and Abouchaar 2003). Connections with parents, culture and community are especially important in improving outcomes for Indigenous students (Closing the Gap Clearinghouse 2011).

Running through notions of collaborative cultures, community engagement and professional learning is a common strand of networking, and use of professional and community networks offers considerable potential for improvement. Moolenaar, Sleegers and Daly (2012) describe research in 53 Dutch elementary schools which showed that well-connected teacher networks were associated with strong teacher collective efficacy, which in turn supported student achievement.

**Pedagogy**

A focus on pedagogy has dominated educational research, producing a wealth of studies of varying degrees of quality, breadth and relevance. From a curriculum perspective, this provides a rich insight into the kinds of teaching activities which might be expected to lead to successful learning of intended outcomes. However, much pedagogical research does not give sufficient attention to the particular outcomes which effective teaching is said to develop, and therefore glosses over the contribution to learning of curriculum. In many cases, when comparisons are made of the impact of various intended curricula, only commercially packaged products are considered.

Hattie’s (2009) wide ranging work of meta-analyses of studies of teaching and learning is a case in point here, as very little information is provided about how the outputs of studies (the dependent variables) included in the analysis were measured. Thousands of studies are combined, presumably on the assumption that differences in outcome measures were not relevant to the analysis. However, this is a big assumption. Consequently, such work, while valuable, provides only very general guidance at the level of determining which particular learning activity might effect some particular curriculum goal.

Hattie (2009: 10) defends his work against criticisms that the approach combines ‘apples and oranges’ by saying that his interest is in ‘fruit’, and therefore that generalising across such diverse studies is appropriate. While generalisations about fruit can no doubt be made, trying to grow apples and
For instance, Hattie (2009) concludes that inquiry based teaching has an overall effect size of .31, which does not meet Hattie's desirable level of effect. However, Furtak et al. (2012) analyse a smaller number of meta-analyses of inquiry learning, but distinguish the features on which the inquiry treatments differed from controls. This more fine-grained analysis showed effect sizes ranging from .11 to .75 depending on whether the distinctive aspect of the comparison was on the social, procedural or epistemological aspects of inquiry teaching, or some combination of them. To reduce these to a mean effect would seem to disguise the fact that some approaches to inquiry have been shown to be extremely effective, while others have had little apparent impact.

Studies of pedagogy such as Hattie's are a valuable resource as a general guide for planning teaching (the enacted curriculum), but can only be used in conjunction with a deep understanding (by both teachers and students) of just what the intended curriculum is aiming for, how this can be made manifest in student activities and responses, and what kinds of curriculum and teaching will produce them.

Given the interest in pedagogy in recent times, summaries of successful pedagogy abound. In 2005, the Victorian Department of Education and Training published a summary of key findings on trends in learning and pedagogy, and reported work on deep theoretical knowledge and understanding, discipline knowledge and concept formation, collaborative learning, building learning communities, interdisciplinarity and assessment practices. Similar themes continue to be relevant in research on pedagogy.

The UK National Foundation for Educational Research highlights findings from a range of educational research projects into teaching, summarized in Table 2. Similar items appear in other research summaries such as that by Siraj-Blatchford et al. (2011) on effective teaching of year 5 English and Mathematics in the UK, where strategies which distinguished high performing schools and classes were:

- Efficient organization allowing productive use of time
- Shared objectives made clear to students
- Meaningful homework arising from what students were learning
- Positive teacher-pupil and peer-peer relationships
- Less disruptive behavior
- Collaborative learning
- Personalised teaching with rich and varied learning materials
- Making extra- and cross-curricular links explicit
- Dialogic teaching and learning through instructional conversations, especially in maths
- Assessment for learning with frequent feedback and extensive reflection on learning
• Plenary sessions to provide further discussion on issues in depth and extend concepts

Many of these features appear throughout the literature on teaching, but the list is very broad. As argued earlier, the relative importance of particular approaches is likely to vary with the intended outcome. For instance, the recommendations by Pashler et al. (2007: 1) are aimed to ‘facilitate learning and remembering information, and to enable students to use what they have learned in new situations’. This inclusion of memorizing gives the list of recommended strategies a particular flavour:

1. Space learning over time. *Arrange to review key elements of course content after a delay of several weeks to several months after initial presentation.*

2. Interleave worked example solutions with problem-solving exercises. *Have students alternate between reading already worked solutions and trying to solve problems on their own.*

3. Combine graphics with verbal descriptions. *Combine graphical presentations (e.g., graphs, figures) that illustrate key processes and procedures with verbal descriptions.*


5. Use quizzing to promote learning. *Use quizzing with active retrieval of information at all phases of the learning process to exploit the ability of retrieval directly to facilitate long-lasting memory traces.*
   - 5a. Use pre-questions to introduce a new topic.
   - 5b. Use quizzes to re-expose students to key content.

6. Help students allocate study time efficiently. *Assist students in identifying what material they know well, and what needs further study, by teaching children how to judge what they have learned.*
   - 6a. Teach students how to use delayed judgments of learning to identify content that needs further study.
   - 6b. Use tests and quizzes to identify content that needs to be learned.

7. Ask deep explanatory questions. *Use instructional prompts that encourage students to pose and answer “deep-level” questions on course material. These questions enable students to respond with explanations and supports deep understanding of taught material.*

The increasing emphasis on deep learning has led to greater research interest in teaching which engages students in thoughtful exploration of the reasons behind answers rather than in aiming for the right answers alone. This relates to the work by Dweck (2000) and others who promote a mastery rather than a performance approach to learning. (See the section in this report on Motivation.)

In a review of more than 100 classroom studies, Watkins (2010) makes a similar distinction between learning oriented classrooms and performance oriented classrooms, and summarises the differences as follows:

**In a learning oriented classroom**

**In a performance oriented classroom**
Tasks generate equal participation by all
Talking and working happens in pairs, threes and mixed groups
The class is engaged in generating rules, and there is freedom of ways of working
Praise is informative and credible
The message is that improvement is the focus
Peers seek and give help to each other
Performance in tests is not linked to other factors such as ability or prestige

The tasks are to volunteer responses to the teacher
Whole class lessons dominate.
There is little cooperation and students keep their work private from others
Rules and sanctions are repeated, along with procedures to be followed
Praise is used for behaviour or for neatness
Teachers are only available to answer questions at designated times
There is much talk of tests and their importance, and students enquire if this task is to be graded

In an earlier review, Watkins (2005: 48) investigated the extent to which classrooms were able to develop the characteristics of learning communities, an approach which ‘goes beyond the idea of learning as individual sense-making, toward the view that learning is constructing knowledge with others. In a learning community the goal is to advance the collective knowledge and, in that way, support the growth of individual knowledge’. He found ‘adequate evidence to support the idea that the development of learning communities should be a key feature of twenty-first century schools. The connectedness of outcomes – social, moral, behavioural, intellectual and performance – is a particularly important feature...’ (Watkins 2005: 59).

Within these broad conditions for learning, questions remain about the specific activities which teachers should implement in the daily interactions of the classroom. Hattie’s (2009) research shows strong effects for what has been labeled ‘direct instruction’, a teaching sequence which includes engaging students, modeling what is to be learned, checking for understanding, and guided and independent practice. Hattie is clear that this approach, with its highly interactive focus on guided and independent practice, is a much more active process than didactic teacher-centred approaches, emphasizing as it does the need for students to apply their learning independently:

Students need opportunities for independent practice, and then there need to be opportunities to learn the skill or knowledge implicit in the learning intention in contexts other than those directly taught. (207)

Direct instruction is often held up as being in opposition to or incompatible with more student-centred approaches like problem solving or inquiry learning. However, it is possible to see the direct instruction sequence as a scaffold for the development of inquiry and problem solving. If the goal is for students to be autonomous, self-regulated problem solvers and decision makers, the notion of independent practice in new contexts requires that students engage in inquiry...
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where making decisions and solving problems are the desired outcomes.

Problem solving is seen as a highly desired approach to teaching and learning, but the evidence for its value in terms of student learning has been difficult to demonstrate. A study by Wirkala and Kuhn (2011) into problem-based learning (PBL) illustrates what is needed here. In a rigorously designed study of year 6 classrooms, comparisons were made of students learning the same material under three instructional conditions: lecture/discussion, small-group PBL, and solitary PBL. Assessments of comprehension and application of concepts in a new context 9 weeks after instruction showed superior mastery in both PBL conditions, relative to the lecture condition, and no difference between the two PBL conditions.

Underlying the focus on problem solving is the more general commitment to inquiry teaching as embodying the ideal form of mastery of and approach to knowledge. Morgan et al. (2007: 32) have elaborated an approach to inquiry aimed at expanding students’ cognitive capacities. The approach encapsulates the spirit of the calls for an emphasis on deep learning in schools, in that:

- Inquiry focuses student attention on thinking about their own thinking.
- Inquiry creates an analytical orientation towards their lives – they learn to ask questions, to look for deeper reasons.
- Inquiry helps students learn to teach themselves.
- Inquiry negates reliance on procedural thinking. The messiness of doing research forces students to recognise the limits of methodological purity.
- Inquiry moves students to the realm of knowledge production as it induces them to organise information, to interpret. They become responsible agents who engage in their own interpretations of the world around them.
- Inquiry improves thinking by making it just another aspect of everyday existence. Findings are always tentative and provisional, and being revised and reconsidered, and in the light of new evidence can never be regarded as final.

Deakin Crick (2012: 687) relates inquiry to deep engagement, and sees it as ‘the co-construction of knowledge through disciplined enquiry which involves building on a prior knowledge base, striving for in-depth understanding and expressing findings through elaborated communication’.

Associated with the goal of autonomous learning is the idea of self-regulation (Duckworth et al. 2009), or what is sometimes called independent learning (Meyer et al. 2008), the ability to plan and adapt thoughts, feelings and actions to the attainment of personal goals. Included here are capacities like the ability to set goals for learning, concentrate on teaching, organize ideas and use resources effectively, monitor performance, manage time and hold positive beliefs about one’s capabilities. Duckworth et al. (2009) review research which shows a positive overall relationship between self-regulation and academic achievement, in that students with more adaptive personal skills and learning resources are more likely to succeed academically. Individual elements of self-regulation such
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as attitudes towards learning, attention and persistence are also related to academic achievement. Metacognition is a key element and driver of self-regulation. Importantly, aspects of self-regulation such as attention, persistence, flexibility, motivation and confidence can all be improved as a result of effective teaching and learning practices.

Enacting principles of inquiry and self-regulation engages students in the processes of knowledge creation, and provides a base for lifelong learning. The aim is to empower students to become autonomous learners. Studies such as those by Furtak (2012) mentioned above show that inquiry learning can have strong effects on learning. However, recent research on inquiry goes to some pains to distance itself from the notion that students do not require guidance and structure. For instance, in the case of problem based learning, Wirkala and Kuhn (2011: 1158) observe that 'Far from being “unstructured” ... good PBL instruction requires complex, carefully designed instructional protocols, including well-designed scaffolding during each stage of the process'. Similarly, the Futurelab inquiry model presented by Morgan et al. (2007) moves across a school year from teacher directed structured inquiry to teacher-student agreed supported inquiry to student directed open inquiry.

One obstacle here is that teachers may presume that such work is beyond the capacity of their students. This may be true if students are not introduced to the necessary skills and relationships which make such work possible, or if the move to autonomous learning is not structured in the way recommended. On the other hand, it may simply be that teachers are caught up in the mire of low expectations, which are an important obstacle to be overcome (Masters 2011). Setting high expectations is a basic requirement for successful teaching, and is not limited to the inquiry setting. Tomlinson and Javius (2012) elaborate what this means for teaching. They outline a process of ‘teaching up’, including accepting that each student has something of value to contribute to the group, and the group is diminished without that contribution; developing a growth mind-set rather than being governed by assumptions about the limits to learners’ capacities; creating a base of rigorous learning opportunities for all; and creating flexible classroom routines and procedures that attend to learner needs.

High levels of cognitive operation have been shown to be possible even at the youngest ages and across a range of abilities. Metz (2011) illustrates how first grade students, when pursuing an investigation into a question of their choosing, were able to deal with uncertainty, think about how to improve their study and see that there were multiple causes for phenomena. Metz (2011: 50) concludes that ‘children’s relatively deep familiarity with the domain, experience in assuming increasing responsibility for structuring scientific inquiry, and investment they had in their own investigations contributed to the surprisingly robust epistemic reasoning they revealed in this context’. Zohar and Peled (2008) show that the explicit teaching of ‘metastrategic knowledge’ (naming strategies, discussing when, why and how they should be used, etc.) resulted in substantial gains in student reasoning when compared with a control group, and that the largest gains were for low achieving students.
### Teaching environment
- Calm, well-disciplined, orderly
- Safe/secure
- An ethos of aspiration and achievement for all
- Positive emotional climate
- Purposeful, stimulating
- Bright, attractive and informative displays
- Clean, tidy and well organised
- New or redesigned buildings/spaces
- Lower class sizes

### Teaching approaches
- Interactive (e.g. working and learning together – social constructivism)
- Use of teacher-pupil dialogue, questioning
- Monitoring pupil progress (including the use of feedback)
- Pupil assessment (including AfL)
- Pupil agency and voice (active engagement in their learning)
- Enquiry-based
- Effective planning and organisation
- Scaffolding learning
- Building on the prior experience and learning of pupils (a constructivist theory of learning)
- Personalisation, responding to individual needs
- Home-school learning, knowledge exchange
- Use of new technology/ICT
- Collaborative practice
- Good use of teaching assistants
- Creative use of visits/visiting experts

### Teacher characteristics
- Good subject knowledge
- Self-efficacy/belief
- High expectations
- Motivational
- Provides challenge
- Innovative/proactive
- Calm
- Caring
- Sensitive
- Gives praise
- Uses humour as a tool
- Engenders trust and mutual respect
- Flexible (where appropriate)
- Builds positive relationships with pupils (relationships for learning)
- Self-reflecting

<table>
<thead>
<tr>
<th>Teaching environment</th>
<th>Teaching approaches</th>
<th>Teacher characteristics</th>
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<tbody>
<tr>
<td>Calm, well-disciplined, orderly</td>
<td>Interactive (e.g. working and learning together – social constructivism)</td>
<td>Good subject knowledge</td>
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<tr>
<td>Safe/secure</td>
<td>Use of teacher-pupil dialogue, questioning</td>
<td>Self-efficacy/belief</td>
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<tr>
<td>An ethos of aspiration and achievement for all</td>
<td>Monitoring pupil progress (including the use of feedback)</td>
<td>High expectations</td>
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<td>Positive emotional climate</td>
<td>Pupil assessment (including AfL)</td>
<td>Motivational</td>
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<tr>
<td>Purposeful, stimulating</td>
<td>Pupil agency and voice (active engagement in their learning)</td>
<td>Provides challenge</td>
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<tr>
<td>Bright, attractive and informative displays</td>
<td>Enquiry-based</td>
<td>Innovative/proactive</td>
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<tr>
<td>Clean, tidy and well organised</td>
<td>Effective planning and organisation</td>
<td>Calm</td>
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<tr>
<td>New or redesigned buildings/spaces</td>
<td>Scaffolding learning</td>
<td>Caring</td>
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<tr>
<td>Lower class sizes</td>
<td>Building on the prior experience and learning of pupils (a constructivist theory of learning)</td>
<td>Sensitive</td>
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<td></td>
<td>Personalisation, responding to individual needs</td>
<td>Gives praise</td>
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<td></td>
<td>Home-school learning, knowledge exchange</td>
<td>Uses humour as a tool</td>
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<td>Use of new technology/ICT</td>
<td>Engenders trust and mutual respect</td>
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<td></td>
<td>Collaborative practice</td>
<td>Flexible (where appropriate)</td>
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<td></td>
<td>Good use of teaching assistants</td>
<td>Builds positive relationships with pupils</td>
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<td></td>
<td>Creative use of visits/visiting experts</td>
<td>(relationships for learning)</td>
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<td>Self-reflecting</td>
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Table 2: The key features of effective teaching (Rowe, N., Wilkin, A. and Wilson, R. 2012: 5.)
Metacognition is only one of a number of strategies that attempt to maximize student engagement and learning. Another is the use of self and peer assessment, which is reported to have positive effects on pupil learning, self-esteem and engagement, though it was not necessarily influential in isolation, since self and peer assessment were usually found to occur in classrooms where teachers shared control of the process (Sebba et al. 2008).

Another label sometimes used in this connection is that of personalization, strategies which provide a learning program and approach specifically tailored to the abilities, interests, preferences, and other needs of the individual student (Wolf 2010). Some views of the possibilities for a personalized learning system arise from ideas in industry and technology, such as mass customization, mobile anywhere/everywhere availability, digital interactive media, unbundled learning objects and blended learning (Wolf 2010: 13). A more conventional version sees the essential elements of the concept to be flexible, anytime/everywhere learning; a redefined role for the teacher as facilitator and the use of community mentors; project-based/authentic learning opportunities; student driven learning paths; and a mastery/competency-based progression/pace.

A personalized approach to curriculum provides teachers and students with choices by drawing on different types and sources of information. Access to multi-modal curriculum options ensures that learning can be personalized according to reading levels, social interaction, and other preferences. Modularized content allows for the use of unbundled but aligned learning objects and resources. The use of well-developed learning progressions allows customization and relevance to the student within the framework of learning standards. Personalization also expands curriculum to include learning in the community, cross-curricular opportunities, group or team learning, and problem-based experiences (Wolf 2010).

An interesting comment on the idea of personalized learning comes from the UK Teaching and Learning Research Program (TLRP) (Pollard and James 2004: 6).

In our view, based on our evidence, Personalised Learning is not a matter of tailoring curriculum, teaching and assessment to ‘fit’ the individual, but is a question of developing social practices that enable people to become all that they are capable of becoming.

The view is that if personalized learning becomes synonymous with individualized learning, this will limit the potential for knowledge creation. However, ‘if personalization becomes linked to participation in communities of learning and partnerships between teachers, parents and young people, then we will be building a solid basis for educating young people for the 21st century’ (Pollard and James 2004: 19). The TLRP identified lessons for personalized learning from a number of its research projects. In assessment, suggestions were to give pupils opportunities to decide their own learning objectives; provide guidance on asking questions, giving feedback and using criteria to help pupils
assess their own and one another’s learning; and to give pupils opportunities to assess one another’s work. Other relevant strategies included authentic consultation with students about their learning, and engaging parents with a view to providing learners with opportunities to bring together their learning experiences inside and outside school.

As mentioned earlier in this section, there are difficulties in discussing pedagogy free of the particular context of what is to be learned. However, it is commonly done, and the preceding discussion has not avoided this. Nonetheless, there are no curricula in learning; there are only curricula in learning something, whether it be traditional subjects, integrated studies or cross-curricular skills. The focus on deep learning, problem-solving and autonomous learning has led to research about the nature of subjects, disciplines and interdisciplinary studies as the source of theories and concepts which are the tools of deep learning. To reiterate the statement by Stenhouse (1975: 82), knowledge ‘arises because the structures of knowledge are not mere classification and retrieval systems but constitute a raw material for thinking’.

This is not to suggest that general models of learning are not useful in setting directions, or that there are not skills that are useful across all kinds of problems. However, problems are defined and analysed within discourses of terminology, classification and explanation, and deep understanding requires familiarity with and even immersion in these discourses, as discussed here in the earlier section of that name. This is borne out by Hattie’s (2009: 203) reference to findings of metaanalyses that domain specific activities are the most important influence on student learning, including his own conclusions that ‘surface level study strategies can be learnt across domains, but with deeper strategies the best results are obtained when the strategies are taught directly with the domain’.

Boaler’s interesting observation is relevant here. Boaler (2002: 43) describes research which shows that students who were taught mathematics with conventional textbook learning did less well than those who were engaged in the discussion and use of mathematical ideas. Her interesting observation is that while we might conclude that students in the former method learned less, a better explanation might be that they learned something different, viz. to watch and faithfully reproduce procedures and ... to follow different textbook cues that allowed them to be successful as they worked through their books. Problems occurred because such practices were not useful in situations outside the classroom.

In light of her research, Boaler (2002: 43) ‘moved from thinking about mathematical capability as a function only of knowledge to viewing it as a complex relationship between knowledge and practice’. For the present discussion, Boaler’s suggestion is that to some extent the medium is the message, offering another important perspective on the significance of pedagogy.
Assessment and data

Assessment has become an increasing focus of educational debate, policy and research, to a point probably unparalleled in educational history. This is largely because the accountability movement has promoted the use of assessment, not just as a guide to learning and teaching, but as a measure of the quality of the education system itself. This has given rise to the now common distinction between assessment of learning and assessment for learning, where the latter approach focuses on the important contribution that assessment can make to the learning process. This is the focus of the present discussion.

In general terms, the purposes of assessment could be seen to comprise three main types (Black 1998): support of learning; certification, progress and transfer; and accountability. In specific terms, variations on these basic types lead to a number of more detailed distinctions. For instance, Newton (2007) identifies 18 different purposes of assessment evident in educational practice, including:

- formative assessment used to identify student learning needs;
- monitoring of individual student learning against desired outcomes, perhaps linked to performance targets;
- identifying students’ status when transferring to a new school or class;
- placement of students in teaching groups or programs;
- diagnosing learning difficulties;
- guiding educational and employment decisions;
- certification and awarding qualifications;
- selection for further education or jobs;
- students’ or parents’ choice of school;
- monitoring school or system standards;
- identifying needs for the allocation of resources;
- evaluating programs;
- establishing comparability of standards.

The importance of this list lies in the fact that each of the purposes has particular implications for the kind of assessment best fit for purpose. For instance, Newton (2007: 163) states that formative assessment requires ‘frequent, fine-grained analyses of attainment in small sub-domains … to guide interventions’; assessment for guidance requires comparability of standards across subjects to identify student strengths; assessment for selection assumes that there is reliability across the full range of abilities; and assessment for certification must have high reliability around the cut-off score which determines the award.

The potential for assessment to improve student learning is well demonstrated. For instance, the United Kingdom Assessment Reform Group (2002: 4) showed in a review of research that considerable achievement gains can be made through the use of assessment practices whose main aim is to improve learning, rather than, for instance, to grade, select or stream students, or the many other uses to which assessment can be put. This places priority on formative
assessments, whose features have been identified by Looney (2010: 4) as:

- Integral to classroom culture
- Oriented toward clear learning goals
- Incremental and interactive
- Providing feedback that is timely and specific
- Focused on the process of learning as much as the outcome
- Using varied methods to deepen learning and meet diverse student needs

The approach to assessment is referred to as assessment for learning, and comprises the following ‘deceptively simple’ practices (Assessment Reform Group 2002):

- Providing effective feedback to pupils;
- Actively involving pupils in their own learning;
- Adjusting teaching to take account of the results of assessment;
- Recognising the influence of assessment on the motivation and self-esteem of pupils, both of which crucially affect learning;
- Enabling pupils to assess themselves and understand how to improve.

The UK EPPI-Centre review of research (Higgins, Baumfield and Hall 2007) detailed some of the ways in which assessment practices enhance learning. Assessment assists in clarifying desired outcomes and consequently the learning processes needed to achieve success in a particular context. Formative assessment tasks can be designed to scaffold awareness of learning processes and their importance for success. This provides a frame for teacher feedback during the task, but also acts as a means for this to become gradually internalised and self-regulated by students.

Research of this kind has been the basis for the UK Assessment Reform Group’s (Assessment Reform Group 2002) list of principles of assessment for learning:

- Planning for teaching should provide opportunities for both learner and teacher to identify and use information about progress towards learning goals.
- Learners need to understand the goals they are pursuing and the criteria that will be applied in assessing their work.
- Assessment should help learners to become as aware of the process of their learning as they are of what is to be learned.
- Assessment processes are an essential part of everyday classroom practice and involve both teachers and learners in reflection, dialogue and decision-making. Tasks and questions routinely prompt learners to demonstrate their knowledge, understanding and skills, and judgements are made about how learning can be improved.
- Assessment should take account of the importance of learner motivation. Any assessment has an emotional impact, as comments, marks and grades can influence learners’ confidence and enthusiasm. Assessment feedback is more productive of both learning and motivation when it is as
constructive as possible, focuses on the work rather than the person, and emphasises progress and achievement rather than failure. Comparison with others who have been more successful is unlikely to motivate learners.

- Assessment should promote commitment to learning goals and a shared understanding of the grounds on which they are assessed.
- Assessment should develop students’ capacity for self-assessment so that they can become reflective, self-managing and autonomous learners. Standards statements provide valuable tools with which students can gauge their own progress and identify the next steps in their learning.

If assessment was once extraneous to teaching, the assessment for learning approach places it at the heart of the teaching and learning process, so that assessment becomes an integral part of classroom activity. While Bennett (2011: 5) has criticised the work on assessment for learning for the wide range of strategies that go under its name, and the lack of rigorous research on which its claimed effects are based, he does acknowledge the general support for the approach, recommending that ‘new development should focus on conceptualising well-specified approaches built around process and methodology rooted within specific content domains’. A contrary view to this measurement emphasis is that assessment for learning should not be dominated by measurement questions, as its main contribution is as an integral part of the learning process (Heritage 2010).

Newton’s list of purposes of assessment illustrates the range of stakeholders with an interest in the forms and outcomes of assessment practices. It is worth noting that the students are often the least powerful of these stakeholders, and yet the entire project of teaching and assessment is claimed to be in their interests. Consequently, the effects of assessment on students need to be given important attention.

For instance, Miller and Lavin (2007) studied the effects of introducing to the primary school classroom assessment practices typical of the formative approach to assessment. Their study found significant positive effects on students’ self-worth, self-competence and overall self-esteem. Improvements in self-esteem were shown for both boys and girls, though boys’ self-esteem improved more than that of girls. Self-esteem rose significantly for both lower and higher ability groups, and rose especially for students who had previously been identified by teachers as lacking confidence.

The principal feature of assessment for learning is the emphasis on formative assessment and feedback. Hattie and Timperley (2007: 102) review a range of studies that show the power of feedback as a contributor to learning, concluding that ‘feedback is among the most critical influences on student learning’, though they point out that there are important factors associated with the nature of the feedback which determine its effects. These include the timing of the feedback and the appropriate use of positive and negative feedback.
Four aspects or levels of the feedback process are identified, with important implications for practice at each level. Feedback should address the task, the process for completing the task, and the strategies or metacognitive processes for going beyond the task. The fourth aspect, the focus on the self, is often interpreted to mean praise, but the authors claim that praise alone is seldom effective if it does not address the learning process itself. The implication is that the teacher-student relationship needs to focus on learning. An important point is that feedback is not just for students, but also provides important information for the teacher on the success of the teaching strategies used.

In a series of research reviews conducted at the Evidence for Policy and Practice Information and Co-ordinating Centre (EPPI-Centre) at the University of London (Harlen and Deakin Crick, 2002; Harlen, 2004), a number of conclusions about the effects of assessment on students were identified.

One issue addressed was the effect of testing on student learning, given the trend in recent times for increased resort to external testing in many countries. The EPPI-Center reviews conclude that after the introduction of the National Curriculum tests in England, low-achieving pupils had lower self-esteem than higher-achieving students, whereas before the tests, there had been no correlation between self-esteem and achievement. The importance of this lies in the fact that low self-esteem reduces the chance of future effort and success.

It was also found that a strong emphasis on testing produces students with a strong extrinsic orientation towards grades and social status, i.e. a motivation towards performance rather than learning goals. Students dislike high-stakes tests, showing high levels of test anxiety, and are aware that the tests give only a narrow view of what they can do.

The reviews also looked at research on the main alternative to external testing, the use of teacher assessments for summative purposes. In contrast to the external testing environment, the reviews found that interest and effort are increased in classrooms which encourage self-regulated learning by providing students with an element of choice, control over challenge and opportunities to work collaboratively. The review found that, in internal summative assessment, non-judgemental feedback motivates students for further effort, but that using grades as rewards and punishments is harmful to learning. This links to the aspects of feedback analysed by Hattie and Timperley (2007) mentioned above.

Differences also exist in the effects of different forms of assessment within the classroom. A study by Brookhart and Durkin (2003) compared students' responses to classroom assessments in the form of performance assessments, such as group projects and presentations, with responses to tests and quizzes. They found that:

- Performance assessments were associated with higher student self-efficacy than that associated with tests. Performance assessments were associated with a positive relationship between mastery and performance goal orientations, thus potentially tapping several sources of motivation at once.
In interviews about group performance assessments, students talked about wanting to help others or to learn from others. Group performance assessments may be more able to elicit the social aspects of motivation (Brookhart and Durkin 2003: 52).

The benefits of teacher-led assessment are not automatic, however. The EPPI-Centre reviews found that students need help, in the form of detailed descriptions and examples, to understand assessment criteria and what is expected of them. Also, the impact of this form of assessment depends on how high the stakes are in the use of the results, and on the teachers’ interpretation of their role, either in improving learning or maximising marks.

Teachers vary in the way they respond to the role of assessor and in the approach they take to interpreting external assessment criteria. Strict adherence to the criteria leads them to be less concerned with students as individuals. The EPPI-Centre reviews found that, in assessment for internal purposes, the introduction of assessment techniques that require students to think more deeply leads to changes in teaching that extend the range of students' learning experiences. New assessment practices are likely to have a positive impact on teaching if teachers find that they help them to learn more about their students and to develop their understanding of curriculum goals.

However, even with internal assessment, high-stakes use can result in teachers reducing assessment to routine tasks, restricting students' opportunities for learning from them. Internal assessment is effective only if criteria are clear for both teachers and students. Without this, there is little positive impact on teaching and a potential negative impact on students. Teachers need opportunities to share and develop their understanding of assessment procedures by collaborating with colleagues both within and across schools. They also need time to experience and develop some ownership of practices to enhance their positive impact.

There are dangers in making assessment a tool for individual accountability. Leithwood (2002) argues that the dominant forms of accountability measurement encourage a superficial performance approach to learning at the expense of an intrinsic or mastery orientation to the construction of personal meaning. When the purpose of assessment becomes closely aligned with accountability, the stakes become higher and pressure is often placed on teachers to deliver curriculum which is solely test-focused (Black 1998). This pressure and resulting lack of curriculum creativity limits the productive nature of what is happening inside the classroom for students by narrowing the focus of what is being taught.

Other studies have focused on teachers' views of their professional role in the context of these reforms. Olsen and Sexton (2008: 15) report that Californian teachers believed that neither the broader education policy nor their school district respected their professional practice, with the result that they were 'dissatisfied by the depersonalization and decreased trust'. The teachers spoke about how the macro-policy climate of standardization, conformity, and
high-stakes testing—all threat rigidity effects—ignored the teachers’ training, talent, artistry, and skill as educators’. Leithwood (2002) reports almost identical concerns in a study of Ontario teachers, who also ‘expressed disbelief that the government’s accountability initiatives were motivated by educational concerns’. Rather teachers saw them to be motivated by political interests or the desire for more consistency across schools and greater teacher accountability.

Accountability is an important requirement of any professional practice, but the form it takes must obviously be compatible with the goals of the practice itself. In the case of education, there is clear evidence that this is not always the case.

The literature reveals a number of factors which help create an assessment culture driven toward improving student learning. Central to fostering assessment for learning is teacher input through professional dialogue (Priestley and Sime 2005). Teachers play an integral role in creating a culture within the classroom which supports and nurtures student development in a positive and constructive manner. It is, therefore, imperative to include teachers in decisions about assessment and how it can be implemented constructively.

A coherent assessment system cannot be developed in isolation. Consideration of curriculum and pedagogy along with assessment must also occur (Hayward, 2007). Problem-based learning is an excellent example of the opportunities for integrating teaching and assessment, and is often seen as a more “authentic” way in which to structure curriculum in schools, and hence assessment tasks (Barron et al. 1998). The challenge for teachers is to create an environment which allows students multiple ways of finding an answer. The need for students to focus on problem solving strategies helps to make explicit the processes of learning, and students’ self-monitoring on the basis of identified criteria and standards makes assessment an integral part of the process.

The recent emphasis on assessment for accountability has led to greater attention to test results such as PISA and, in Australia, the National Assessment of Progress in Literacy and Numeracy (NAPLAN). Australian education systems have produced useful information in the interpretation of data produced by these tests to promote what has come to be called data driven decision-making (DDDM) (Victorian Curriculum and Assessment Authority 2008). However, there is a danger here that NAPLAN data will overwhelm the consideration of other data in the planning of teaching. A number of negative consequences can flow from this.

First, an overemphasis on large-scale external testing can constrain teaching and curriculum (Au 2007; Berliner 2011: Binkley et al. 2012), and have negative effects on students’ approach to learning (Harlen and Deakin Crick, 2002; Harlen, 2004) with little or no evidence of overall benefits for achievement (National Research Council 2011). Further, the nature and extent of error on large-scale tests are often ignored and may not be well understood by those interpreting them (Wu 2010).

The emphasis on tests and league tables can disguise the fact that, as Matters
(2006: 31) points out: ‘The crucial evidence of what students know and can do, and of how well they know it and can do it, is the (non-trivial) work that students produce in the classroom or under examination/assessment conditions’. Matters (2006) presents a list of data sources proposed by Earl which would offer useful information for analysis in any attempt to maximize student learning, including student demographics, student achievement, teaching and assessment practices, parent opinions and behaviours, school culture, staff demographics, school programs, resources and materials and physical plant. In the student achievement category, data sources include standardized, norm-referenced and criterion-referenced tests, questioning in class, performance based assessments, teacher made tests and projects, teacher observation and student work. This is an extensive range, much of which is readily available and even part of normal classroom practice.

The key issue is to what extent data is seen by users as providing answers to questions that will improve practice. Shephard et al. (2011) found that analysis of test results produced heightened attention and intensification of effort among teachers, usually resulting in the reteaching in whole class sessions of work poorly done on tests. However, Shephard et al. (2011: 35) note that, consistent with other research (U.S. Department of Education 2009; Bulkey 2010), interim assessment data did not provide teachers with insights about what to do next other than reteach:

Disappointingly, however, interim assessments do not provide teachers with information about students’ thinking or diagnostic insights about their understanding that would suggest a particular way to intervene. Thus, the efficiencies appear to be largely managerial, rather than substantive. In responding to standard and item-level information, instructional improvements are often limited to student placement into leveled classes or ability groups rather than substantive feedback and attention to student misconceptions.

This rather restricted response from teachers raises the need to see assessment as an opportunity to reflect on the entire process of planning curriculum and teaching, rather than simply providing evidence of a deficiency in students which requires reteaching in the hope that students will learn the material from a second run through.

In this connection, it is important to emphasise the role of assessment in curriculum planning, as distinct from diagnosis of individual student learning. Much of the literature on diagnostic and formative assessment takes the curriculum (the objectives, concepts, content and skills to learned in any unit) as a given, so formative assessment and diagnosis are applied to student learning of this given specification. However, assessment should be used to examine the effectiveness of the curriculum.

One strategy is to increase the focus on initial assessment before teaching takes place. This should be seen, not just as a pretest of intended learnings, but as an opportunity to discover what students already know about the topic, concepts
and skills to be addressed, including any misconceptions they might have, as well as how the work might relate to their interests and what they can bring to the topic (The Quality Improvement Agency 2008). This provides the opportunity to make adjustments to programs to match students’ needs before rather than after the event.

Griffin (2012) advocates a developmental approach to assessment which links assessment more closely to curriculum decisions. He describes a process in which student performance on assessment items can be mapped onto a continuum of levels of achievement, similar to Rasch analysis. This serves as a means of tracking student progress, but also as a way of checking the extent to which the curriculum is sequenced in a way that facilitates student learning: ‘The developmental progression is therefore an organizing framework for communication, reporting and scaffolded intervention purposes’ (Griffin 2012: 10).

In addition to its role in informing curriculum decisions at the program level, data can also inform teaching, and much attention has been given to how teachers can use data for this purpose. This needs to operate as a system across the range of planning done in the school. For example, Halverson, Grigg, Prichett, and Thomas (2007: 163) describe data-driven instructional systems in which six elements—data acquisition, data reflection, program alignment, instructional design, formative feedback, and test preparation—work together to ‘link the results of summative testing to formative information’.

A U.S. Department of Education study (2009: 37) identified four stages in teachers’ engagement in data informed decision making:

- **Question posing**, in which teachers identify important questions about learning which can be derived from given data.
- **Data comprehension**, where data is manipulated or combined to focus on particular aspects of the evidence or questions.
- **Data interpretation**, where data is analysed for patterns, distributions and change.
- **Data use**, where results of the interpretation are mapped to the curriculum and strategies for differentiating the curriculum.

It is important that assessment and the use of data are not seen as information of value only to teachers. For instance, the U.K. Department for Education and Skills (2005:32) identified a series of practices which should guide the use of assessment data, and included student peer and self assessment in the process:

**Peer and self assessment**

- During lessons pupils are encouraged to reflect on what they have learned and what they need to do to improve.
- Pupils are trained how to assess each other’s work and provide fair and helpful feedback.
- There are planned opportunities for pupils to assess their own work and each other’s work.
During lessons pupils are encouraged to discuss what strategies they might use to learn what they need to.
Pupils take increasing responsibility for assessing their own progress and can relate this to their personal targets.

Curricular target setting
- Teachers have a good understanding of progression in their subject.
- Subject leaders review summative assessment information to help identify curricular targets.
- Progression towards curricular targets is at the forefront of teachers’ lesson planning.
- Teachers use an appropriate range of data to baseline pupil performance, set targets and judge progress.
- Pupils are aware of their medium and longer-term personal targets and help set, and assess their progress towards them.

Finally, the value of assessment in planning curriculum does not lie only at the end of a teaching and assessment sequence. The process of constructing assessment programs and items can be even more powerful in clarifying the goals and demands of curriculum and teaching. Wyatt-Smith and Gunn (2009: 92) report research into the impact on learning and teaching of a process of teacher collaborative planning and development of assessment:

Fundamental and productive changes in learning and teaching practice resulted from critical reflection on the assessment evidence to be collected, with this reflection occurring before teaching began. Professional conversations focusing on assessment as evidence-based practice occurred at the stage of task design, with teachers interrogating the quality and demands of the assessment they were developing relative to the standards they planned to use in judging quality. Through such a focus on assessment expectations and quality task design prior to commencing the unit of work, the teachers reported that they developed a language for talking about quality in the classroom and gained confidence in the feedback they gave the students.

Technology

ICT is recognized as an essential element of education, both as curriculum goal and teaching resource and strategy, and has become a key part of government education policy worldwide (Bakia et al. 2011). This development arises from and is integral to the increasing influence of technology in social and economic development and everyday life. The potential for education in this is enormous, to the point where education has been seen as a defining element of the 'learning society'.

The forms of learning envisaged as part of this concept have the potential to change schooling fundamentally, if not make the conventional notion of it obsolete. Cisco corporation (2010) describes the implications of the learning society as:
• Engendering a culture of learning throughout life.
• Taking learning to the learner, seeing learning as an activity, not a place.
• Believing that learning is for all, that no one should be excluded.
• Recognizing that people learn differently, and working to meet those needs.
• Cultivating new learning providers, including public, private, and NGOs.
• Developing new relationships and networks between learners, providers (new and old), funders, and innovators.
• Providing the increasingly virtual infrastructure learners need to succeed.
• Supporting systems of continuous innovation and feedback to develop knowledge of what works in which circumstances.

Developments in the use of technology in education are changing rapidly. Johnson, Adams and Haywood (2011) predict that new technologies will inevitably become part of mainstream education. Their predicted schedule was that cloud computing and mobile devices would be first to enter mainstream use, followed by game-based learning and open content within 2-3 years and learning analytics and personalized learning environments within 4-5 years.

An interesting feature of these developments is the role of commercial technology companies in promoting ICT in education. A number of reports cited in this review are funded and/or published by technology companies. The recent announcement by News Corp of its Amplify program, which aims to develop assessment through mobile tools, curriculum design and online distribution of resources to tablet computers, is just one of the corporate initiatives in the area. In the words of former New York City education chancellor and CEO of Amplify, Joel Klein 'The strategy of Amplify is to fundamentally change the way we think about delivering education in the K-12 space' (Ferenstein 2012).

Wolf (2010) describes these developments and their prospects for personalized learning, including digital content accessible anywhere, anytime, online learning platforms and instructional software. They can be organized, indexed, searched and accessed according to each student’s needs. Interactive multimedia resources can engage students, and support individualized pacing, reading levels, and opportunities for review or extension depending on a student's needs. Learning algorithms can track progress, identify skill gaps, and suggest learning resources. Web 2.0 methods assist students to collaborate with peers and create their own content (McElvaney and Berge 2009).

Dreambox Learning (2012) reports a survey of US District administrators who were asked to rate the potential benefits of technology in learning. The list in order of greatest potential was that technology:

1. Provides a way to differentiate instruction with larger class size.
2. Engages students in self-directed independent learning.
3. Provides teachers with real time reporting on student comprehension of concepts.
4. Provides administrators with real time reporting on student progress against standards.
5. Increases the effectiveness of teachers through the use of technology.

Looney (2010) describes research on the use of a range of technologies with promise for teaching:

- Polling tools or learner response systems allow on-the-spot surveys, which can link to the teacher's computer.
- Automated feedback, including software developed from extensive research into common patterns of student response.
- Blending instruction and assessment in interactive media to follow the process of students' reasoning, including simulations.
- Online graphic organisers such as concept mapping software and other diagrammatic representation of information and concepts.
- Social networking tools, including weblogs, wikis, discussion forums, online chat groups which enable students to work collaboratively on projects, sharing and structuring information (See Strategic ICT Advisory Service 2011).
- Data bases which track student progress over time, or ‘learning analytics’ (Johnson, Adams and Haywood 2011).

Exploiting this potential has given rise to a very wide range of examples of learning innovation through technology (Staker 2011). There is particular interest in the use of technology for the development of 21st Century skills and thinking skills (Wegerif 2006) and innovation (Moyle 2010).

Software has also been developed to assist curriculum planning, though much of it is still rather rudimentary. There are computer based systems comprising templates for scope and sequence charts, lesson and unit plans, constructing rubrics and recording assessment results. One obvious value of these systems is that they operate as archives of the curriculum work of the school across classes and grades, and are a first step in establishing alignment. Templates are usually relatively passive recording devices based on conventional categories for storing objectives, knowledge, skills, teaching strategies, resources and assessment.

Sophisticated systems are interactive, with built-in assistance for curriculum planning. They can also be constructed around innovative ways of constructing curriculum, and provide for collaborative teamwork in developing programs. Systems such as Rubicon Atlas provide for collaborative writing and mapping of curriculum, and can produce reports extracting elements from across units and year levels to examine curriculum alignment and emphases (http://www.rubicon.com/AtlasCurriculumMapping.php). The Victorian Department of Education and Early Childhood Development Ultranet provides similar functions, among a range of others (http://www.education.vic.gov.au/about/directions/ultranet/benefits/teachers.htm). The Collaborative Curriculum Design Tool developed by the Harvard Graduate School of Education uses an innovative set of elements drawn from a research-based theory of curriculum design (http://learnweb.harvard.edu/alps/ftu/design_online.cfm).

In all of this, from the curriculum perspective, the challenge, as elsewhere, is to
use the technology to promote higher order questions which produce thoughtful responses and deep learning rather than superficial use focusing on information.

Research has shown benefits in student learning outcomes for ICT. A British study on the impact of technology found that it triggered new ways of orchestrating and monitoring class activities, as well as adding rich resources to exposition and constructing solutions (Crook et al. 2010). Tamim et al. (2011) report a meta-analysis which shows positive effects of the use of technology in teaching, including greater effects for its use to support cognition than for direct computer aided instruction. Roschelle et al. (2010) showed strong improvement in aspects of mathematics learning through the integration of an interactive representational technology, paper curriculum and teacher professional development.

There is considerable potential in the use of technology in assessment. Wolf (2010) notes the opportunity to include more personalized and dynamic options such as embedded or formative assessments, especially with online or portfolio options. Looney (2010) refers to technology’s potential for formative assessment in enabling more frequent feedback, creating immersive learning environments, which highlight problem-solving processes and make student thinking visible, and by providing opportunities for independent and collaborative learning. Kimber and Wyatt-Smith (2010) suggest the need for new assessment frameworks which reflect the nature and processes of knowledge of online knowledge use.

The use of ICT for recording and analyzing assessment data is becoming widespread, though the former practice is more common than the latter. Typical of the development of commercial resources of this kind is ActivProgress, which is described as ‘an integrated, web-based data management and social learning solution that combines real-time assessment and reporting to enable data-driven decisions and personalized instruction in the classroom’ (http://www.prometheanworld.com/en-gb/education/products/curriculum-and-assessment-management/activprogress).

Csapo et al. (2012) note that technology can improve the processes of assessment in facilitating the development and delivery of tests, the presentation of audio-visual stimuli, the scoring of responses and the distribution of results. It can also change the nature of what is tested, by providing opportunities for interactive assessment which respond to students actions, such as in assessing student problem solving strategies through interactive simulations. The skills and resources for developing and using these more innovative applications of technology in assessment may limit their potential for use at the school level, but this likely to be an area of increasing development.

It is important to consider here the readiness of students to engage in this brave new world of digital possibility. The popular view is that students today are ‘digital natives’ who find immersion in the online and interactive computer world comfortable and familiar. This is not universally the case (Warschauer and Matuchniak 2010) and practices like online searching need to be taught to
develop the necessary critical skills (Gasser et al. 2012). Koutropoulos (2011) warns of the disservice we do if we neglect the differences in access and competence among students. Australian students have very high levels of digital reading literacy as measured on PISA (Thomson and De Bortoli 2012). However there is still considerable variation with SES and location in the usual directions. Home computer use showed similar variation. Also of interest is the fact that Australian students showed a less positive attitude to computers than the OECD average, though they were very confident about doing computer tasks. Females had less positive attitudes to computers than males, and students from the most disadvantaged backgrounds reported the least positive attitudes to computers.

The online world is not a ready made solution to improving student learning. It is a resource to be used in an informed and discriminating way. As Gasser et al. (2012: 7) note, the fact that students are skilled users in some respects does not necessarily transfer to the kinds of skill which schools seek to promote.

Though content creation and dissemination practices from the personal and social contexts are significant for the academic context because they relate to information quality issues, the practices and norms that youth form around their content creation activities in the personal/social context may frequently clash with classroom norms and expectations. This complicates hopes of straightforward “skill transfer,” but leaves open the possibility that engagement with the entire culture of content creation and dissemination can bring skills into the classroom context in a way that a decontextualized approach to and understanding of youth skills may fail to do.

Implications for curriculum planning, development and change

The range of considerations here is large and diverse, but there is mutually supporting relationship among recommended developments in teaching, school environment and culture and pedagogy and assessment, many of which will be supported by creative use of technology. Some key implications are:

**The teacher and the curriculum**
- Planning for change needs to address the concerns identified in research which influence teachers’ response to innovations.
- Change strategies should recognize that teachers’ practice is closely linked to their beliefs, and provide for the integration of both.
- Collaborative professional learning is an essential element of change and continuing improvement, with teacher input into the content and process of learning.
- Professional learning should use a variety of strategies and be an ongoing process over the long term.
- Professional standards for teachers provide a framework for identifying the range of aspects of teacher capacity to be developed.

**School Environment**
- Implement models for creating the school environment as a learning
organization and a professional learning community.

- Ensure that student wellbeing is a priority in all decisions and procedures.
- Consider strategies and protocols for engendering trust among members of the school community.
- Develop and implement a model for planning change, such as that proposed by Everard, Morris and Wilson (2004).
- Develop programs for community engagement, especially parental engagement.
- Encourage and support networking, especially online professional exchanges and interactions beyond the school.

**Pedagogy**

- Review pedagogical practice using recommendations from the literature (e.g. Siraj-Blatchford 2011 or Watkins 2010) as frameworks for self and peer evaluation.
- Establish a balance between individual and community contexts for learning and between direct instruction and inquiry approaches.
- Incorporate a structured developmental approach to inquiry learning and problem solving as a priority throughout the curriculum.
- Promote student self-regulation as part of learning skills development.
- Ensure staff pedagogical beliefs and practices and school organization guarantee high expectations for all students.
- Assess curriculum and teaching for the extent of personalization of learning provided, and implement strategies to extend it, such as the use of technology, modularized content and diverse resources.

**Assessment**

- Develop fine-grained formative assessments to match planned progressions in depth and breadth of learning.
- Engage teachers in the collaborative development of assessment tasks with a focus on clarifying intended learning outcomes.
- Implement Assessment for Learning strategies informed by the UK Assessment Reform Group (2002) and similar work.
- Develop teacher expertise in and commitment to productive feedback.
- Ensure frequent opportunities for performance assessment.
- Develop collegial systems of accountability which do not distract from deep learning outcomes and creativity.
- Develop systems and expertise to integrate a wide range of data to inform decision-making.

**Technology**

- Continuously monitor and evaluate ICT products and facilities for ways to enhance curriculum, teaching, student engagement and teacher professional development.
- Evaluate and implement technologies such as those identified by Looney (2010)
- Monitor and take steps to remedy skill deficits and unequal access to technology among students.
6. Focus on the learner

Gorard, See and Davies’ (2012) recent review of the relationships between aspirations, attitudes and behaviours, and attainment and participation in school is critical of much of the research in this area for its lack of convincing evidence. In particular, the authors claim that few studies in the area have taken into account prior attainment, background or ability, and that when they do, the importance of the particular aspiration, attitude or behaviour becomes difficult to identify. A key issue here is the sequence and direction of the effect. For instance, does high self-concept lead to success at school, or does success at school cause high self-concept, or are both self-concept and success the result of some other influence like socio-economic status or prior learning? Consequently, Gorard, See and Allen (2012: 49) state that there is ‘some limited but somewhat disputed evidence of an association between self-concept and attainment’. Similar issues arise, for instance, in evidence that participation in extracurricular activities correlate with academic achievement (Finn and Zimmer 2012), but it is very difficult to show the nature of any causal relationship here.

Gorard, See and Allen (2012) set the benchmark very high for what they regard as adequate evidence. The problem here is that to ignore so many studies, such as correlational designs, reduces the amount of available and relevant research to a very large degree. While it must be acknowledged that research in this area often struggles to achieve very clear definitions and measures of its constructs other than pencil and paper test instruments, and to establish direct and unequivocal evidence of effects, contributors to the collection edited by Christenson, Reschly and Wilie (2012), for instance, cite numerous studies of correlations and effects of factors like motivation and engagement and associated concepts. In the following discussion, a similarly broad net is cast on what is regarded as relevant evidence, but the criticisms of Gorard, See and Allen (2012) should be borne in mind.

Motivation

Boekaerts (2010) notes that motivation has been widely acknowledged as important in learning, but seldom integrated into learning theories. This ignores the important role motivation plays in how students give meaning to tasks and situations. This is not to say that the findings of motivational research are simple or easy to apply. The range of theories of motivation is in itself a challenge (Martin and Dowson 2009). Boekaerts notes that motivation has been unpacked into a number of elements: self-efficacy (beliefs in one’s ability to do something), outcome expectations (beliefs about whether actions will lead to success or failure), goal orientation (beliefs about the purpose of a learning activity), value judgements (about how interesting activities are), and attributions (perceptions of the causes of success or failure).

Sullivan (2011) summarises recent approaches to research on motivation, distinguishing the different responses to learning of students who exhibit a mastery orientation to learning, where students seek useful knowledge that they
can apply to tasks, and a performance orientation, where students give priority to making the correct response. A consequence is that the former are more willing to persist with learning and look to broaden their understanding, and more likely to believe that they can master tasks if they make sufficient effort, whereas the latter prefer familiar tasks and are threatened by challenging tasks.

These processes come together in the way students appraise tasks, and relate them to their sense of self. The importance of this is summarized by Boekaerts (2010: 95):

Appraisals – task-specific motivational beliefs – play a central role in self-regulation. One of their key functions is to assign meaning and purpose to the learning activity: how relevant, boring or interesting it is; what outcome is expected; why one needs to do it; whether one feels effective or not; what causes success and failure. An equally important function is to direct activities in the self-regulation system, either towards expanding personal resources (extending knowledge, or improving learning strategy or competence) or to set bounds on well-being (e.g. feeling safe, secure, satisfied). Motivational beliefs thus influence willingness to engage in learning activities, even without students being aware of them.

Research has shown a clear relationship between mastery goals and higher levels of cognitive engagement and deeper processing (Sinatra and Mason 2008). While the nature and source of these relationships are complex and not well understood, Sinatra and Mason’s (2008: 582) summary gives cause for promoting mastery goals for learning:

Goals impact the types of strategies students employ during learning (for example, the use of either shallow and superficial or deep and metacognitive strategies). Cognitive factors such as the depth and breadth of students’ content knowledge and the degree to which domain-specific study strategies can be automatically activated and employed, determine the degree to which students can successfully execute their intended learning strategies. Goals may prove to be the linchpin to unlocking this nuanced interaction between levels of awareness, knowledge, and the intentional reconstruction of knowledge.

Drawing on a broad range of research into motivation, Boekaerts (2010: 96) presents the implications of these analyses as a series of key principles which underpin motivational beliefs. Students are more motivated to engage in learning:

- when they feel competent to do what is expected of them. If they feel unprepared or incompetent, they are unlikely to commit to a task.
- when they perceive stable links between specific actions and achievement. Students need to be aware of explicit strategies for completing a task, so that they can link their performance or lack of it to the strategy rather than to some vague notion of their ‘ability’.
- when they value the subject and have a clear sense of purpose.
Emphasising tests and exams as reasons to commit to tasks is to engender a performance orientation, whereas a mastery orientation is best developed by linking learning to students’ interests and personal goals.

- When they experience positive emotions towards learning activities. It is important that students have positive experiences of learning, including the sense that they have achieved learning on their own merit.
- And are more persistent in learning when they can manage their resources and deal with obstacles efficiently. When students formulate specific plans to carry out their intentions, this facilitates both the detection of obstacles and the ability to address them. Teaching and modeling work habits is valuable in this context.
- When they perceive the environment as favourable for learning. Different situations provide different levels of structural, motivational, social and emotional support. To complicate matters, students have different preferences about the nature and kind of support they find valuable. Encouraging students’ strengths and providing diverse, flexible and open-ended tasks in non-threatening situations is more likely to lead to student engagement.

On the other hand,

- Students direct their attention away from learning when they experience negative emotions, such as performance anxiety, shame, boredom, hopelessness. Some students who are used to negative experiences may not be comforted even by some positive experience, as they may focus more on the relief in not being wrong, or explain success away as being a result of luck. Teachers are advised to avoid personal criticism or making comparative judgements about students’ intelligence or social characteristics. Rather, they should emphasise that mistakes are inherent to learning and can contribute to it, and encourage students to assess their own performance.

An important strand running through a number of these points is that of relationships among participants in learning. Martin and Dowson (2009: 328) point out that ‘Ongoing interactions teach individuals about themselves and about what is needed to fit in with a particular group. Accordingly, individuals develop beliefs, orientations, and values that are consistent with their relational environment’. Implications of this perspective are proposed at student, teacher or class, and school levels.

At the student level, recommended approaches focused on optimistic expectations to invoke self-efficacy, mastery goals, and a cooperative climate. Teacher expectations are a major influence here. More general social influences are also relevant, illustrated by the recent research showing the effects of stereotype threat on student motivation and performance (Walton and Spencer 2009). Stereotype threat can be challenged by strategies of affirmation and encouraging students to see themselves as agents with diverse interests and connections to multiple identities (Walton, Paunesku and Dweck 2012). Other recommended strategies for promoting motivation are extracurricular activities to develop social skills and capital, cooperative learning and mentoring. Martin
and Dowson (2009) emphasise the particular importance of relationships for Indigenous students. The school level is where a sense of community can be developed to promote young people's sense of self and efficacy.

At the teacher and classroom level, there is a correlation between student connection to learning and aspects of teacher-student relationships such as student sense of acceptance and support and the belief that teachers are caring and support student autonomy. In contrast, teachers who are more controlling or not perceived as having warmth evoke less mastery motivation and confidence. Martin and Dowson (2009) label the preferred teacher-student relationship as 'connected instruction'. This concept has an important curriculum element described as 'substantive connectedness', which is the relationship between students and subject matter, where important strategies are to set appropriately challenging tasks, assign work that can be seen to be varied, important and meaningful, using material that arouses curiosity and is interesting to young people.

Dweck (2000) has advised that teachers should assist students to develop mastery goals by encouraging them to accept challenge and effort rather than be threatened by them, and to identify how they might apply their efforts to completing tasks. They should also be persuaded to recognize that people's abilities are not fixed but can be extended, since studies have shown that such beliefs affect learning outcomes, and that student can be taught such beliefs with positive effects on learning (Blackwell, Trzesniewski and Dweck 2007; Walton, Paunesku and Dweck 2012). In terms of student interest, Boekaerts (2010: 101) asserts that personal interest develops from stimulated situational interest being sustained over time, with the educational context allowing an elaborate understanding of the course content to develop.

**Student engagement**

Motivation can be viewed as an underlying psychological process influencing the level of involvement or connection between person and activity, known as engagement (Ainley 2012). While the emphasis here is on those aspects of engagement related to school practice and the curriculum in particular, it is important to recognize that engagement is influenced by a range of non-school factors, including peer relationships, aspirations and future plans, family context and life events, and that there are also protective factors which reduce any negative effects of these influences (Callanan et al. 2009).

As measured by an index of disciplinary climate combining PISA items on such things as disorderly classes, student distractions and loss of time on task, Australian schools are placed close to the OECD average. High performing Asian countries score well on these measures, though interestingly Finland does not. However, comparisons like these do not necessarily indicate the absolute extent of engagement among students. Pianta, Hamre and Allen (2012) relate a range of US research documenting a lack of engagement among students, and a clear decline in engagement as students move through the years of schooling. (It is interesting to note that on the PISA measures, disciplinary climate in the US is
better than in Australia (Thomson et al. 2010: 257))

Gettinger and Walter (2012) cite research findings that academic engaged time in learning is a strong predictor of student achievement, and that this is influenced by students’ motivation. They further note that student willingness to invest time in learning and their actual involvement or participation in learning is related to the instructional context. Unfortunately, they also report US research that the level of on-task behavior may be as low as 45%.

Pianta, Hamre and Allen (2012: 365) define engagement as a relational process which:

reflects students’ cognitive, emotional, behavioral, and motivational states and capacities but is conditioned in part on interpersonal relationships as activators and organizers of these states and capacities in the service of some larger developmental task or aim.

As a result of the significance of engagement, research has sought to identify strategies which might increase it. Gettinger and Walter (2012) identify three types of strategies for maximizing engaged time. Managerial strategies relate to monitoring student behavior and minimizing off-task behavior, where consistent routines and smaller classes and learning groups are seen to be helpful. Instructional strategies include focusing on explicit learning objectives, using multiple teaching methods, ensuring that students understand directions, and facilitating active student responding and providing frequent feedback. For student-mediated strategies, teachers help students use metacognitive and study strategies, incorporate self-monitoring and self-management skills, and set their own goals.

Pianta, Hamre and Allen (2012) also suggest strategies to promote engagement on three fronts: relational support, competence supports and relevance. Relational supports have been shown to be effective when teachers form personal connections with students and spend nondirective time with them. Students express a desire for a sense of being cared about. Pianta, Hamre and Allen (2012: 370) report that ‘youths’ sense of social connection within settings predicts outcomes ranging from higher achievement scores to greater student engagement and more positive academic attitudes’. Autonomy/competence supports are those targeted at producing ‘a developmentally calibrated sense of control, autonomy, choice, and mastery’. For adolescents, this often means that teachers need to see the desire for self-expression and autonomy not as negatives to be controlled, but as energies to harnessed to learning. In contrast, some play-based philosophies in the early years lack a scaffold that might produce significant learning.

Relevance refers to connections with real life experience and can contribute in important ways to engagement. Pianta, Hamre and Allen (2012: 371) cite research evidence for their conclusion that:

involving students in significant, real-world, voluntary community service
and then discussing it within the classroom in an ongoing way has been found to reduce disruptive behavior by 50% in randomly controlled trials, with similar effects upon other outcomes in youths’ lives as well.

Relevance is very difficult to achieve if teaching is focused on a narrow and closed approach to knowledge where knowing the right answer takes priority over thinking and reasoning ... ‘findings from studies of large and diverse samples of middle schools demonstrate quite clearly that competitive, standards-driven instruction in decontextualized skills and knowledge contributes directly to this sense of alienation and disengagement’ (Pianta, Hamre and Allen 2012: 367).

These strategies need to operate within a positive emotional climate, since ‘children and youth are most motivated to learn when adults support their need to feel competent, positively related to others, and autonomous’ (Pianta, Hamre and Allen 2012: 372). Important here is teacher sensitivity, or responsiveness to student cues, as well as encouraging students to offer their views on how best to learn: ‘there is ample support that adolescents also thrive when given some degree of control and choice over their learning’ (p. 374). Achieving this kind of classroom climate involves particular approaches to behaviour management and teaching. Students need opportunities to express existing skills and scaffold more complex ones and to develop metacognitive skills. Teaching needs to focus on concept development, giving feedback and engaging students in rich conversations about their learning.

Similarly, Finn and Zimmer (2012) cite research which highlights the importance of teacher warmth and supportiveness, belief in student capabilities and willingness to assist students in their learning. They also endorse instructional approaches such as student-student interaction, provision for students to express their views and authentic instruction as contributing to engagement. At the school level, safe environments are important, and school size is a factor, though small school dynamics can be constructed within large schools. Nichols and Dawson (2012: 457) conclude that ‘summative testing systems tend to connect with traditional motivation processes such as goals and efficacy-related beliefs, whereas formative systems tend to connect with engagement-related processes such as self-regulated learning and self-determination’.

Davis and McPartland (2012: 515) identify dimensions of student motivation and engagement with implications for practice in high schools, including claims that students:

- respond to rewards like good grades and teacher praise when high schools provide extra help for needy students to narrow skill gaps or recognize individual progress.
- benefit through increased intrinsic interest in school programs when learning activities challenge their minds and creativity.
- find more relevance in their studies when high schools integrate academic and career education.
- enjoy a more positive interpersonal learning environment when high
schools use smaller learning communities with teacher teams and advisors.
- exercise their own personal nonacademic talents when schools provide more diverse electives and extracurricular activities.
- feel more connected to shared communal norms when high schools practice fair disciplinary procedures and provide for some shared decision-making.

Self-regulation is an aspect of learning which has been linked to engagement and offers useful strategies for developing a self-reflective mastery orientation to learning through metacognitive strategies. Wolters and Taylor (2012) describe elements of self-regulation in a series of phases related to the learning process:

- forethought and planning, where students activate prior knowledge, set goals, assess the importance, usefulness or interest of a task, identify available resources and respond with confidence or otherwise;
- monitoring, comprising students' efforts to keep on track, monitor progress, evaluate strategies, seek help and respond to progressive feedback;
- control or management, using and managing resources, varying strategies, applying critical thinking and metacognition;
- reflection, including reviewing strategies, self-evaluation and responding to feedback on the task as a whole

While Wolters and Taylor (2012) were proposing this sequence as a theoretical model, there is a clear potential here for teachers to structure explicit classroom discussion of these steps as strategies for learning which could contribute to students' autonomy as learners.

Student Voice

Encouraging student voice can be seen as an attempt to engage students as well as to personalize learning. School teachers and administrators are exhorted to listen to student voice in order to engage students in a learning partnership in which learners can identify and constructively work with the aims and methods of schooling. In addition, according to sources cited in the Futurelab report (Rudd, Colligan and Naik 2006), teachers who listen to student voice can expect to understand learners' aspirations and concerns, and develop more meaningful partnerships that will help with learner development and teachers' provision of successful learning experiences. The Futurelab report and that by Bragg (2010) illustrate a range of approaches and strategies for gathering and listening to student voice, including the potential of new technologies and social media in the process.

Arnot and Reay (2007) caution about a naïve assumption that students are in a position to give voice to their concerns unconstrained by the discourses and power relations of the school, or that they necessarily understand the rules of these relations and discourses. One consequence is that some students will be better equipped than others to have their voices heard, which may actually
create divisions among students (Bragg 2007). The following caution is worth noting (Bragg 2010: 31):

It is disingenuous to see children as finding, discovering, or being given a voice, as if we can simply access their authentic core being. What they say depends on what they are asked, how they are asked it, ‘who’ they are invited to speak as in responding; and then, in turn, on the values and assumptions of the researcher or audience interpreting their ‘voices’.

However, armed with this understanding, there is much that schools can do to engage students by giving voice to their understanding of their needs and aspirations.

Even a quite limited notion of student voice can be effective. In studying the effect of providing choice of homework tasks to students, Patall, Cooper and Wynn (2010) randomly assigned students in one instructional unit either to receive a choice of homework options or to be assigned an option for all homework. Conditions were reversed for a second unit. When students received a choice of homework they reported higher intrinsic motivation to do homework, felt more competent regarding the homework, and performed better on the unit test. In addition, a trend suggested that having choices enhanced homework completion rates.

Most research has defined student voice more broadly. Pekrul and Levin (2007) suggest that the engagement of student voice is particularly important in school reform, including curriculum change, since it allows student buy-in to changes, provides unique perspectives on change and opens up avenues for constructivist approaches to learning. They describe the Manitoba School Improvement Program (MSIP) and the various roles of students who were engaged in the process. Schools were asked to involve students in planning, to collect data from students as part of their internal needs assessment, and to consider ways to promote student engagement in change. MSIP and its network of schools together created a Student Voice curriculum to give effect to these strategies. Students were given training on the nature and practice of student voice, and participated in school district policy development and advisory committees. Students also acted as researchers on educational issues, presenting findings to other students, staff and parent and community organisations. The Students at the Centre program developed learning modules to promote student understanding of learning styles, emotional and multiple intelligences and action research. Student responses to these various strategies were positive, and Pekrul and Levin (2007) describe a range of beneficial outcomes for schools.

Similarly, Rudduck (2007) describes a series of projects engaging student voice and states that interviews with students and teachers found that students felt more included in the school’s purposes, and felt positive about themselves as a result of being involved and seeing the difference that their comments and actions had made. In addition, teachers commented that they had a more open perception of young people’s capabilities and saw them differently, with a renewed energy and practical agenda for improvement and confidence that
more partnership-oriented relationships with students were possible.

Thomson and Gunter (2006) describe a process in which students were involved in evaluating a curriculum innovation. Consulting with the students informed their other data collection, which included observation, student focus groups and teacher interviews. An internal research team including students read and commented on survey data, voted on the key issue to be addressed and discussed methods to be used.

Mitra and Serriere (2012) report a two-year case study of fifth grade girls who participated in a series of democratic pedagogies and forums, including curriculum related service learning, cross age student advising groups, student run assemblies and student participation in schoolwide decision-making on school rules. The authors relate these experiences in terms of their meaning for student agency, belonging and competence. They also observe the opportunity provided to engage students in a discourse of diverse ideas working toward a common goal, and develop civic efficacy. Mitra and Serriere (2012) also point to the contexts and conditions of the program that support positive youth development, such as scaffolding youth learning, establishing inquiry as the framework for teaching and learning, and establishing a clear vision of the school as a place that fosters student voice. This example of a school harnessing the potential for student voice well illustrates the range of contexts and relationships involved, from classroom to school to community.

The rationale for this form of student involvement goes beyond the goal of active engagement with learning tasks (Bragg 2010). It relates to personalized learning more generally, as well as recognition of student rights, and the development of skills of cooperation central to a democratic society. From this perspective, student voice can be seen to range over a spectrum from expression, consultation, participation, partnership, activism and leadership (Toshalis and Nakkula 2012).

Fielding and Bragg (2003) report a project in which teachers in an English school selected 18 year 8 students to address problems of engagement in that year. Three groups of students and staff attended a training day off-campus and then met weekly, each working on a different topic, such as notions of the good lesson, good teacher and grouping practices. The student researchers devised questionnaires, interviewed teachers and students, observed lessons and presented regular reports to the headteacher and a presentation at a year assembly. Teachers reported that they had underestimated students, who they acknowledged were ‘an underused resource’, and became more receptive to student input into curriculum planning. The year co-ordinator observed a positive impact, particularly on the learning of Year 8 boys.

**Implications for curriculum planning, development and change**

**Motivation**

- Identify and implement strategies which promote mastery rather than performance goals in teaching.
• Consider implications of research in motivation for curriculum and teaching (e.g. Boekaerts 2010)
• Take steps to promote student confidence and combat potential stereotype threat.

Engagement
• Use managerial, instructional and student-centred strategies to maximize student engagement (Gettinger and Walter 2012).
• Identify ways of recognizing and responding to students’ needs for relational and competence support and relevance (Pianta, Hamre and Allen 2012).
• Provide choice of challenging activities in curriculum, teaching and extracurricular activities and a fair disciplinary environment.
• Design programs to develop students’ capacity for self-regulation.

Student voice
• Create avenues for student input into curriculum, teaching and assessment.
• Use ICT and social media to provide opportunities for students to give voice to their interests, needs and concerns.
6. Conclusion

The range of issues addressed in this review illustrates the magnitude and complexity of the tasks facing schools and teachers. The range and diversity of relevant research is equally daunting. However, if schools are to achieve the high expectations the community places on them, the task of addressing and responding to the implications of the research is unavoidable.

One consequence is the need for resources, especially time, but also material resources of staff and technology, so that concerted and systematic effort can be made to integrate the range of implications identified here. It is important that governments and school systems appreciate that the greatest resourcing need is at the school level, where the range of policies and strategies discussed here combine in the real work of teachers.

The implications derived from the various sections of this review are attempts to highlight what needs to be done. The list is long, and the demands are great.

Fortunately, there is some synergy among the recommendations across the range of areas reviewed. Successful school environments and cultures, the intended outcomes of deep learning and C21 skills, productive approaches to teaching and assessment, and the most fruitful relationships with students are compatible in many important respects. They all suggest a need for trust and responsibility to promote the development of autonomous but collaborative practices and relationships among teachers, students and the community. They require reflective critique and self-evaluation for schools, teachers and students to monitor learning and progress, aimed at deep and rigorous learning with high expectations for all. They imply a welcoming of new ideas and practices, and an outward looking approach to schools’ relationships with each other and with their community. The results of curriculum change will depend on the extent to which these overarching qualities can be progressed.
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Curriculum Planning in a Context of Change: A Literature Review


## 8. Glossary of Terms

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<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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<tbody>
<tr>
<td>Assessment</td>
<td>A process of gathering, interpreting and using information about learning.</td>
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<tr>
<td>Authentic assessment</td>
<td>Assessment tasks which assess student ability to solve problems and perform tasks in simulated or actual “real life” contexts and/or conditions.</td>
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<tr>
<td>Autonomous learning</td>
<td>Occurs when the student is able and motivated to think critically and independently, and to plan and manage his or her learning.</td>
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<tr>
<td>Cooperative learning</td>
<td>An approach to organizing classroom activities in which members of teams contribute to a learning task in different ways to reach the common learning goal, and assist each other to learn in the process.</td>
</tr>
<tr>
<td>Curriculum</td>
<td>A process in which knowledge is translated into regulations, goals, achievement standards and outcomes, textbooks and teaching aids, and enacted in the practice of teaching and learning in classrooms and schools.</td>
</tr>
<tr>
<td>Curriculum alignment</td>
<td>The degree to which programs, teaching, assessment and resources reflect and reinforce the curriculum objectives and standards.</td>
</tr>
<tr>
<td>Deep learning</td>
<td>An approach to learning which gives priority to understanding which can be applied to new, unfamiliar contexts. A key aspect is the explicit use of powerful concepts which organize and structure ideas and explanations in knowledge domains.</td>
</tr>
<tr>
<td>Didaktik</td>
<td>A theory and approach to curriculum and teaching originating in the German educational traditional. It emphasizes the values base and cultural origins of education, and the need to connect teaching to the child’s growing moral and intellectual autonomy and experience in the world.</td>
</tr>
<tr>
<td>Distributed leadership</td>
<td>An approach to leadership based on the view that all members of an organization have particular expertise which qualifies them to provide leadership for others in the area of that expertise.</td>
</tr>
<tr>
<td>Engagement</td>
<td>Engagement has a quantitative dimension in the degree of effort students are willing to apply to a task, and a qualitative dimension in the quality of the approach to learning they use, such as self-regulation and strategic use of cognitive and metacognitive processes.</td>
</tr>
<tr>
<td>Formative assessment</td>
<td>Assessment used to evaluate students’ skills, knowledge and understanding in order to adjust teaching to improve student achievement.</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
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<tr>
<td>Initial assessment</td>
<td>Assessment of students' skills, knowledge and understanding at the beginning of or in preparation for a unit of learning so that curriculum and teaching can be developed with knowledge of students' current abilities.</td>
</tr>
<tr>
<td>Inquiry learning</td>
<td>An approach to teaching which engages students in researching the answers to questions, usually through some explicit sequence of steps. Students are encouraged to generate questions, gather information and propose answers with varying degrees of teacher scaffolding and assistance.</td>
</tr>
<tr>
<td>Learning analytics</td>
<td>Learning analytics or data mining is the collection, analysis and interpretation of data about learners and their contexts, in order to understand and optimise learning and the environments in which it occurs.</td>
</tr>
<tr>
<td>Learning demand</td>
<td>The gap or distance between the skill or cognitive demands of a particular learning task and the learner's current level of skill or understanding.</td>
</tr>
<tr>
<td>Mastery orientation to learning</td>
<td>A mastery orientation to learning is driven by the desire to acquire competence and understanding to master the learning task. The main motivator is the satisfaction of having achieved, which usually leads to greater perseverance. See also performance orientation.</td>
</tr>
<tr>
<td>Metacognition</td>
<td>The process of conscious and active monitoring, evaluation and control of the cognitive processes and strategies used in learning, inquiry or problem solving. Its essence lies in making thinking processes explicit so that thinking and problem solving strategies can be evaluated, revised and improved.</td>
</tr>
<tr>
<td>Motivation</td>
<td>The state of being interested or wishing to engage in some learning task. Intrinsic motivation is defined as engaging in an activity for its inherent satisfactions rather than for some consequence separate from the activity itself. Extrinsic motivation applies when an activity is done in order to attain some separable outcome, either because of some self-chosen incentive or because of unchosen demands from others.</td>
</tr>
<tr>
<td>Pedagogy</td>
<td>The study and practice of teaching.</td>
</tr>
<tr>
<td>Performance assessment</td>
<td>Assessment activities that allow learners to demonstrate learning by creating a product or performance for a given audience outside an examination context.</td>
</tr>
<tr>
<td>Performance orientation to learning</td>
<td>A performance orientation to learning is driven by a student's wish to achieve highly on external indicators of success, such as exam results. This may lead to anxiety which can distract from learning, and the competitive motive may not sustain engagement if superior results are not achieved.</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
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<tr>
<td>Personalised learning</td>
<td>The tailoring of teaching and learning environments to meet the needs and aspirations of individual learners, increasingly seen to involve the use of technology in the process.</td>
</tr>
<tr>
<td>Problem solving</td>
<td>Problem solving is both an ability and an approach to teaching. It refers to students’ capacity to use higher order thinking to provide answers and solutions to questions which are complex and unfamiliar to them, rather than recall or routine application to known contexts or questions. It has been formalized as an approach to teaching in problem based learning, where concepts and skills are learned through engaging with problems in the contexts in which the concepts and skills are used.</td>
</tr>
<tr>
<td>Scaffolding</td>
<td>Scaffolding is the process whereby teachers support student learning by providing templates, guides, coaching, modeling and skill development required for completing a learning task or program. The aim is to assist students to master tasks independently.</td>
</tr>
<tr>
<td>Self-regulated learning</td>
<td>Self-regulated learning occurs when learners take control of and evaluate their learning and behavior through metacognition, planning, monitoring and evaluating progress and managing time and resources.</td>
</tr>
<tr>
<td>Stereotype threat</td>
<td>Stereotype threat is the feeling of anxiety or concern experienced by a person in a situation where they feel they are expected to conform to a negative stereotype about their social group. If negative stereotypes are present regarding a specific group, members of the group are likely to become anxious about their performance which may hinder their ability to perform at their maximum level. For instance, in situations where cultural minorities sense that the teachers have low expectations of their performance, the resulting anxiety becomes a factor leading to the expectation being confirmed.</td>
</tr>
<tr>
<td>Summative assessment</td>
<td>Assessment conducted at the end of a lesson, unit or program of study to measure achievement of a completed process of learning. Contrasted with formative assessment, though summative assessment may have some formative role in the teaching of subsequent lessons, units and programs.</td>
</tr>
<tr>
<td>Twenty-first century skills</td>
<td>Skills identified as particularly important for informed and successful engagement with the global knowledge economy and information society. Various formulations have been proposed, but all give weight to digital literacies, critical and creative thinking and problem solving, and communication, collaboration and social and personal skills.</td>
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</tbody>
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