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# Standards for Graduation and Initial Teacher Certification: the International Experience

Lawrence C Ingvarson, *ACER*



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**STANDARDS FOR GRADUATION  
AND INITIAL TEACHER  
CERTIFICATION: THE  
INTERNATIONAL EXPERIENCE**

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**Lawrence Ingvarson**

**Australian Council for Educational Research**

**October 2012**

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## PROMOTING TEACHER QUALITY

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International interest in policies that promote teacher quality has increased markedly in recent years (OECD, 2005). With mounting evidence that the most important in school influence on student achievement, is teachers' knowledge and skill (e.g., Hattie, 2008; Hanushek, 2004) policymakers have been giving closer attention to strategies that will recruit, prepare and retain the best possible teachers. These strategies call for clear and valid descriptions of what good teachers know and do, which teaching standards aim to provide.

When it comes to the quality of opportunities for students to learn in schools, the research is clear; nothing is as fundamental as the professional knowledge, judgment and skills of their teachers. Several studies, such as that by McKinsey & Company (Barber and Mourshed, 2007: 13), show that the world's best performing school systems, such as Finland, Singapore and South Korea, give priority to policies, strategies and institutions for recruiting, preparing and recognising quality teachers.

A country's teaching profession and its schools constitute an infrastructure just as important to long term economic viability as more obvious types of infrastructure, such as energy production and transport. This infrastructure has to be nurtured constantly and replenished over the long term. There are no short cuts to building a high quality school system. Countries such as Finland, South Korea, Singapore and Taiwan, which consistently rank highly on international tests of student achievement, have steadily pursued policies to improve the quality of their teachers since the Second World War. Others have neglected what was a major asset and allowed the status and quality of teachers to decline.

Internationally, curriculum goals for students make it clear that the expertise required of teachers is increasing. National curricula are increasingly ambitious about what teachers are expected to achieve. The old model of teaching, as something almost anyone can do well, will no longer do. Recent OECD reports (OECD, 2010; 2011) point out that the best way to compete in the global economy is to provide all citizens with the quality of education formerly provided only to the elite. This will not happen unless a country has strong arrangements in place to lift the quality of its teachers.

Policies to promote teacher quality need to operate at several stages from recruitment to retention of good teachers. A recent IEA study, the *Teacher Education and Development Study in Mathematics* (TEDS-M) (Ingvarson, et al. 2013; Tatto, et al. 2012), shows the importance of coordination among policies designed to assure teacher quality. The TEDS-M study gathered data on quality assurance arrangements in seventeen countries at the following four stages:

1. *Recruitment and selection*: The focus here was on policies and agencies a country has to monitor and assure the quality of *entrants* to teacher education. In particular, policies with respect to:
  - Enrolment in teacher education
  - Making teaching an attractive career option, and
  - Subject matter requirements for admission to teacher education.

2. *Accreditation of teacher education institutions*: The focus here was on policies and agencies to monitor and assure the quality of teacher education institutions and their *programs*.
3. *Entry to the teaching profession*: The focus here was on policies and agencies to ensure that *graduates* are competent and qualified before gaining certification and full entry to the profession.
4. *Advanced certification*: The focus here is on policies and systems to define standards for high quality teaching and to provide incentives for most teachers to attain those standards.

These are the four main mechanisms by which countries seek to ensure the quality of future teachers. Together they form a coherent set of policies for promoting teacher quality.

The IEA TEDS-M study found a significant relationship between the rigour of quality assurance arrangements and the quality of graduates from teacher education programs, as measured by the tests of mathematical knowledge and mathematical content knowledge used in TEDS-M (Ingvarson, et al., 2013). Countries with strong quality assurance arrangements, such as Chinese Taipei and Singapore, scored highest on these measures. Countries with weaker arrangements, such as Georgia and Chile, tended to score lower on measures of mathematical knowledge and mathematical content knowledge.

The TEDS-M study shows, for example, that countries, such as Chinese Taipei and Singapore, that do well on international tests of student achievement (e.g. TIMSS; Mullis, et al., 2007) not only ensure the quality of entrants to teacher education. They have strong systems for reviewing, assessing and accrediting teacher education providers. They also have strong mechanisms for ensuring that graduates meet high standards of performance before gaining certification and full entry to the profession, and finally they provide relatively attractive salaries, working conditions and career paths that reward evidence of reaching high teaching standards.

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## ACCREDITATION AND ENTRY TO THE TEACHING PROFESSION

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The focus of this paper is on the second and third stages; that is, on policies and practices for assuring the quality of teacher education programs and of teachers who graduate from those programs *before* they gain full entry to the profession. Standards for new teachers, such as the Chilean *Estándares Orientadores Para Egresados De Carreras De Pedagogía En Educación Básica*, obviously have an important role to play here. Entry to the profession is arguably one of the most critical decision points in assuring teacher quality. Once a teacher gains official entry, he or she may teach for thirty years or more, affecting the development of hundreds of students. In some school systems, it may be difficult to remove incompetent teachers without protracted legal proceedings.

Various terms, such as *certification*, *registration* or *licensing*, are used to refer to an endorsement that a person has attained the standards necessary to gain full entry to a profession. Depending on the country, a government agency, a statutory authority, or an independent professional body, may be responsible for providing this endorsement. The

certification body is often the same agency that is responsible for accreditation of professional preparation programs (e.g. the General Teaching Council for Scotland).

In the past, gaining a university teaching *qualification* was often seen as a sufficient basis for gaining *certification* from a professional standards agency and eligibility to be employed in schools as a teacher. It was assumed that graduation from a teacher education program was, in itself, a guarantee that a teacher was competent to practice. This practice is declining. Increasingly, countries are introducing methods for determining whether graduates from teacher education programs should gain certification and full entry to the profession.

To assure the quality of new teachers, many countries such as England, The Oman, Philippines, Spain and most states in the USA, are requiring graduates to take an external test (e.g. tests of literacy and numeracy skills and professional knowledge) and/or some kind of competitive examination, in addition to gaining a university qualification. The responsible body is usually a state or a national government body.

A further trend in countries with strong quality assurance arrangements is to require graduate teachers to successfully complete an induction or probationary period in schools before gaining certification and full entry to the profession. This provides opportunities to support their development and assess their performance in a variety of ways to ensure they have attained the designated standards of practice.

Australia, Chinese Taipei, Germany and some states in the USA are examples of countries where certification and/or entry to the profession depends not only on passing further tests of professional knowledge, but also formal assessments of performance during a probationary period. These countries have agencies separate from universities that require formal assessments of classroom performance, in addition to examinations, before new teachers can gain certification and full entry to the profession (as in Australia and the USA) or a position in a school, or access to the civil service (as in Germany).

Graduates from teacher education programs in *Chinese Taipei*, for example, face a rigorous set of quality assurance procedures before they can finally gain a tenured teaching position. After completing their teacher education program with a passing grade, graduates have to take the Ministry of Education's Teacher Qualification Assessment (TQA). The TQA is a common national test held once every year. It takes place two months after the students have finished the Education Practicum, which is at the end of March. The Ministry of Education's Teacher Qualification Verifying Committee and an administrative work institution appointed by MOE develop the TQA.

If graduates pass the TQA, the Ministry issues them with a teaching credential and they are officially qualified to teach in the field. However, if they apply for a teaching position in a particular region, qualified teachers must then undergo a "screening" process administered by the school district in two stages. The first consists of written tests to assess an applicant's education professional knowledge and subject matter knowledge. Only a few applicants usually pass the first round. Graduates who make the second round are assessed through a demonstration of their teaching and personal interview, evaluated usually by two sets of three to five judges respectively (mainly school teachers and a principal; occasionally, university faculty.)

These emerging systems for assuring the rigour of the initial certification process obviously depend on the development of valid standards describing what beginning teachers should know and be able to do. The discussion will now turn to an examination of the meaning of teaching standards and a review of international approaches to their development.

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## THE MEANING OF TEACHING STANDARDS

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The connotations of the word *standard* are rich and various, and redolent with intimations of security, permanence and quality. This probably helps to account for its perennial popularity with education commentators. For some, standards look back to times of confidence and certainty. Standards have been falling reportedly since classical times. Standards are, by this definition, always slightly out of date. For others, standards aim to inspire by describing a vision of what could be. Their future-oriented standards are based on capturing the essence of the best that is emerging from current practice and research about good teaching practices.

Dictionaries give two inter-related uses of the term “standard”: in the original usage, a standard was a banner, or flag, around which soldiers would rally on a battlefield. In more recent usage, standards refer variously to norms or requirements, or the legal magnitude of a unit of measurement or indicators of levels of professional excellence. This paper will be using the latter meaning.

As rallying points, standards aim to articulate core educational values that teachers seek to make manifest in their practice. Developers of professional standards will be guided by conceptions of learning and development; what they believe it means, for example, to educate a mind, to learn with understanding, and to think independently of the teacher. Standards, by definition, are statements about what is valued.

As measures, standards will not only describe what teachers need to know and be able to do to put these values into practice; they will describe how attainment of that knowledge will be assessed, and what counts as meeting the standard. *A standard, in the latter sense, is the level of performance on the criterion being assessed that is considered satisfactory in terms of the purpose of the evaluation.*

Absolute standards need to be distinguished from relative standards. An absolute standard is a cutting score or designated level of performance that is set without reference to the distribution of individuals in the intended assessment population for which the standard will be used. For example, setting an essay score requirement of 10 on a 12-point scale, or requiring a pole vault of five metres are absolute standards.

A relative standard is a cutting score or designated level of performance that is set with reference to how other individuals perform on an assessment and without reference to an absolute performance level. For example, scoring in the highest quartile on a writing test, or being among the top ten discus throwers in a group of 100 individuals are relative, not absolute standards.

In principle, teaching standards for registration or advanced certification should be absolute standards. For example, assessing a teacher on the standard, ‘The teacher is able to orchestrate

discourse among students about scientific ideas’ , would require the development of a scoring rubric; that is, a set of descriptors, rules, guidelines, or benchmarks for scoring different levels of performance.

In practice, teaching standards, where they have been developed at all, are more often relative standards, determined by teacher supply and demand factors, or the limited number of promoted positions available.

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## DESCRIBING VERSUS SETTING STANDARDS

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The task of *describing* standards needs to be distinguished from that of *setting* standards. Describing standards is an attempt to articulate the professional knowledge and skill that is valued. These are often referred to as *Content Standards*. This process necessarily depends on bringing expert practitioners together and, through extensive iterations of discussion, drafting, circulation for comment, redrafting, and so on, working toward a consensus about what an accomplished teacher in that subject area must know and be able to do to promote quality learning. (Appendices 1 and 2 contain examples of content standards from several countries, including Australia, Chile, England, Scotland, Singapore and the USA.)

*Setting* standards is quite a different exercise. Crudely speaking, standard setting is a process of agreeing on how good is good enough: that is, setting the *Performance Standards*. It is about determining the performance level considered acceptable for a specified purpose, and setting the cutting or passing score; for example, the score for deciding whether a probationary teacher has reached state registration standards, or whether an experienced teacher has attained advanced standards set by a professional body. A standard points to and describes a desirable level of performance.

In summary, there are three essential steps in developing standards for teacher evaluation:

1. *Describing good teaching*, defining what is to be assessed – i.e. what do-accomplished teachers know, and do. (these are often call “**content**” standards)
2. *Developing valid and consistent assessment methods for gathering evidence* about what a teacher knows and is able to do in relation to the standards; and
3. *Developing reliable procedures for assessing that evidence* and deciding whether a teacher has met the standard. (i.e. setting **performance** standards).

Teaching standards must identify the *central tasks* of teaching, and adapt from time to time to changing public expectations of schools. Some would argue that subject matter is at the core of teachers’ work and that the central task of teaching is helping diverse students learn important subject matter. Other roles such as nurturer, classroom manager, role model are means to that end.

Standards also need to identify the *unique* features of what teachers who teach particular disciplines or who teach at particular levels of schooling know and do. One tradition of research on teaching has sought principles of good practice that apply no matter what the subject matter being taught (Brophy, 1991). On the other hand, research on teaching and learning over recent years has emphasised the highly context-specific nature of teaching expertise ( e.g. Shulman, (1987). (We will return to this topic later under subject-specific standards).

Standards do not just describe current practice; they clarify what teachers should know and be able to do in the light of research and best practice (Dwyer, 1994). In this way, standards provide a bridge between research and practice. Standards are a means of translating research into expectations for teachers' practice. Standards are not immutable; they need regular revision in the light of research and professional knowledge.

Standards for practising teachers clarify what teachers should get better at over the long term. This is the purpose of the standards for accomplished teachers developed by the National Board for Professional Standards in the USA. Standards describe trajectories for professional and career development, as illustrated later by the standards from Australia. They make manifest the idea that good teaching is something a person learns how to do over time; that good teaching is not just a bundle of personality traits. Standards reject the mindset that teaching is just a matter of personal style and 'doing your own thing'.

Standards give warrant to the claim that teaching is a profession with the capacity to evaluate its own practice and implement professional models of accountability. Standards provide a foundation for teachers and their associations to provide leadership in their profession, as illustrated by the standards developed by teachers' associations, such as the Australian Science Teachers Association (2002) and the National Council for Teachers of Mathematics in the USA (1989).

## **DEFINING GOOD TEACHING: DEVELOPING CONTENT STANDARDS**

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There is a long history of efforts to define good teaching. Mary Kennedy (2010) provides a thorough review of how conceptions of the "good teacher" changed over the past century, tracing the movement toward standards towards the end of the century as a way of defining what good teachers know and do. Early efforts into the 1960s tended to focus on broad personality traits of the teacher rather than classroom practices. This was followed by a period up to the 1990s, influenced by process-product research, that focused on identifying specific behaviours that characterised effective teaching. Neither approach proved to be satisfactory in terms of capturing the educational significance of what was happening in classrooms. Teaching standards proved to be a sounder basis on which to judge the quality of opportunities that teachers provided for their students to learn, particularly when they drew attention to the intellectual substance of what was being taught, how it was being represented and how students interacted with it.

As a first step in developing teaching standards, writers need to articulate a vision of quality learning that will guide their more detailed work of describing what teachers should *know*, *believe* and be able to *do*. The ultimate purpose of standards is to improve the quality of learning opportunities for students in schools. As Kennedy (2010) points out, standards need to be driven by a vision of high quality learning *of something*, whether it is literacy, numeracy, art or science, and why it is important for students to learn it. A contemporary vision of what learners need to know and be able to do will often be found in national curriculum statements.

A productive approach to beginning the process of writing standards is to bring groups of expert teachers and researchers together to discuss, first, not teaching, but their views on what counts

as quality learning in their field of teaching (e.g. primary teaching; specialist mathematics teaching). This discussion can be facilitated with questions such as the following:

- What counts as quality learning in your discipline field?
- What would we see in a classroom where quality learning was taking place?

National curriculum guidelines will often be useful for this kind of discussion. The National Curriculum for science in Australia, for example, is organised around three interrelated strands: science understanding; science inquiry skills; and science as a human endeavour. Each of these is elaborated in turn providing a vision for the importance of learning science in schools. National Curricula in most countries usually provide similarly inspiring visions for learning in the various subject areas.

As the discussion begins to resolve around some clear, common views on quality learning, it can then turn to the central question for standards writing groups, which is

- What would teachers need to know and be able to do to promote what we regard as quality learning in our field of teaching?

In addressing this question, standards writers will draw on a variety of sources, such as the experience and wisdom of expert teachers and research on effective teaching practices in the fields in which they teach. Well-written standards are grounded in a clear understanding of what counts as quality learning for students. Box 1 provides an example from the National Council for the Teaching of Mathematics Standards. The NCTM standards are driven by a clear view about the importance of learning mathematics.

**Box 1: An example of teaching standards based on a vision of quality learning**

The National Council for the Teaching of Mathematics *Professional Standards for Teaching Mathematics* (NCTM, 1989) was one of the first sets of standards developed by a national subject association of teachers.

The NCTM standards are an example of standards based on a clearly articulated conception of quality learning in a *specified subject area arising from academic and practitioner research*. Central to the NCTM Standards was the development of *mathematical power* for all students.

*Mathematical power includes the ability to explore, conjecture, and reason logically; to solve non-routine problems; to communicate about and through mathematics; and to connect ideas within mathematics and between mathematics and other intellectual activity. Mathematical power also involves the development of personal self-confidence and a disposition to seek, evaluate, and use quantitative and spatial information in solving problems and in making decisions. Students' flexibility, perseverance, interest, curiosity, and inventiveness also affect the realisation of mathematical power. (p. 1)*

The teachers who wrote the NCTM standards began with this vision of quality learning. This was the foundation. The next step was to describe the kind of *teaching* that might produce that kind of learning. This was followed, in turn, by an analysis of the *knowledge, skills and dispositions* a teacher needed to provide that kind of teaching, supported where possible by research on teaching and learning mathematics.

As the NCTM standards aim to capture what accomplished teachers of *mathematics* should aspire to, they provide challenging, long-term goals for professional learning.

Standards for teaching need to be grounded in a coherent view of what a society views as a sound education and the role of a teacher in providing that education. Based on this understanding, writers of standards seek to avoid two problems characteristic of past approaches to developing criteria for teacher evaluation. The first, of being too broad and too general to be useful for assessment purposes. This was a characteristic, for example, of approaches to teacher evaluation last century that focussed on the general personality characteristics of teachers (Kennedy, 2010) . The second of being too specific; of breaking teaching down into a set of competencies and focusing evaluation of narrowly on specific behaviours (thereby often losing sight of the meaning behind what teachers were trying to achieve).

## LEVELS OF STATEMENTS WITHIN STANDARDS FRAMEWORKS

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As they go about their task, standards writers are essentially describing the scope of teachers’ professional work and responsibilities. They need to reach agreement on the scope of teachers’ duties and responsibilities and the underlying principles that guide them. The statements they write typically move from the general to the specific, as shown by the levels in Figure 1; that is, they move from principles to more detailed descriptions of what good teachers know and do and elaborations of these for each field of teaching.

| Figure 1: Levels of statements within standards frameworks |  |
|--|--|
| Level 1 Principles   | Guiding vision of quality learning and teachers’ work  |
| Level 2 Domains  | Organising categories for the teaching standards   |
| Level 3 Standards  | Descriptions of what teachers should know and be able to do within each domain   |
| Level 4 Elaborations                                       | Elaborations of what the standards mean for particular fields of teaching (these form the basis for designing assessments and rubrics for assessing performance) |

*Level 1: Principles* Statements at this level are highly generalised and abstract. They aim to capture the deeper, long-term educational values and purposes that teachers pursue. They are not intended to be used to assess a teacher’s professional knowledge or performance or to judge the quality of a teacher education course.

*Level 2: Domains* These statements define the scope of teachers’ work and the main categories within that work.

*Level 3: Standards* Statements at this level identify the standards with each of the Level 2 domains. The standards form the basis for developing assessments. They describe what teachers need to know and be able to do in particular areas of teaching.

*Level 4 Elaborations* Statements at this level explain the meaning of each standards within each domain. Elaborations point to elements of observable, appropriate actions, but do not prescribe specific teaching methods or styles (There will be many ways to meet the standard. While they do not standardise teaching, they provide the basis for rubrics to be used in assessing teacher performance.

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## DOMAINS: ORGANISING CATEGORIES FOR TEACHING STANDARDS

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As standards writers explore the kinds of knowledge, skills and commitments that, for example, new teachers should have gained from their teacher education programs, they quickly experience a common challenge – which is to decide how to contain and organise all the ideas they are producing. Just as there are many ways to slice a cake, there are many ways to organise standards frameworks for teachers. However, it remains the same cake.

While there is no one best way to organise the main categories or “domains” of teachers’ work, a remarkable similarity has emerged in the categories and sub-categories emerging from standards developed across different countries. To some extent, this is a reflection of the work done over the past twenty-five years exploring to what extent claims about a knowledge base for the teaching profession can be justified (E.g. Shulman, 1987; Reynolds, 1989; Cohen and Ball, 1999).

Darling-Hammond and Bransford (2005) gather much of this work together in their volume, which addresses three questions about what beginning teachers need to know and be able to do:

- What kinds of *knowledge* do effective teachers need to have about their subject matter and about the learning process and development of their students?
- What *skills* do teachers need in order to provide productive learning experiences for a diverse set of students, to offer informative feedback on students’ ideas, and to critically evaluate their own teaching practices and improve them?
- What professional *commitments* do teachers to help every child succeed and to continue to develop their own knowledge and skills, both as individuals and as members of a collective profession?

These three questions provide a conceptual framework that is now common to sets of standards in many countries, such as Australia, Chile, England, New Zealand, Scotland and the USA (as shown in Figure 2). Several other countries could have been included. Figure 2 illustrates that the standards for each country have a similar underlying framework at the domain level.

Each country in Figure 2 groups their standards into categories or domains similar to the groups above identified by Darling-Hammond and Bransford. To some extent, these categories reflect common sense, but they also identify fields of research that increasingly provide evidence about teaching and learning that should be central to the design of teacher education programs.

While there is an emerging international consensus about features of the standards required for new teachers, it might be expected that local cultural considerations will affect the character of teaching standards. However, from the international examples appearing so far, this is not turning out to be the case, at least not in terms of the structure and content of standards

framework. To some extent, this may be because countries are sharing their standards and borrowing from each other. However, it may be because standards, by definition, aim to be context free, even within countries.

**Figure 2: Organising categories (Domains) for standards in six countries**

| Australia                      | Saudi Arabia                      | England                                  | New Zealand                           | Scotland                                    | USA (InTASC)   |
|--------------------------------|-----------------------------------|--|---------------------------------------|---|--|
| <b>Professional knowledge</b>  | Preparing for learning            | Professional knowledge and understanding | Professional knowledge                | Professional knowledge and understanding    | - The learner and learning<br>- Content                  |
| <b>Professional practice</b>   | Promoting and supporting learning | Professional skills                      | Professional practice                 | Professional skills and abilities           | Instructional practice                                   |
| <b>Professional engagement</b> | Professional Responsibilities     | Professional attributes                  | Professional values and relationships | Professional values and personal commitment | -Professional engagement<br>-Professional responsibility |

In one sense, it should not be surprising that the standards domains and their organisation look much the same across different countries. Local knowledge will, of course, play a vital part in implementing the standards, but it is not the role of standards to articulate this knowledge for each school context. It is not that well-written standards enforce some kind of homogenisation either. It is probably more the case that the nature of teachers’ work and conceptions of good teaching are not a function of the country or culture to any strong degree. For example, what a teacher of mathematics needs to know and be able to do is unlikely to vary greatly from one country to the next.

A recent PhD thesis by Junjun Chen (2010) explored conceptions of excellent teaching in Chinese Middle Schools and found them to be little different from standards in Western countries. Irving (2005) found that NZ mathematics teachers had almost identical conceptions of accomplished mathematics teaching to those of teachers in the USA. Ingvarson and Kleinhenz (2006) found the same for science teachers in Australia and the USA; each group had very similar conceptions of what good science teachers know and do. And the Chilean Ministry of Education decided in the early 2000s to adopt a set of standards for beginning teachers from the USA with little change.

### STANDARDS WITHIN DOMAINS

The next step for standards writers is to identify the standards that will be included in each of the domains. Figure 3 shows a typical set of domains and standards from Australia. It shows

how seven standards for graduate teachers have been grouped under the three broad domains identified by Darling-Hammond and Bransford.

This standards framework is similar to that of many other countries. Internationally, most sets of standards for classroom teachers are similar at the domain and standards levels, as shown in Appendix 1. (Appendix 1 contains examples of generic standards frameworks from England, New Zealand, Scotland and the USA.). Most are organised around three or four main categories or domains as shown in Figure 1. Most contain similar standards within each of the domains such as, *knowledge of subject matter and how students learn it, creating a supportive learning environment, or contributing to the school’s professional community.*

**Figure 3: National Professional Teaching Standards Framework for Australia**

| Domains                              | Standards within each domain                                     |
|--------------------------------------|--|
| <b>Professional Knowledge</b>        | Knowledge of students and how they learn                         |
|                                      | Knowledge of content and how to teach it                         |
| <b>Professional Practice</b>         | Plan for and implement effective learning and teaching           |
|                                      | Assess, provide feedback and report on student learning          |
|                                      | Create and maintain supportive and safe learning environments    |
| <b>Professional Responsibilities</b> | Engage in professional learning                                  |
|                                      | Engage professionally with colleagues, parents and the community |

The aim of such frameworks is to set the main dimensions of teachers’ knowledge and practice clearly and logically within specified areas that define a knowledge base and serve as a map for teachers’ professional learning.

The meaning and scope of each of the standards in the Australian Framework is elaborated by developing a list of ‘elements’ or ‘indicators’. Figure 4 shows six indicators for each of the two standards in the Professional Knowledge Domain.

**Figure 4: Domain 1: National Professional Teaching Standards Framework for Australia:**

| Domain                        | Standard                            | Indicators  |
|-------------------------------|-------------------------------------|---|
| <b>Professional Knowledge</b> | 1. Know students and how they learn | 1.1 Physical, social and intellectual development and characteristics of students |
|                               |                                     | 1.2 Understand how students learn   |
|                               |                                     | 1.3 Students with diverse linguistic, cultural, religious and                     |

|  |                                     |  |
|--|-------------------------------------|--|
|  |                                     | <p>socioeconomic backgrounds</p> <p>1.4 Strategies for teaching Aboriginal and Torres Strait Islander students</p> <p>1.5 Differentiate teaching to meet the specific learning needs of students across the full range of abilities</p> <p>1.6 Strategies to support full participation of students with disability</p>  |
|  | 2. Know content and how to teach it | <p>2.1 Content and teaching strategies of the teaching area</p> <p>2.2 Content selection and organisation</p> <p>2.3 Curriculum, assessment and reporting</p> <p>2.4 Understand and respect Aboriginal and Torres Strait Islander people to promote reconciliation between Indigenous and non-Indigenous Australians</p> <p>2.5 Literacy and numeracy strategies</p> <p>2.6 Information and Communication Technology (ICT)</p> |

Each of the standards and indicators is then described in more detail at four levels of certification, as shown in Figure 5; Graduate Teacher, Proficient Teacher, Highly Accomplished Teacher and Lead Teacher. A full list of indicators for all standards in the Australian Framework can be found on the AITSL website (<http://www.teacherstandards.aitsl.edu.au/>)

**Figure 5 Standard 1: National Professional Teaching Standards Framework for Australia:**

| DOMAIN 1<br>STANDARD 1  |  | CERTIFICATION LEVELS /CAREER STAGES  |  |   |   |
|---|--|--|--|---|---|
|   |  | Graduate Teacher   | Proficient Teacher   | Highly Accomplished Teacher   | Lead Teacher  |
| <b>PROFESSIONAL KNOWLEDGE</b><br><b>1. Know students and how they learn</b> | 1.1<br>Physical, social and intellectual development and characteristics of students | Demonstrate knowledge and understanding of physical, social and intellectual development and characteristics of students and how these may affect learning | Use teaching strategies based on knowledge of students' physical, social and intellectual development and characteristics to improve student learning. | Select from a flexible and effective repertoire of teaching strategies to suit the physical, social and intellectual development and characteristics of students. | Lead colleagues to select and develop teaching strategies to improve student learning using knowledge of the physical, social and intellectual development and characteristics of students. |

Further elaborations of the Australian standards are currently being written, together with exemplars for different content areas and fields of teaching. Some standards writers prefer list of indicators to elaborate on the meaning of the standards; some prefer to use a prose style of writing that aims to reflect the integrated nature of good teaching to avoid the standards being used as a list discrete items on an assessment checklist. We will return to this issue later in examining examples of subject-specific standards.

## GENERIC STANDARDS

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The Australian Framework is an example of a ‘generic’ standards framework, in the sense that it is meant to be common to most teachers, regardless of the level at which they teach or the subjects they teach. The frameworks in Appendix 1 for England, New Zealand, Scotland and the USA (InTASC) are all generic and Singapore has also produced a set of Graduated Teacher Competencies recently<sup>1</sup>.

Internationally, most current standards frameworks remain generic, with some notable exceptions such as standards developed by Chile and the National Board for Professional Teaching Standards in the USA, which are discussed later. Like the Australian framework, statements within these frameworks are organised at several levels, from broad ‘domains’, which set out the main *categories* of teachers’ work to standards and elaborations of the standards. Standards and their elaborations should point to elements of observable, appropriate actions, but transcend references to specific practices.

Logic and careful use of language are important in writing standards to avoid overlap and repetition. As noted earlier, Darling-Hammond and Bransford (2005) make a clear, logical distinction between the three main domains of knowledge, skills and commitments. Knowledge of subject matter, for example, is in Domain 1. However, the skill to help students learn that subject matter is in Domain 2. Domains 1 and 2 are conceptually distinct. While Domain 1 is about what a graduate teacher needs to know in order to plan and teach well, Domain 2 is about performance in the classroom with students; it describes what good teachers are able to do in promoting student learning.

In developing standards frameworks, it is preferable to differentiate statements about what teachers should know from statements about skills or performance (what teachers should be able to do) and statements about teachers’ wider commitments as members of a profession. Some standards frameworks fail to make this distinction

The distinction between Domain 1 (knowledge) and Domain 2 (performance) is similar to the distinction between “knowing that” and “knowing how” made by Gilbert Ryle (1946). The Australian standards tend to blur this distinction by referring, for example, to teaching strategies

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<sup>1</sup> <http://www.nie.edu.sg/files/about-nie/TE21%20online%20version.pdf>

and “knowing how to teach the content in Domain 1, when skills such as these are more appropriately located in Domain 2.

Failure to make this distinction can lead to unnecessary repetition in a set of standards and indicators. The following examples of generic standards will be used to illustrate this point. It is also important to ensure that statements in a standards framework are placed at the appropriate ‘level’ in the framework (i.e. at the domain, standard or indicator level) and that standards are placed in the appropriate domain..

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## EXAMPLES of GENERIC STANDARDS FRAMEWORKS

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### *The Danielson Framework for Teaching*

The *Framework for Teaching* developed by Charlotte Danielson (2007) provides an example of a generic standards framework where the domains are clearly distinguished and there is minimal repetition. Figure 6 provides a summary of her Framework. Its structure shows the careful thinking that has gone into its planning. It is logically coherent. It illustrates how clear distinctions have been made between the knowledge standards in Domain 1, the performance standards in Domains 2 and 3 and the wider professional responsibilities in Domain 4. The detailed Framework provides rubrics for assessing teachers on each standard at four levels; unsatisfactory, basic, proficient and distinguished.

**Figure 6: The Danielson Framework for Teaching**

| Domains                             | Standards   |
|-------------------------------------|---|
| <b>1: Planning and Preparation</b>  | <ul style="list-style-type: none"> <li>• Demonstrating knowledge of Content and Pedagogy</li> <li>• Demonstrating Knowledge of Students</li> <li>• Selecting Instructional Goals</li> <li>• Demonstrating Knowledge of Resources</li> <li>• Designing Coherent Instruction</li> <li>• Designing Student Assessment</li> </ul> |
| <b>2: The Classroom Environment</b> | <ul style="list-style-type: none"> <li>• Creating an Environment of Respect and rapport</li> <li>• Establishing a Culture for Learning</li> <li>• Managing Classroom Procedures</li> <li>• Managing Student Behavior</li> <li>• Organizing Physical Space</li> </ul>  |
| <b>3: Instruction</b>               | <ul style="list-style-type: none"> <li>• Communicating with Students</li> <li>• Using Questioning and Discussion Techniques</li> <li>• Engaging Students in Learning</li> <li>• Using Assessment in Instruction</li> <li>• Demonstrating Flexibility and Responsiveness</li> </ul>  |
| <b>4: Professional</b>              | <ul style="list-style-type: none"> <li>• Reflecting on Teaching</li> <li>• Maintaining Accurate Records</li> </ul>  |

|                         |  |
|-------------------------|--|
| <b>Responsibilities</b> | <ul style="list-style-type: none"> <li>• Communicating with Families</li> <li>• Participating in a Professional Community</li> <li>• Growing and Developing Professionally</li> <li>• Showing Professionalism</li> </ul> |
|-------------------------|--|

The Danielson Framework was designed as an instrument for classroom observation, with pre-lesson and post-lesson interviews about the lesson, and is the most widely used teacher evaluation instrument in the USA. The Danielson Framework is also noteworthy for having a clear underlying dynamic to its structure, which is representative of the typical cycle of teachers' work - from planning to teaching to assessment and reflection in preparation for the next lesson. It also recognises the importance of interviewing teachers before and after observation in order to have a clear understanding of the reasoning behind their actions and their capacity to analyse the effects of their actions on student learning. However, while the Danielson framework is a very useful basis for assessing teacher performance in the classroom, it was not designed as a more general guide to the content of teacher education programs, unlike the following example.

*The InTASC Model Core Teaching Standards*

The Interstate Teacher Assessment and Support Consortium (InTASC) is a consortium of state education agencies and national educational organizations in the USA dedicated to reforming the preparation, licensing, and on-going professional development of teachers. These agencies came together in 1992 to develop a set of standards that articulated the common core of teaching knowledge and skills that all new teachers should have. The “common core” outlined “the common principle’s and foundations of teaching practice that cut across all subject areas and grade levels and that all teachers share. (InTASC, 2010, p. 4).

In 2010, InTASC released a revised version of its 1992 model standards. These provide an interesting contrast from those discussed above in the way they are organised. Figure 7 shows how the framework for the InTASC standards is divided into four domains. (Elaborated versions of these standards can be found in Appendix 1E.)

The new InTASC standards comprise a set of ten principles of effective teaching, which have been revised from the 1992 version in response to new expectations for teaching. They are intended to help policymakers and educators achieve their education reform goals and are designed to be compatible with the recently released Common Core (Curriculum) Standards for the USA and other professional education standards.

The following quote illustrates this stance. It is taken from the Introduction to the Model Core Teaching Standards recently developed by the CCSSO Interstate Teacher Assessment and Support Consortium InTASC).

*The following “Model Core Teaching Standards” are an initial effort to articulate, through the lens of the teacher, what effective teaching and learning would look like in that new system. The drafting committee began with a focus on the learner—who our students are today, what assets and needs they bring to the learning experience, what*

*engages them, and how we address the expectation that every learner will learn to high levels. It is clear that today’s students are more diverse—racially, linguistically, with special needs. Yet, their differences are strengths. . . (InTASC, July, 2010*

**Figure 7: The InTASC Model Core Teaching Standards (Draft version)**

| Domains                     | Standards  |
|-----------------------------|--|
| The Learner and Learning    | <p>1. <i>Learner Development</i> The teacher understands how children learn and develop, recognizing that patterns of learning and development vary individually within and across the cognitive, linguistic, social, emotional, and physical areas, and designs and implements developmentally appropriate and challenging learning experiences.</p> <p>2. <i>Learning Differences</i> The teacher uses understanding of individual differences and diverse communities to ensure inclusive learning environments that allow each learner to reach his/her full potential.</p> <p>3. <i>Learning Environments</i> The teacher works with learners to create environments that support individual and collaborative learning, encouraging positive social interaction, active engagement in learning, and self-motivation.</p> |
| Content Knowledge           | <p>4. <i>Content Knowledge</i> The teacher understands the central concepts, tools of inquiry, and structures of the discipline(s) he or she teaches and creates learning experiences that make these aspects of the discipline accessible and meaningful for learners.</p> <p>5. <i>Innovative Applications of Content</i> The teacher understands how to connect concepts and use differing perspectives to engage learners in critical/creative thinking and collaborative problem solving related to authentic local and global issues.</p>  |
| Instructional Practice      | <p>6. <i>Assessment</i> The teacher understands and uses multiple methods of assessment to engage learners in their own growth, to document learner progress, and to inform the teacher’s ongoing planning and instruction.</p> <p>7. <i>Planning for Instruction</i> The teacher draws upon knowledge of content areas, cross-disciplinary skills, learners, the community, and pedagogy to plan instruction that supports every student in meeting rigorous learning goals.</p> <p>8. <i>Instructional Strategies</i> The teacher understands and uses a variety of instructional strategies to encourage learners to develop deep understanding of content areas and their connections, and to build skills to access and appropriately apply information.</p>  |
| Professional Responsibility | <p>9. <i>Reflection and Continuous Growth</i> The teacher is a reflective practitioner who uses evidence to continually evaluate his/her practice, particularly the effects of his/her choices and actions on others (students, families, and other professionals in the learning community), and adapts practice to meet the needs of each learner.</p> <p>10. <i>Collaboration</i>. The teacher collaborates with students, families, colleagues, other professionals, and community members to share responsibility for student growth and development, learning, and well-being.</p>   |

Each of the ten InTASC standards has the structure shown in Figure 8. Each is presented in a different way from most standards, such as those discussed previously. Figure 8 illustrates this for Standard 1. Each standard is essentially a “performance” standard. Each puts the

performance expected of a teacher first – the kinds of practices that should be observable and assessable in relation to student learning. Each standard lists not only the performance expected, but also the knowledge and attitudinal elements (dispositions) that support or underpin the ability to meet that performance standard. And, under critical dispositions, it identifies the attitudes and commitments that drive those practices.

**Figure 8: Standard 1 from the InTASC Model Core Teaching Standards**

| <b>Standard 1: Learner Development</b>  |   |
|---|---|
| The teacher understands how children learn and develop, recognizing that patterns of learning and development vary individually within and across the cognitive, linguistic, social, emotional, and physical areas, and designs and implements developmentally appropriate and challenging learning experiences.  |   |
| <b>Performances</b>   | <b>Essential Knowledge</b>  |
| <p>(a) The teacher regularly assesses individual and group performances in order to design and modify instruction to meet learners’ needs in each area of development (cognitive, linguistic, social, emotional, and physical) and scaffolds the next level of development.</p> <p>(b) The teacher creates developmentally appropriate instruction that takes into account individual students’ strengths, interests and needs and that allow each student to advance and accelerate his/her learning.</p> <p>(c) The teacher collaborates with families, colleagues and other professionals to promote student growth and development.</p> | <p>(d) The teacher understands how learning occurs - how students construct knowledge, acquire skills, and develop disciplined thinking processes - and knows how to use instructional strategies that promote student learning.</p> <p>(e) The teacher understands that each student’s cognitive, linguistic, social, emotional, and physical development influences learning and know how to make instructional decisions that take these factors into account.</p> <p>(f) The teacher identifies readiness for learning, and understands how developments in any one area may affect performance in others.</p> <p>(g) The teacher understands the role of language and culture in learning and knows how to modify instruction to make language comprehensible and instruction relevant, accessible, and challenging.</p> |
| <b>Critical Dispositions</b>  |   |
| <p>(h) The teacher respects students’ differing strengths and needs and is committed to using this information to further each student’s development.</p> <p>(i) The teacher is committed to using students’ strengths as a basis for growth, and their misconceptions as opportunities for learning.</p> <p>(j) The teacher takes responsibility for promoting students’ growth and development.</p> <p>(k) The teacher values the input and contributions of families, colleagues and other professionals in understanding each student’s development.</p>  |   |

It also needs to be kept in mind that the InTASC Core Model Teaching Standards provides the framework for more detailed elaborations of the standards within each of the specialist areas of teaching, such as primary teaching, of secondary science teaching. Unlike the Danielson Framework, the InTASC standards purpose is to provide a ‘curriculum’ for teacher education programs; they cover in more detail what the objectives of a teacher education program should be.

The InTASC standards are one of the best examples of generic standards extant. They are certainly challenging. One concern expressed by commentators is that they may be too challenging and set the bar at an unrealistic level for beginning teachers.

While the InTASC standards are impressive, one drawback is the degree of repetition that this method of organisation leads to in a set of standards, unlike the Danielson framework. This is especially the case under the heading of “Performance”. Several standards, in addition to Standard 1, list items similar to (a), (b) and (c) in Figure 8 in the performance column. Standard 1 is mentioned in most of the other standards, in some similar form or other. For example, statements like “planning and teaching in ways that meet the needs of individual students” are repeated in several standards. The importance of knowledge of subject matter is also repeated in several standards. Certain dispositions, such as respecting student diversity and valuing collaboration are mentioned in several standards as well.

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## **SUBJECT-SPECIFIC AND LEVEL-SPECIFIC TEACHING STANDARDS**

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Neither the Danielson Framework nor the InTASC standards aim to drill down to differentiate what each standard means for different fields of teaching, such as a primary teaching or a secondary subject teaching. Clearly, what a future primary teacher should know about the characteristics of their students and the subjects they teach is different from what a future secondary teacher should know.

A standards framework that remains at the generic level, provides a limited basis for assessing teachers’ knowledge and practice. For example, most standards include a statement such as “Teachers should have a deep understanding of the content they are expected to teach.” What this statement means in practical terms clearly needs to be explained before such a standard will provide a useful guide for developing assessments. What it means for a future primary teacher of mathematics will clearly be different from the depth of knowledge expected of future teacher of mathematics at the senior secondary.

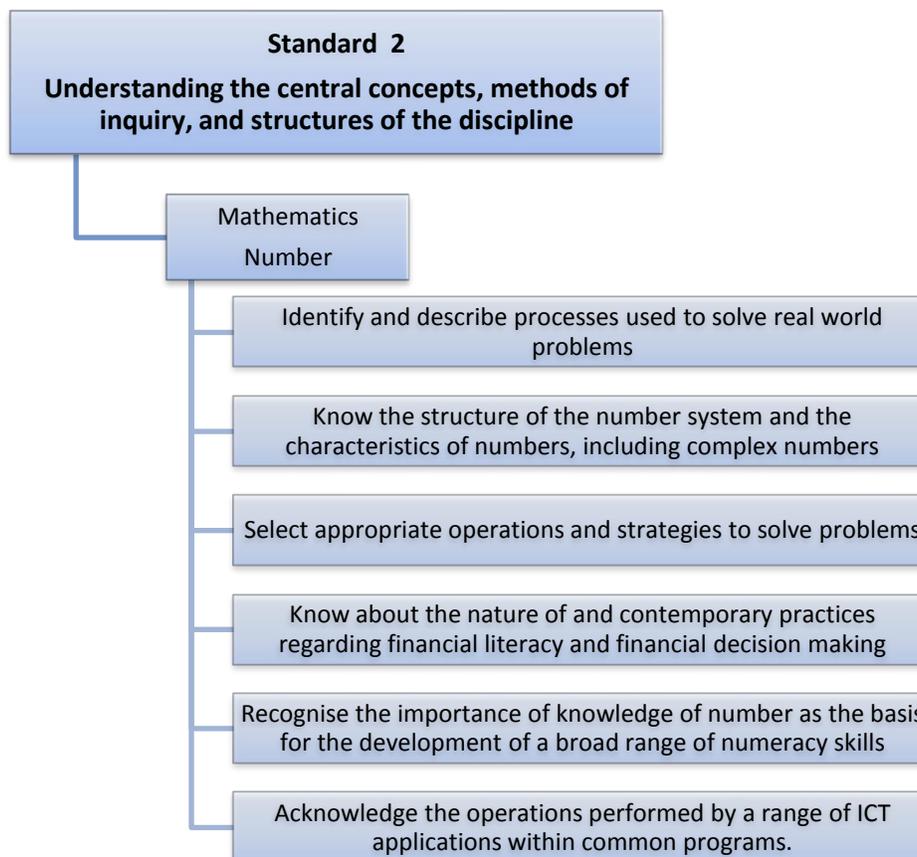
All teachers are, in a sense, specialist teachers. Therefore, teaching standards need to identify, not only what is common to all teachers; they also need to identify what is unique about good teaching in the different specialist fields of teaching. This is just as true for primary teachers as secondary teachers. The former are just as much specialists in their field as secondary teachers. What a teacher in the early primary years needs know about learning to read is very different from what a secondary science teacher needs to know about helping students to learn physics. What a primary teacher needs to know about child development is different from what a high school teacher needs to know about adolescent development. And so on.

Standards need to be written at two levels. First at the generic level, where they identify aspects of teachers’ knowledge and practice that apply to *all* teachers, regardless of what or who they teach. The InTASC core standards provide an example. Second, standards writers then need to move to deeper levels where they elaborate on what good teachers know and do in the many specialist fields that make up the teaching profession.

The InTASC standards, for example, have been elaborated in several specialist fields. The specialist fields each country chooses will depend on the way in which schooling is organised within that country, but they usually include *levels*, such as early childhood education, primary and secondary teaching and, within these levels, areas of specialist subject teaching, such as mathematics, literacy or art for example.

If standards are to be useful as a guide to developers of teacher education programs, they also need to “drill down” further and be more specific about what teachers need to know and be able to do. Generic standards need to be elaborated to identify what is unique about what, for example, English, history, mathematics and science teachers need to learn in their teacher education programs. They need to differentiate between what good teachers know and do in the different specialist fields. Figure 9 provides one example of this drilling down for just one topic area in mathematics, *Number*.

**Figure 9: Drilling down to the subject-specific level**



Standards for primary teachers should also provide a clear guide on such matters if they are to be useful for program planning and assessment. What, for example, should a primary teacher know about recent research on learning to read? What approaches to overcoming reading difficulties should they be able to demonstrate? Appendix 2 provides examples of generic standards that have been elaborated for particular levels (e.g. primary teaching in Chile) and for particular subjects (e.g. science and mathematics).

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## EXAMPLES OF SUBJECT-SPECIFIC STANDARDS:

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### **The National Board for Professional Teaching Standards**

The National Board for Professional Teaching Standards (NBPTS) in the USA provides one of the most extensive examples of level- and subject-specific standards in the world. The NBPTS is an independent, private, nonprofit, and nonpartisan organization governed by a board of directors, the majority of whom are classroom teachers. Its core role is to provide a professional certification system for teachers that employing authorities can use to reward teachers who have reached high standards. Certification is based on rigorous assessments of a teacher's professional knowledge and performance.

Since it was established in 1987, nearly 100,000 teachers have achieved National Board Certification, approximately half the teachers who have applied. National Board Certification was recently recognized by the National Research Council as having a positive impact on student achievement, teacher retention, and professional development (National Research Council, 2008).

Figure 10 provides an example of a framework for subject-specific standards from the NBPTS, in this case for secondary teachers of science. It is one of 25 sets of standards developed by the National Board for the certification of highly accomplished teachers for different subjects and different levels of schooling, which give nearly 95% of teachers access to NB certification.

The full set of science standards contains elaborations of each of the 13 standards in Figure 10. Standard 2, *Knowledge of Science*, for example, goes into detail about what teachers should know about the nature of science and the fundamental ideas in each field of science. It is over 40 pages long and can be viewed on the NBPTS website ([www.nbpts.org](http://www.nbpts.org)).

There are several things to note about the NBPTS standards in Figure 10. The first is that they have an underlying domain structure similar to the generic standards described earlier. There are standards covering knowledge, practice and professional responsibilities. Like the Danielson framework, the standards are organised in a way that matches the structure of teachers' work. They reflect the dynamic nature of what good teachers do. Domain I begins with what good teachers know and be able to do to plan and prepare for student learning. Domain II includes what good teachers do to establish a supportive environment for learning of science and

Domain III identifies what is unique about the kind of learning that a good teacher of science should be promoting. Domain IV covers a science teacher's wider professional responsibilities in the school and the community. These three standards are based on what curriculum experts in science agree to be the main elements of quality learning in science; they form the three main objectives for teaching science. Second, the NBPTS standards identify in much more detail what kinds of kinds of knowledge science teachers need and what kinds of learning they should be promoting. The introduction to the science standards points out that

**Figure 10: NBPTS Standards for Accomplished Teachers of Science in Secondary Schools**

| Domains   | Standards  |
|---|--|
| <b>I. Preparing the Way for Productive Student Learning</b>       | <p>1. <i>Understanding students</i> - Highly accomplished science teachers know how students learn, actively come to know their students as individuals, and determine student's understandings of science as well as their individual learning backgrounds.</p> <p>2. <i>Knowledge of Science</i> - Highly accomplished science teachers have a broad and current knowledge of science and science education, along with in-depth knowledge of one of the sub-fields of science, which they use to set important learning goals.</p> <p>3. <i>Instructional Resources</i> - Highly accomplished science teachers select and adapt, instructional resources, including technology and laboratory and community resources, and create their own to support active student exploration of science.</p>         |
| <b>II. Establishing a Favourable Context for Student Learning</b> | <p>4. <i>Engagement</i> - Highly accomplished science teachers stimulate interest in science and technology and elicit all their students' sustained participation in learning activities.</p> <p>5. <i>Learning environment</i> - Highly accomplished science teachers create safe and supportive learning environments that foster high expectations for the success of all students and in which students the values inherent in the practice of science.</p> <p>6. <i>Equitable Participation</i> - Highly accomplished science teachers take steps to ensure that all students, including groups from which have historically not been encouraged to enter the world of science, participate in the study of science.</p>   |
| <b>III. Advancing Student Learning</b>                            | <p>7. <i>Science Inquiry</i> - Highly accomplished science teachers develop in students the mental operations, habits of mind and attitudes that characterise the process of scientific inquiry.</p> <p>8. <i>Conceptual Understandings</i> - Highly accomplished science teachers use a variety of instructional strategies to expand students' understandings of the major ideas of science.</p> <p>9. <i>Contexts of science</i> - Highly accomplished science teachers create opportunities for students to examine the human contexts of science, including its history, reciprocal relationships with technology, ties to mathematics and impacts on society so that students make connections across the disciplines of science and into other subject areas.</p>                                     |
| <b>IV. Supporting Teaching and Student Learning</b>               | <p>10. <i>Assessment</i> - Highly accomplished science teachers assess student learning through a variety of means that align with stated learning goals</p> <p>11. <i>Family and Community Outreach</i> - Highly accomplished science teachers productively work with families and communities to serve the best interest of each student.</p> <p>12. <i>Collegiality and Leadership</i> - Highly accomplished science teachers contribute to the quality of the practice of their colleagues, to the instructional program of the school, and to the work of the larger professional community.</p> <p>13. <i>Reflection</i> - Highly accomplished science teachers constantly analyse, evaluate and strengthen their practice in order to improve the quality of their students' learning experiences</p> |

*“the standards are designed to specify the critical aspects of highly accomplished science teaching. In practice, the facets of teaching enumerated in the standards are densely interwoven and often occur simultaneously because exemplary teaching is a seamless activity with many disparate purposes being served at any given moment.*

A special feature of the NBPTS standards is the third domain. Unlike many generic standards, this domain makes it clear that accomplished teachers are expected to provide evidence that they can advance student learning. Unlike generic standards, it drills down to identify the kinds of learning that a teacher should be able to promote, in this case a science teacher. Three main types of learning are identified; science inquiry, conceptual understanding and contexts of science. A full description of Standard 7, *Science Inquiry*, is reproduced in Appendix 2.

The standards make it clear that a teacher applying for National Board certification is expected to provide evidence that they can promote each kind of learning in their students. Similarly, the standards developed by the NBPTS for other subject areas and levels of schooling identify the unique kinds of learning that teachers are expected to promote in their specialist fields.

Third, although this set of standards, as a set, is specific to science teaching, there are several individual standards that remain generic and are similar across all the NBPTS standards. These include, for example, standards in Domain 2 about the learning environment, equitable participation and standards 11 to 13 in Domain 4 concerning wider professional responsibilities. The content of these standards remains much the same across the different specialist fields, however each still needs to be elaborated carefully.

Last, a key feature of the NBPTS standards is that they have been developed *with their assessment purposes in mind*. They have been developed so that they provide a clear guide about what is to be assessed. It is clear that the standards call for different types of assessment. Some, such as Standard 2, call for written assessments that cover the subject matter knowledge expected of science teachers. Others, such as Standards 1 and 10, also call for assessments of a teacher’s knowledge about how to help students learn that subject matter and how to identify and deal with difficulties that may arise. (Teachers applying for National Board certification attend designated assessment centres where their knowledge is assessed by means of computer delivered constructed response exercises.)

Standards 7, 8 and 9 call for a different kind of assessment. They call for evidence of a teacher’s *performance* in providing three different kinds of opportunity for students to learn. This is where the NBPTS has made a major contribution to methods of teacher assessment. It has engaged the services of experts in educational assessment to develop structured portfolio tasks based, for example, on samples of student work over time that demonstrate learning, and videotapes of classroom interaction that demonstrate the ability to sustain quality discussion. The NBPTS has also developed portfolio tasks designed to assess standards in Domain 4, based on records of contribution to the school and professional community.

Teachers applying for NB certification complete a total of ten assessment tasks; six assessments centre exercises and four portfolio exercises. Together, these exercises provide evidence for each of the thirteen standards in several forms. The exercises are assessed by teachers who work in the same field of teaching, who have been trained to high levels of consistency.

The length of subject-specific standards such as those of the NBPTS is a concern to some. They are usually more detailed than generic standards. Administrators are usually more concerned about this than teachers in our experience. While brevity may be a virtue in some circumstances, the danger with generic sets of standards is that, on close analysis, they can be devoid of educational meaning and purpose. They do not reflect well the complexity and sophistication of what good teachers know and do. They lack, therefore, the capacity to inspire, which is basically the original meaning of a standard. Because of their generality, they have a limited capacity to guide teacher education or to measure. They are also less likely to gain the respect that teachers have for standards such as those teachers have developed for the NBPTS.

### Teaching Standards in Chile

Chile provides an example of a country that has made rapid progress in the development of teaching standards over the past ten years (Meckes, 2011). What makes this development highly relevant to other countries is the extent to which Chile has gone beyond generic teaching standards to develop elaborated standards specific to primary teachers and specialist teachers in secondary schools.

In 2003, the Chilean Ministry of Education published a generic *Framework of Good Teaching*, after a wide process of consultation with teachers and other stakeholders. This framework is now widely used for the assessment of practising teachers. Every public school teacher has to undergo an assessment every four years.

During the 2000s, concern grew in Chile about the performance of Chilean students on international tests of student achievement, such as PISA and TIMSS. An OECD report on the Chilean education system in 2004 identified weaknesses in the teacher education system as one of the reasons, especially weaknesses in the system for accrediting teacher education programs. Mechanisms for assuring the quality of the teacher education system and the quality of beginning teachers were weak. There was an oversupply of graduates. The IEA TEDS-M study showed that future teachers of mathematics graduating from teacher education programs scored significantly lower on tests of mathematical knowledge and pedagogical knowledge in mathematics than most countries participating in the study (Ingvarson, et al., forthcoming).

As a result of these concerns, in 2009 the Chilean Ministry of Education commissioned the development of national standards for graduate primary teachers and methods for assessing graduates against the standards. The existing generic Framework of Good Teaching needed to be elaborated if it was to be useful for planning the content of teacher education programs and assessing graduates. It contained statements such as

- Teachers master the contents of the subjects they teach and they know the National Curriculum.
- They know about the new developments in their field.
- They understand the relationships between the contents they teach and those of other disciplines and they can establish relationships between these contents and the real world.
- Teachers know how to teach their subject and are knowledgeable about different pedagogic strategies that are consistent with learning goals.

The knowledge and skills needed to teach each subject were not sufficiently specified by the Framework of Good Teaching. Greater specificity was needed about the knowledge that beginning teachers should be able to demonstrate in the subjects that they would be expected to teach; namely, Language, Mathematics, Science and Social Studies; and what they should know about how to teach those subjects.

In 2011, the Government published the new national standards for graduate primary teachers, which now specify the knowledge and skills required to teach each subject to primary pupils. Chile is one of the few countries that have developed standards to this depth. Teams consisting of teachers, teacher educators and subject specialists developed them. National tests, aligned to the standards to be undertaken by teachers at the end of their initial teacher training, will also be developed. Success on the tests will be required for teachers applying for positions in schools that receive public funding.

The Government has commissioned similar development work on standards for graduates from secondary teacher education programs in History, Mathematics, Language, Chemistry, Biology and Physics. Standards are also being developed for graduates from pre-school programs.

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### CHARACTERISTICS OF WELL-WRITTEN STANDARDS

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The NBPTS in the USA and Chile provide examples of well-written standards that drill down to elucidate the kind of knowledge teachers should have about the subject matter they are expected to teach and how to help students learn it: standards for accomplished teachers in the case of the NBPTS, and standards for beginning teachers in the Chile case. These standards form a more valid and useful basis on which to develop assessments of teacher knowledge and performance than generic standards.

For example, it is common to find a statement such as the following in sets of generic standards:

*Accomplished teachers use a range of teaching strategies*

This kind of statement is of little use in as a guide to the content of teacher education programs, or as a basis for developing methods for assessing teacher performance. It focuses on what the teaching is doing rather than what the students are learning. What would counts as meeting the standards is unclear. It ignores the fact that appropriate strategies are deeply dependent on what is being taught and to whom.

What a primary teacher needs to know about strategies for teaching reading is very different from what a secondary mathematics teacher needs to know about strategies for teaching calculus. Teaching standards need to identify these differences. Recent research, for example, indicates the importance of a teacher's subject-specific pedagogical knowledge in promoting student learning (e.g. Baumert et al., 2010). Hill, Rowan & Ball, (2005) use the expression "knowledge of mathematics for teaching" to describe this kind of knowledge in the case of primary teachers.

As mentioned earlier, well-written standards for teachers are grounded in a clear understanding of what counts as quality learning for students in particular subject areas or at levels of

schooling. Take for example this extract from one standard in a set of standards for accomplished science teachers developed by the Australian Science Teachers Association (2002):

**Standard:** *Accomplished teachers of science engage students in scientific inquiry. .*

**Elaboration:** *Highly accomplished teachers of science guide their students in active inquiry which leads students to observe and measure phenomena, formulate hypotheses, record data and reach tentative conclusions consistent with data collected. Their students reflect on the knowledge that results and consider ways to refine the investigation. They analyse and evaluate the evidence they have collected in order to check the validity of their findings.*

*Their teaching reflects both the excitement and challenge of scientific endeavour and its distinctive rigour. They both teach and model practices that allow their students to approach knowledge and experiences critically, recognise problems, ask questions and pose solutions. They actively involve students in a wide range of scientific investigations . . . (p. 18).*

This standard goes on at greater length to describe an important element of what counts as quality learning, *in science classrooms*.

This standard clearly invites the teacher to show how they engage students actively in *doing* science in their school. What kind of assessment does it call for? Clearly, not some kind of national achievement test; it calls for methods of assessment that reflect the complexity of what the teacher is trying to do. It calls for *evidence of what the students are doing and learning as a direct result* of the teacher is teaching.

Several features of a standard such as this are noteworthy. The first is that it points to a large, meaningful and significant “chunk” of a science teacher’s work – it is an example of the challenging educational aims they are trying to achieve. It is not a micro-level competency, or a personality trait. It is a valid thing to ask a science teacher to do to show they are an accomplished teacher.

The second is that the standard is context-free; in the sense that it describes a practice that most agree accomplished science teachers should follow no matter where the school is. By definition, a professional standard applies to all contexts in which teachers work (which is not to say context does not affect practice). No matter where a school is, engaging students in scientific inquiry is likely to be regarded as a core responsibility of science teachers.

The third feature is that the standard is non-prescriptive about teaching strategies or how to engage students in “doing science” and “thinking scientifically”; it does not standardise practice or force teachers into some kind of straightjacket. There are many ways to engage students in scientific enquiry. While the standard identifies an essential element of good science teaching, it does not prescribe how the standard is to be met. In this way, the standard also allows for diversity and innovation. Teachers are invited to show how they meet this standard; how they engage students in scientific enquiry.

The fourth feature is that, as a standard, it points to something that is measurable, or observable. It is possible to imagine the kinds of evidence that a science teacher will assemble over time to show that they meet the standard, such as samples of students’ work or videotape segments over time provided by the teacher.

These features apply to standards in all teaching fields, whether primary or secondary. In summary, using science teaching again as an example, well-written standards:

- are grounded in clear guiding conceptions of quality learning and what it means to do (e.g. science);
- are valid; that is, they represent what teachers who promote quality learning opportunities for students to learn know and do;
- identify the unique features of what teachers *know* and *do*;
- delineate the main dimensions of development the profession expects of a teacher of (e.g. science) –i.e. what (science teachers) should get better at over time, with adequate opportunities for professional development; and
- are assessable; that is, point to potentially observable features and actions.

When teachers examine their practice in the light of a well-written standard such as that above, it provides numerous opportunities for professional development. The standard raises questions such as, “Am I really engaging my students in what it means to do science? What does scientific inquiry mean anyway?” And so on.

In this context, it is important not to polarise or separate standards for developmental purposes and standards for assessment purposes, as some do. A teacher’s development depends in large part on useful feedback and assessments of their performance. Standards will be useful for professional reflection and professional development to the extent that they are useful for assessing performance. The more insightful the assessment, whether self-assessment or feedback from colleagues, the more useful it will be for improving their performance. Improvement of performance in teaching, as for any skill, feeds off accurate, informative feedback. We have come to understand much better how diagnostic assessment is vital to effective classroom teaching (e.g. Black, et al. 2004) – and how the process of assessment can be a vehicle for student learning. This is no less true for teaching and learning to teach or to be a better teacher.

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## STANDARDS-BASED ASSESSMENT OF TEACHERS

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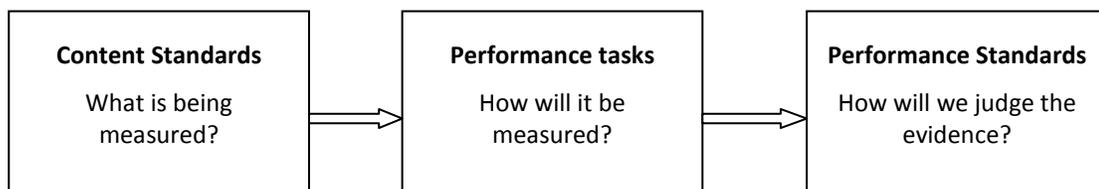
When standards are to be used for assessment and decision-making purposes such as selection, or certification, there are three essential steps in their development. These are:

1. Defining what is to be assessed – e.g. what do beginning teachers need to know and be able to do. (This is what standards framework aim to do. These are often called *content* standards);
2. Developing valid and consistent methods for gathering evidence about what a teacher knows and is able to do in relation to the standards (performance tasks); and
3. Setting standards; this depends on developing reliable procedures for assessing that evidence and deciding whether a teacher has met the standard. (This will depend on developing *performance* standards, in addition to content standards).

In other words, if standards are used in assessing teachers for high-stakes purposes, such as graduation, selection or certification, there are three essential steps in their development, as shown in Figure 11.

Sykes' and Plastrik (1993) define a standard as 'a tool for rendering appropriately precise the making of judgements and decisions in a context of shared meanings and values'. This is a useful reminder that a full set of standards must point not only to what will be measured, but also to how evidence about capability and performance will be gathered, and how judgments will be made about whether the standards have been met.

**Figure 11: Conceptual framework for developing standards-based assessments**



In this sense, standards are not regarded as fully developed until it has been made clear how they will be used to judge performance. A full set of standards must not only describe what good teachers know and do (i.e. what will be assessed), it must also describe how evidence about capability and performance will be gathered, and how judgments will be made about whether the standards have been met. Standards are not fully developed until it has been made clear how they will be used to judge performance (Ingvarson & Hattie, 2008).

The Olympic Decathlon provides a good illustration of the steps involved in developing a standards-based system for assessing performance. The concept behind the Decathlon is the great all-round athlete. The origins of the decathlon go back to early 20<sup>th</sup> Century when King Gustav V of Sweden told the American Jim Thorpe, "You, sir, are the World's Greatest Athlete".

People used to argue, apparently, about what makes a great all-round athlete, just as they still argue about what makes a good teacher. They realised the concept needed definition. What should all-round athletes be able to do? After a lot of debate they decided that the main elements of what constituted a great all-round athlete were *strength, speed, stamina, endurance and perseverance*. In other words, they defined what should be assessed - the *content* standards as it were - if one was to judge whether someone was a good all round athlete.

The next step was to reach agreement on how to judge the all-round athlete; how to assess strength, speed, etc. What should an athlete be asked to do to provide evidence that they are good all-round athlete? Ten events over two days were decided upon somehow, and the concept was thereby operationalised. On day 1 the events are 100 metres, Long Jump, Shot Put, High Jump, and 400 metres. On day 2, the events are 110 metres hurdles, Discus, Pole Vault, Javelin, 1500 metres.

A set of ten events was seen as a sufficient *sample* of evidence on which to make judgments about an athlete's overall ability as an all-round athlete. Of course, the choice of events has to

be somewhat arbitrary (e.g. why 100 instead of 200 metres?), but the events *as a group* must be selected to ensure that there is more than one kind of evidence for each of the elements (i.e. the standards). When evidence about each element is gathered in more than one way, the reliability of the assessment is increased. (This is a fundamental point to keep in mind when assessing teacher performance).

Finally, they needed to *set* the performance standards, which meant reaching agreement on the level of performance in each event that met the standard. Several “benchmark” levels have been set for each event in the Decathlon. (For example, if you run 100 metres in 10.395 seconds you earn 1000 points, 10.827 seconds earns 900 points, 11.278 earns 800 points and 11.756 earns 700 points, and so on for each event).

The overall level of performance is determined by weighting and combining the performance across all events. *Performance standards* not only need to specify how well an athlete must do in *each* event to qualify; they need to specify how well they must do across *all* events on the average to be rated a good all round athlete. Athletes must participate in the same set of events; there is no choice. However, a good performance in one event can compensate for a poor performance in another.

The Decathlon provides a useful example of what is involved in establishing a nationally consistent certification system. It is difficult to imagine that the decathlon would have gained respect if each country had been left to decide on its own events and performance standards. It is equally difficult to see how a respected system for the certification to graduate or accomplished teachers could emerge if each region or local education authority developed its own assessment methods, using the national standards only as a framework. A profession-wide certification system would need nationally consistent methods of assessment and scoring of those assessment tasks.

Similar steps apply to any system that aims provide valid, reliable and fair assessments of teaching (Gitomer, 2009; Pearlman, 2008; Kennedy, 2010). Generic standards framework need to be elaborated before they can be used to assess teacher knowledge and practice. They need to explain what teachers in various fields are expected to know about what they teach and what their students are expected to learn.

It is important to note that standards include a range of different types of knowledge, practices and professional responsibilities. Ideally, the methods chosen for assessment need to cover all the standards (it is recognised that this will not be possible at the graduate level). Therefore, to maximise the reliability of any decision based on the standards, it will be essential to use a range of different assessment methods and different assessors.

Where possible, each method should provide evidence against several standards at the same time. Ideally, the assessments tasks should be valid or “authentic”; that is, they should be based on meaningful chunks of the typical work that teachers do in teaching their discipline. For example, they should represent what a science teacher needs to know and do to promote quality learning opportunities for students to learn science. The most successful types of evidence for this purpose have been highly structured portfolio entries and assessment centre exercises. These assessments provide evidence relevant to several standards at the same time.

## STANDARDS-BASED TEACHER EDUCATION: INTERNATIONAL DEVELOPMENTS

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There is an international trend toward the use of standards to guide and accredit teacher education programs (Darling-Hammond & Bransford, 2005; Wise, et al. 2008; Kennedy, 2010; Ingvarson, Elliott, Kleinhenz and McKenzie, 2006). Countries that have adopted standards-based approaches to teacher education at some level include, among others, Australia, Canada, Chile, England, Germany, Jordan, New Zealand, the Philippines, Scotland, Singapore, Thailand, and the USA.

Most of these countries have established national or state level agencies with responsibility for developing and applying standards for accreditation of teacher education programs and certification of new teachers. The General Teaching Council for Scotland is one example; the Victorian Institute of Teaching in Australia is another. A report from Eurydice, *Quality Assurance in Teacher Education in Europe* (Eurydice, 2006) provides a comprehensive summary of procedures for evaluating and accrediting initial and in-service teacher education in European countries.

Standards aim to clarify the knowledge, capabilities and values that future teachers should gain from their teacher education programs. Standards thereby give teacher education providers clear direction about the *opportunities to learn* that their programs should provide, without prescribing how they should prepare teachers. They make clear to students what they are expected to show they know and are able to do before they will be eligible to join the teaching profession. They provide a sounder basis for assessing and accrediting teacher education programs than traditional approaches that focused on course contents and inputs. By focussing on outcomes they encourage diversity and innovation in teacher education and provide a basis for conducting research on the relative effectiveness of different approaches to helping new teachers meet the standards.

The core components in a standards-based teacher education 'system' include:

1. *Standards* that describe what beginning teachers should know and be able to do as a result of their preparation and thereby provide a guide to professional learning.
2. A *coherent* program for professional learning wherein each course in the program is justified in terms of how it enables students to meet particular teaching standards - and the courses, collectively, cover all the standards.
3. Graduation from the program and certification are based on a range of authentic tasks and performance *assessments* that together provide reliable evidence that students meet all the standards.
4. *Accreditation* of teacher education programs is conducted by an independent professional body and is based on valid and reliable evidence that graduates meet standards for certification and full entry to the profession.

Together, these components form a *system* of mutually supporting elements that strengthen teacher education programs. Alone, their effects on teacher education programs will be minimal. Take one away and the capacity of the system to support effective teacher preparation is undermined.

In theory, the emphasis of standards-based teacher education on outcomes opens greater opportunity for innovation and experimentation, than traditional approaches to accreditation, which tended to focus more on reviewing inputs, such as the nature of course content, reading lists, assignments, and such. One of the main aims of the Interstate Teacher Assessment and Support Consortium (InTASC) standards, for example, is to support reform of teacher preparation and development.

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## RATIONALE FOR STANDARDS-BASED TEACHER EDUCATION

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Perhaps the main justification for the shift to standards-based teacher education is to improve the design of teacher education programs, making them more consistent with what is known about “how teachers learn and develop as professionals” and how they can become “adaptive experts” (e.g. Hammerness et al. 2005, p. 358).

While there is no best way to design teacher education programs, Darling-Hammond et al. (2005) identify several common considerations in designing standards-based programs. A critical one is program coherence. A feature of coherent programs is that aims and objectives for each course within the program are described in terms of their contribution to helping students meet particular standards. Coherence within teacher education programs is clearly important and a shared framework of standards helps to promote this.

Courses within standards-based programs are more likely to be carefully sequenced and to build on each other. They are guided by a consistent vision and model of good teaching, which is constantly revisited. Coherence also refers to strong links between formal coursework, school experiences and assignments. School supervisors share a common understanding with university staff about the standards to be used in assisting student teachers and providing them with feedback about their performance. School experience begins early and occurs regularly. Students are regularly asked to show how they have applied what they are currently learning about in their coursework in school settings.

Darling-Hammond et al. (2005) review research studies showing that standards-guided teacher education programs have a greater impact on “the initial conceptions and practices of prospective teachers than those that remain a collection of relatively disconnected courses. A recent international study of teacher education in seventeen countries also showed a significant relationship between course coherence and perceptions of preparedness among new teachers (Ingvarson et al., forthcoming).

A feature of standards-based teacher education programs is the effort that program designers put into ensuring that the preparation of teachers is based on a genuine partnership between practising teachers and university staff, one that is reflected both in decision making and allocation of funding for teacher education.

Program designers also make explicit to accreditation bodies the fundamental principles of sound pedagogy (i.e. the standards) and the methods they will use to ensure future teachers will learn to implement them. This should not be interpreted as standardising teaching. A well-written set of standards provides a pedagogical framework for thinking about teachers' work and a flexible tool that enables graduates to feel well prepared for the demands of teaching.

Another important design consideration stems from research that demonstrates the central importance of content knowledge to effective teaching (e.g. Hill et al., 2005; Goulding et al. 2002; Kelcy, 2011; Kersting et al. 2012). This includes opportunity for new teachers to gain a deep understanding of the subject matter they will be expected to teach, coupled with content-specific teaching and assessment methods - and knowledge about the difficulties students typically have in learning that content and how to deal with them. There has been a marked shift in Australia over the past fifteen years from generic pedagogy courses to content-focused courses in this sense, and this shift can be attributed in part to the introduction of teaching standards.

There is research indicating that a focus on content and how students learn it is a key characteristic of teacher education programs that have a greater impact on student learning (E.g. Hawley and Valli, 1999; Kennedy, 1999). Research-based standards typically draw attention to the importance of ensuring that programs provide sufficient opportunity to learn content in this sense. Ideally, standards are based on syntheses of research on teaching and learning in particular content areas.

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## ACCREDITATION OF TEACHER EDUCATION PROGRAMS

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The 2005 OECD report *Teachers Matter* (OECD, 2005) drew attention to broad concerns about the supply of talented teachers in many countries, particularly in mathematics and science. It also drew attention to the concern in many countries that arrangements for assessing and accrediting teacher education institutions and programs are weak and have little impact on the quality of teacher education. The authors argue that accreditation criteria should focus more on outcomes of teacher education programs and standards that describe what beginning teachers should know and be able to do as a result of their training.

Similarly, the OECD report documents the growing trend for countries to introduce policies requiring the certification of new teachers, in addition to completion of teacher education programs, before they can gain full entry to the profession. Teacher certification based on professional standards was a policy lever that governments were using increasingly to influence teacher education programs and align them more closely with the needs of schools.

A feature of standards-based teacher education programs is that graduation and initial certification decisions are based increasingly on evidence that students can meet performance standards, rather than traditional forms of assessment used in university courses and examinations (Wilson & Youngs, 2005). Bodies such as the National Council for Accreditation of Teacher Education (NCATE) in the USA having been promoting standards-based teacher education and a move to outcomes-based accreditation for many years (Wise, Ehrenberg & Leibbrand, 2008).

The past fifteen years or so have seen the development of more sophisticated methods for assessing teacher pedagogical content knowledge and performance against teaching standards (e.g. Gitomer, 2009; Kennedy, 2010). The National Research Council in the USA released a report in 2001 surveying the tests used for teacher licensure in the USA (NRC, 2001). Well-written standards provide a model or structure that reflects the dynamic of what it means to think and act like a teacher – including knowledge of students and their needs, selecting worthwhile goals and activities to meet those goals, evaluation of what has been learned and reflection on teaching.

New forms of assessment, such as those developed by the Performance Assessment for California Teachers (PACT) project (Wei and Pecheone, 2010), or the Teacher Work Sample project at Western Oregon University (Shalock, Shalock & Girod, 1997) engage student teachers in designing units of work, analysing student learning over time and evaluating their own performance against standards. Standards-based programs usually place future teachers in the active role of developing a portfolio over time of evidence showing how they meet the standards, and reflecting on that evidence. This is consistent with research on effective modes of professional development (Borko et al., 1997). Teaching standards provide a cognitive map or schema that helps future teachers understand the main dimensions of good teaching and how they fit together.

Box 2 provides an example of how standards-based assessments are built into the Teacher Education Program at Stanford University in the USA to help students meet the “Teaching Performance Expectations” laid down by the California Council on Teacher Credentialing. Another interesting development toward an outcomes-oriented approach to teacher education is the work of Deborah Ball and her team at the University of Michigan. Their project, called TeachingWorks, aims to identify a set of core skills that graduate teachers should be able to perform. Teacher education programs would be built around these “high leverage practices”, providing materials and resources to support practising those skills and methods for assessing their achievement.

External accreditation by an independent professional body is a key component of standards-based teacher education systems. Bodies such as the National Council for Accreditation of Teacher Education (NCATE) in the USA have been promoting standards-based teacher education and a move to outcomes-based accreditation for many years (Wise, Ehrenberg & Leibbrand, 2008). England has arguably one of the most highly regulated teacher education systems in the world, but unlike NCATE, there is limited involvement by the profession or professional bodies in developing its standards or its operation. The government in Chinese Taipei delegates considerable responsibility for the accreditation system to academics and teacher educators, yet it is one of the few examples of systems that have actually discredited teacher educator programs (Ingvarson et al, Forthcoming).

A report from McKinsey & Company (Barber and Mourshed, 2007) provided findings similar to those of the ETS study above. Their report, *How the world's best performing school systems come out on top*, also found a relationship between teacher quality policies and student outcomes, this time relying on PISA measures of student achievement.

**Box 2: Embedded Assessment in the Stanford Teacher Education Program (Extract from STEP report to NCATE)**

Throughout the program, standards-based assessments are also integrated into coursework. To increase the likelihood of candidate success in their future independent practice, these assessments are linked to the program's conceptual framework and to the research base about teaching practices that best support student learning. STEP candidates complete case studies and performance tasks that build sequentially upon one another, which require candidates to use key concepts and theories to analyse their clinical experiences. Candidates plan lesson sequences, create assessment tools, use technology-based materials, analyse the work of diverse learners, and design and implement curriculum units. Additionally, they prepare a classroom management plan and identify opportunities for family involvement. Throughout the year candidates write reflections in which they consider their progress in relationship to the standards. (See, for example, candidates' post-observation reflections and summary reflections included in the graduation portfolio.) Major course assignments are graded by the team of instructors for that course (typically including both professors and teaching assistants), who collaboratively develop the criteria, discuss candidate work together, and ensure that assignments are reviewed by multiple readers if there are concerns about the extent to which a candidate's work has met those criteria. Candidates receive the criteria and/or a rubric for major assignments early in the course so they understand the standards by which their work will be evaluated. At the end of every quarter, the program directors review course grades as one measure of candidates' progress and confer with instructors in cases where a candidate seems to be struggling. Instructors who identify specific concerns about a candidate's work bring these issues to the attention of the program director, who then follows up with other instructors, the supervisor, and/or the cooperating teacher to gather additional evidence about the candidate's progress.

Several studies document weaknesses in teacher education in the USA, that partly explain the trend to standards-based approaches. A study conducted by the National Council on Teacher Quality (Greenberg and Walsh, 2008), *No Common Denominator: the Preparation of Elementary Teachers in Mathematics by America's Education Schools*, found wide variation in teacher education practices in the USA – particularly the proportion of courses within programs that focus on teaching the mathematics those primary teachers will be expected to teach and how to teach that mathematics content. A major review of teacher education in the USA (Levine, 2006), pointed to the lack of coherence within teacher education programs and the need for standards “to counter the relativism and the “anything goes” mentality that dominate teacher education today, leading to a multiplicity of disjointed and conflicting programs” (p. 106).

In 2005, the AERA Panel on Research and Teacher Education published a report titled *Studying Teacher Education*, edited by Marilyn Cochran-Smith, and Ken Zeichner. A chapter by Suzanne Wilson and Peter Youngs focuses on research related to accountability processes in teacher education, such as certification and accreditation. As there is considerable variation from state

to state in how consistently these processes are applied, Wilson and Youngs found it difficult to arrive at definitive conclusions on the effects of certification and accreditation. However, they did find that most studies that focused on mathematics showed a positive correlation between certification as a mathematics teacher and student achievement.

Wilson and Youngs (2005) identify a trend to develop standards-based measures of beginning teacher knowledge and performance, such as the PRAXIS II and III series of assessments (Dwyer, 1994), and the Performance Assessment for California Teachers (PACT) tests being developed for a new licensing scheme in that state (Wei & Pecheone, 2010). It is hoped that such research will provide more reliable benchmarks against which to judge the quality of teacher education programs and graduates in the future.

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# APPENDIX 1

## EXAMPLES OF GENERIC STANDARDS FRAMEWORKS FOR BEGINNING TEACHERS

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## APPENDIX 1A

# NATIONAL PROFESSIONAL STANDARDS FRAMEWORK FOR ENGLAND

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### STANDARDS FOR QUALIFIED TEACHER STATUS

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#### **PROFESSIONAL ATTRIBUTES**

Those recommended for the award of QTS should:

##### **Relationships with children and young people**

1. Have high expectations of children and young people including a commitment to ensuring that they can achieve their full educational potential and to establishing fair, respectful, trusting, supportive and constructive relationships with them.
2. Demonstrate the positive values, attitudes and behaviour they expect from children and young people.

##### **Frameworks**

3. a) Be aware of the professional duties of teachers and the statutory framework within which they work.  
b) Be aware of the policies and practices of the workplace and share in collective responsibility for their implementation.

##### **Communicating and working with others**

4. Communicate effectively with children, young people, colleagues, parents and carers.
5. Recognise and respect the contribution that colleagues, parents and carers can make to the development and well-being of children and young people, and to raising their levels of attainment.
6. Have a commitment to collaboration and co-operative working.

##### **Personal professional development**

7. a) Reflect on and improve their practice, and take responsibility for identifying and meeting their developing professional needs.  
b) Identify priorities for their early professional development in the context of induction.
8. Have a creative and constructively critical approach towards innovation, being prepared to adapt their practice where benefits and improvements are identified.
9. Act upon advice and feedback and be open to coaching and mentoring.

## **PROFESSIONAL KNOWLEDGE AND UNDERSTANDING**

Those recommended for the award of QTS should:

### **Teaching and learning**

10. Have a knowledge and understanding of a range of teaching, learning and behaviour management strategies and know how to use and adapt them, including how to personalise learning and provide opportunities for all learners to achieve their potential.

### **Assessment and monitoring**

11. Know the assessment requirements and arrangements for the subjects/ curriculum areas they are trained to teach, including those relating to public examinations and qualifications.
12. Know a range of approaches to assessment, including the importance of formative assessment.
13. Know how to use local and national statistical information to evaluate the effectiveness of their teaching, to monitor the progress of those they teach and to raise levels of attainment.

### **Subjects and curriculum**

14. Have a secure knowledge and understanding of their subjects/curriculum areas and related pedagogy to enable them to teach effectively across the age and ability range for which they are trained.
15. Know and understand the relevant statutory and non-statutory curricula and frameworks, including those provided through the National Strategies, for their subjects/curriculum areas, and other relevant initiatives applicable to the age and ability range for which they are trained.

### **Literacy, numeracy and ICT**

16. Have passed the professional skills tests in numeracy, literacy and information and communications technology (ICT).
17. Know how to use skills in literacy, numeracy and ICT to support their teaching and wider professional activities.

### **Achievement and diversity**

18. Understand how children and young people develop and that the progress and well-being of learners are affected by a range of developmental, social, religious, ethnic, cultural and linguistic influences.
19. Know how to make effective personalised provision for those they teach, including those for whom English is an additional language or who have special educational needs or disabilities, and how to take practical account of diversity and promote equality and inclusion in their teaching.

20. Know and understand the roles of colleagues with specific responsibilities, including those with responsibility for learners with special educational needs and disabilities and other individual learning needs.

### **Health and well-being**

21. a) Be aware of the current legal requirements, national policies and guidance on the safeguarding and promotion of the well-being of children and young people.  
b) Know how to identify and support children and young people whose progress, development or well-being is affected by changes or difficulties in their personal circumstances, and when to refer them to colleagues for specialist support.

## **PROFESSIONAL SKILLS**

Those recommended for the award of QTS should:

### **Planning**

22. Plan for progression across the age and ability range for which they are trained, designing effective learning sequences within lessons and across series of lessons and demonstrating secure subject/curriculum knowledge.  
23. Design opportunities for learners to develop their literacy, numeracy and ICT skills.  
24. Plan homework or other out-of-class work to sustain learners' progress and to extend and consolidate their learning.

### **Teaching**

25. Teach lessons and sequences of lessons across the age and ability range for which they are trained in which they:  
(a) use a range of teaching strategies and resources, including e-learning, taking practical account of diversity and promoting equality and inclusion  
(b) build on prior knowledge, develop concepts and processes, enable learners to apply new knowledge, understanding and skills and meet learning objectives  
(c) adapt their language to suit the learners they teach, introducing new ideas and concepts clearly, and using explanations, questions, discussions and plenaries effectively  
(d) demonstrate the ability to manage the learning of individuals, groups and whole classes, modifying their teaching to suit the stage of the lesson.

### **Assessing, monitoring and giving feedback**

26. (a) Make effective use of a range of assessment, monitoring and recording strategies.  
(b) Assess the learning needs of those they teach in order to set challenging learning objectives.  
27. Provide timely, accurate and constructive feedback on learners' attainment, progress and areas for development.

28. Support and guide learners to reflect on their learning, identify the progress they have made and identify their emerging learning needs.

### **Reviewing teaching and learning**

29. Evaluate the impact of their teaching on the progress of all learners, and modify their planning and classroom practice where necessary.

### **Learning environment**

30. Establish a purposeful and safe learning environment conducive to learning and identify opportunities for learners to learn in out-of-school contexts.
31. Establish a clear framework for classroom discipline to manage learners' behaviour constructively and promote their self-control and independence.

### **Team working and collaboration**

32. Work as a team member and identify opportunities for working with colleagues, sharing the development of effective practice with them.
33. Ensure that colleagues working with them are appropriately involved in supporting learning and understand the roles they are expected to fulfil.

## APPENDIX 1B

# AOTEAROA NEW ZEALAND: GRADUATING TEACHER STANDARDS

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These standards recognise that the Treaty of Waitangi extends equal status and rights to Māori and Pākehā alike.

Graduates entering the profession will understand the critical role teachers play in enabling the educational achievement of all learners.

### Professional Knowledge

#### Standard One: Graduating Teachers know what to teach

- a. have content knowledge appropriate to the learners and learning areas of their program.
- b. have pedagogical content knowledge appropriate to the learners and learning areas of their program.
- c. have knowledge of the relevant curriculum documents of Aotearoa New Zealand.
- d. have content and pedagogical content knowledge for supporting English as an Additional Language (EAL) learners to succeed in the curriculum.

#### Standard Two: Graduating Teachers know about learners and how they learn

- a. have knowledge of a range of relevant theories and research about pedagogy, human development and learning.
- b. have knowledge of a range of relevant theories, principles and purposes of assessment and evaluation.
- c. know how to develop metacognitive strategies of diverse learners.
- d. know how to select curriculum content appropriate to the learners and the learning context.

#### Standard Three: Graduating Teachers understand how contextual factors influence teaching and learning

- a. have an understanding of the complex influences that personal, social, and cultural factors may have on teachers and learners.
- b. have knowledge of tikanga and te reo Māori to work effectively within the bicultural contexts of Aotearoa New Zealand.
- c. have an understanding of education within the bicultural, multicultural, social, political, economic and historical contexts of Aotearoa New Zealand.

## Professional Practice

### **Standard Four: Graduating Teachers use professional knowledge to plan for a safe, high quality teaching and learning environment**

- a. draw upon content knowledge and pedagogical content knowledge when planning, teaching and evaluating.
- b. use and sequence a range of learning experiences to influence and promote learner achievement.
- c. demonstrate high expectations of all learners, focus on learning and recognise and value diversity.
- d. demonstrate proficiency in oral and written language (Māori and/or English), in numeracy and in ICT relevant to their professional role.
- e. use te reo Māori me ngā tikanga-a-iwi appropriately in their practice.
- f. demonstrate commitment to and strategies for promoting and nurturing the physical and emotional safety of learners.

### **Standard Five: Graduating Teachers use evidence to promote learning**

- a. systematically and critically engage with evidence to reflect on and refine their practice.
- b. gather, analyse and use assessment information to improve learning and inform planning.
- c. know how to communicate assessment information appropriately to learners, their parents/caregivers and staff.

## Professional Values & Relationships

### **Standard Six: Graduating Teachers develop positive relationships with learners and the members of learning communities**

- a. recognise how differing values and beliefs may impact on learners and their learning.
- b. have the knowledge and dispositions to work effectively with colleagues, parents/caregivers, families/whānau and communities.
- c. build effective relationships with their learners.
- d. promote a learning culture which engages diverse learners effectively.
- e. demonstrate respect for te reo Māori me ngā tikanga-a-iwi in their practice.

### **Standard Seven: Graduating Teachers are committed members of the profession**

- a. uphold the New Zealand Teachers Council Code of Ethics/Ngā Tikanga Matatika.
- b. have knowledge and understanding of the ethical, professional and legal responsibilities of teachers.
- c. work co-operatively with those who share responsibility for the learning and wellbeing of learners.
- d. are able to articulate and justify an emerging personal, professional philosophy of teaching and learning.

# APPENDIX 1C

## GENERAL TEACHING COUNCIL FOR SCOTLAND

### STANDARD FOR INITIAL TEACHER EDUCATION (SITE)

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The Standard for Initial Teacher Education (SITE) outlines what is expected of a student teacher at the end of Initial Teacher Education, seeking provisional registration with us.

The elements of the Standard provide a comprehensive set of benchmark statements which are the requirements for each programme of Initial Teacher Education in Scotland.

Programmes of Initial Teacher Education need to promote three main aspects of professional development:

- Professional knowledge and understanding
- Professional skills and abilities
- Professional values and personal commitment

#### Elements of the Standard

The Elements of the Standard specify what is expected of a student teacher at the end of Initial Teacher Education and also the design requirements for programmes of Initial Teacher Education.

#### 1. Professional knowledge and understanding

| ASPECT OF PROFESSIONAL DEVELOPMENT | ELEMENT OF THE STANDARD   |
|------------------------------------|---|
| 1.1 Curriculum                     | 1.1.1 Acquire knowledge and understanding of the relevant area(s) of pre-school, primary or secondary school curriculum.  |
|                                    | 1.1.2 Acquire the knowledge and understanding to fulfil their responsibilities in respect of cross-curricular themes including citizenship, creativity, enterprising attitudes, literacy and numeracy; personal, social and health education; and ICT, as appropriate to the sector and stage of education. |
|                                    | 1.1.3 Acquire the knowledge and understanding to enable them to plan coherent and progressive teaching programmes, and justify what they teach.   |

|  |  |
|--|--|
|  | 1.1.4 Acquire an understanding of the nature of the curriculum and its development.  |
| 1.2 Education systems and professional responsibilities. | 1.2.1 Acquire a broad and critical understanding of the principal features of the education system, educational policy and practice. |
|  | 1.2.2 Acquire a good working knowledge of the sector in which they teach and their professional responsibilities within it.          |
| 1.3 Principles and perspectives.                         | 1.3.1 Draw on relevant principles, perspectives and theories to inform professional values and practices.                            |
|  | 1.3.2 Acquire an understanding of research and its contribution to education.  |

## 2. Professional skills and abilities

| ASPECT OF PROFESSIONAL DEVELOPMENT         | ELEMENT OF THE STANDARD   |
|--|---|
| 2.1 Teaching and learning                  | 2.1.1 Plan coherent, progressive teaching programmes which match their pupils' needs and abilities, and justify what they teach.                                |
|  | 2.1.2 Communicate effectively, using a variety of media, to stimulate pupils and achieve the objectives of lessons.   |
|  | 2.1.3 Employ a range of teaching strategies and justify their approach.   |
|  | 2.1.4 Set expectations and a pace of work which make appropriate demands on all pupils.   |
|  | 2.1.5 Work effectively in co-operation with other professionals, staff and parents in order to promote learning.  |
| 2.2 Classroom organisation and management. | 2.2.1 Organise classes and lessons to ensure that all pupils are safe and productively employed when working individually, in groups or as a class.             |
|  | 2.2.2 Manage pupil behaviour fairly, sensitively and consistently by the use of appropriate rewards and sanctions and know when it is necessary to seek advice. |
| 2.3 Pupil assessment                       | 2.3.1 Understand and apply the principles of assessment, recording and reporting.   |
|  | 2.3.2 Use the results of assessment to evaluate and improve teaching and to improve standards of attainment.  |

|  |  |
|--|--|
| 2.4 Professional reflection and communication. | 2.4.1 Access and evaluate professionally relevant literature.  |
|  | 2.4.2 Construct and sustain reasoned and coherent arguments about educational matters and professional practices.  |
|  | 2.4.3 Reflect on and act to improve the effectiveness of their own practice and contribute to the processes of curriculum development and school development planning. |

### 3. Professional values and personal commitment

| ASPECT OF PROFESSIONAL DEVELOPMENT              | ELEMENT OF THE STANDARD   |
|---|---|
| 3.0 Professional Values and Personal Commitment | 3.1 Value and demonstrate a commitment to social justice, inclusion and protecting and caring for children.             |
|   | 3.2 Value themselves as growing professionals by taking responsibility for their professional learning and development. |
|   | 3.3 Value, respect and show commitment to the communities in which they work.   |

## APPENDIX 1D

# USA: INTERSTATE TEACHER ASSESSMENT AND SUPPORT CONSORTIUM (INTASC)

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### THE MODEL CORE TEACHING STANDARDS

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[http://www.ccsso.org/Resources/Publications/InTASC\\_Model\\_Core\\_Teaching\\_Standards\\_A\\_Resource\\_for\\_State\\_Dialogue\\_\(April\\_2011\).html](http://www.ccsso.org/Resources/Publications/InTASC_Model_Core_Teaching_Standards_A_Resource_for_State_Dialogue_(April_2011).html)

#### **FREQUENTLY ASKED QUESTIONS**

The [Model Core Teaching Standards](#) were developed by states for states through the Council of Chief State School Officers' Interstate Teacher Assessment and Support Consortium (INTASC). The standards are voluntary and are intended as a resource for state dialogue. They are currently out for public comment.

#### **What are the Model Core Teaching Standards?**

The standards articulate a common core of teaching knowledge and skills that cut across all subject areas and grade levels. Their purpose is to outline what all teachers should know and be able to do to help all students reach the goal of being college and career ready in today's world. These standards are an update of the 1992 Model Standards for Beginning Teacher Licensing and Development: A Resource for State Dialogue, which were also developed by INTASC.

#### **How are the standards intended to be used?**

States can use the standards as a resource for:

- updating their own teacher standards to ensure they reflect the new knowledge and skills teachers need for today's learning context;
- drafting program approval requirements to ensure that preparation programs in their state provide teacher candidates with opportunity to learn these new knowledge and skills;
- outlining specifications for the design of teacher licensure assessments to ensure they are aligned to the standards; and
- setting professional development requirements for license renewal to ensure in-service teachers have opportunity to learn the new knowledge and skills.

Teacher education faculty and preparation program providers can use the standards as a resource to rethink and redesign their programs to ensure teacher candidates have access to learning opportunities that are aligned with the needs of today's learners and expectations of teachers.

Assessment developers can use the standards to design innovative, performance based, and team-based assessment tools that capture the complexities of today's teaching and learning.

Professional development providers can design learning opportunities and tools to promote continuous growth of teachers that is aligned to the standards.

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## SUMMARY OF THE INTASC<sup>2</sup> CORE TEACHING STANDARDS

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The standards have been grouped into four general categories to help users organize their thinking about the standards:

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### THE LEARNER AND LEARNING

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Teaching begins with the learner. To ensure that each student learns new knowledge and skills, teachers must understand that learning and developmental patterns vary individually, that students bring unique individual differences to the learning process, and that students need supportive and safe learning environments to thrive. Effective teachers have high expectations for each and every student and implement developmentally appropriate, challenging learning experiences within a variety of learning environments that help each and every student reach his or her full potential. They do this by combining a base of professional knowledge, including an understanding of how cognitive, linguistic, social, emotional and physical development occurs, with the recognition that students are individuals who bring differing personal and family backgrounds, skills, abilities, perspectives, talents and interests. Teachers collaborate with students, colleagues, school leaders, families, members of the students' communities, and community organizations to understand better their students and maximize their learning. They promote students' acceptance of responsibility for their own learning and collaborate with them to ensure the effective design and implementation of both self-directed and collaborative learning.

*Standard 1: Learner Development.* The teacher understands how children learn and develop, recognizing that patterns of learning and development vary individually within and across the cognitive, linguistic, social, emotional, and physical areas, and designs and implements developmentally appropriate and challenging learning experiences.

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<sup>2</sup> Interstate Teacher Assessment and Support Consortium

*Standard 2: Learning Differences.* The teacher uses understanding of individual differences and diverse communities to ensure inclusive learning environments that allow each learner to reach his/her full potential.

*Standard 3: Learning Environments.* The teacher works with learners to create environments that support individual and collaborative learning, encouraging positive social interaction, active engagement in learning, and self motivation.

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## CONTENT

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Teachers must have a deep and flexible understanding of their content area(s) and be able to draw upon it as they work with students to access information, apply knowledge in real world settings, and work with meaningful issues. Today's teachers make content knowledge accessible to students by using multiple means of communication, including digital media and information technology. They integrate cross-disciplinary skills (e.g., critical thinking, problem solving, creativity, communication) to help students use content to propose solutions, forge new understandings, solve problems, and imagine possibilities. Finally, they make content knowledge relevant to students by connecting it to local, state, national, and global issues.

*Standard 4: Content Knowledge.* The teacher understands the central concepts, tools of inquiry, and structures of the discipline(s) he or she teaches and creates learning experiences that make these aspects of the discipline accessible and meaningful for learners.

*Standard 5: Innovative Applications of Content.* The teacher understands how to connect concepts and use differing perspectives to engage learners in critical/creative thinking and collaborative problem-solving related to authentic local and global issues.

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## INSTRUCTIONAL PRACTICE

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Effective instructional practice today requires that teachers understand and integrate assessment, planning, and instructional strategies in coordinated and engaging ways. Beginning with their end or goal, teachers first identify student learning objectives and align assessments to those objectives. They understand how to design, implement and interpret results from a range of formative and summative assessments. This knowledge is integrated into the instructional practice so that teachers have access to information that can be used to provide immediate feedback to reinforce student learning and to modify instruction. Planning focuses on personalizing learning for each student by using a variety of appropriate and targeted instructional strategies to address unique and diverse ways of learning, to incorporate new technologies to maximize and individualize learning, and to allow students to take charge of their own learning and do it in creative ways.

*Standard 6: Assessment.* The teacher understands and uses multiple methods of assessment to engage learners in their own growth, to document learner progress, and to inform the teacher's ongoing planning and instruction.

*Standard 7: Planning for Instruction.* The teacher draws upon knowledge of content areas, cross-disciplinary skills, learners, the community, and pedagogy to plan instruction that supports every student in meeting rigorous learning goals.

*Standard 8: Instructional Strategies.* The teacher understands and uses a variety of instructional strategies to encourage learners to develop deep understanding of content areas and their connections, and to build skills to access and appropriately apply information.

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## PROFESSIONAL RESPONSIBILITY

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Creating and supporting learning environments that result in students achieving at the highest levels is a teacher's primary responsibility. To do this well, teachers must engage in professional self-renewal, which means they regularly examine their own and each other's practice through self-reflection and collaboration, providing collegial support and feedback that assures a continuous cycle of self-improvement. This kind of professional learning results in discovery and implementation of better practice for all. As professionals, teachers also contribute to practices that improve teaching and learning consistent with their school's mission and in collaboration with colleagues, school leaders, parents, guardians and other adults significant to students. They demonstrate leadership by modelling ethical behaviour and by contributing to positive changes in policy and practice around activities that connect school, families and the larger community.

*Standard 9: Reflection and Continuous Growth.* The teacher is a reflective practitioner who uses evidence to continually evaluate his/her practice, particularly the effects of his/her choices and actions on others (students, families, and other professionals in the learning community), and adapts practice to meet the needs of each learner.

*Standard 10: Collaboration.* The teacher collaborates with students, families, colleagues, other professionals, and community members to share responsibility for student growth and development, learning, and well-being.

For the full set of InTASC standards see:

[http://www.ccsso.org/Resources/Publications/InTASC\\_Model\\_Core\\_Teaching\\_Standards\\_A\\_Resource\\_for\\_State\\_Dialogue\\_\(April\\_2011\).html](http://www.ccsso.org/Resources/Publications/InTASC_Model_Core_Teaching_Standards_A_Resource_for_State_Dialogue_(April_2011).html)

## APPENDIX 2

### EXAMPLES OF ELABORATED STANDARDS

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#### 1. USA: NATIONAL BOARD FOR PROFESSIONAL TEACHING STANDARDS: STANDARDS FOR CERTIFICATION OF SCIENCE TEACHERS

([http://www.nbpts.org/the\\_standards/standards\\_by\\_cert](http://www.nbpts.org/the_standards/standards_by_cert))

#### STANDARD 7 SCIENCE INQUIRY

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## **Advancing Student Learning**

This third section of the AYA/Science standards focuses on the heart of the matter — the salutary effect that accomplished science teaching has on students. The generic goal of science instruction has already been described as the fostering of science literacy in students. Consistent with the Introduction and the description of a teacher's background knowledge of science in Standard II — *Knowledge of Science*, science literacy is presented in this section in terms of developing in students three main capacities: experience with the science

### **Standard VII: Science Inquiry**

Accomplished science teachers develop in students the mental operations, habits of mind and attitudes that characterize the process of scientific inquiry.

The fund of scientific information grows exponentially with each succeeding decade, it seems. Even fleeting coverage of the ever-expanding amount of scientific information would be impossible in school science. Accomplished science teachers know that as important as it is for students to acquire the fundamental understandings of science, they must also learn the strategies and procedures for approaching a problem scientifically. It is not a basic goal of science instruction to fill students with as much information as possible; rather, it is to help students acquire the mental operations, habits of mind and attitudes that characterize the process of scientific inquiry — that is, to teach them how scientists question, think and reason.

Science teachers understand that the inquiry process itself is not a uniform series of pre-determined steps; that scientists vary widely in how they go about seeking new knowledge about natural phenomena. Nevertheless, certain patterns in the methods of successful scientists are evident, for example, in their capacity to recognize problems, ask rel-

evant questions, formulate working hypotheses, observe phenomena, record data accurately, reach tentative conclusions consistent with the data, and express themselves clearly about the significance of findings. It is the acquisition of mental capacities such as these by students, and the habits of mind and attitudes that underlie them, that stand at the pivot point of the science curriculum.

How is that best facilitated? Teachers recognize that students learn best by doing. To learn to view the world through a scientific lens, students must have abundant opportunities to practice the myriad skills such an ambitious goal entails. They must have frequent opportunities to take part in hands on science activities and then to reflect on the significance of what they have been doing. Accordingly, teachers organize their classrooms around frequent, open-ended investigations of natural phenomena in which students assume active roles as investigators in the pursuit of knowledge that is new to them.

In choosing or designing activities, teachers keep a number of important criteria in mind. They

look for activities that are age-appropriate to the developmental level of students being taught; likely to raise interesting, worthwhile questions; relevant to the lives of all their students; and flexible, allowing active participation and student control over the manipulation of variables and posing of questions.

Teachers know that the processes of science are underpinned by habits of mind and attitudes that both describe the ethos and represent the core values of the scientific community. Ideally, these include such qualities as curiosity, openness to new ideas, skepticism, the demand for evidence, respect for reason, honesty and objectivity, the rejection of dogma or authority as arbiters of whose position prevails, the acceptance of ambiguity, the willingness to modify explanations in light of new evidence, and teamwork. Teachers work to incorporate these values in their classrooms so that students acquire a sense of how science communities function by being part of one.

Accomplished science teachers ensure that the hands on activities that occupy their students are also “minds on” and set the stage for increasingly sophisticated classroom discourse. This focus on the interchange of ideas, whether through discussions or the sharing of written work, is key, for it is through such discourse that a classroom of individuals seeking personal knowledge transforms into a community of learners seeking common understanding. As individual students communicate their observations to their peers, they discover to what extent their perceptions are shared — and if not, why not. In the course of this multi-directional conversation, students refine and elaborate their personal understandings of the natural world while also developing a sense of the rules of evidence and modes of argument that guide the inquiry process.

In facilitating classroom discussions or activities, accomplished teachers ask thought-provoking and relevant questions. Such questions stimulate a rich interchange of ideas as teacher and students test one another’s assumptions, promises and conclu-

sions. Raising questions integrally related to the student’s concerns of the moment is one path to success in this arena. It is also the case that a well-posed question will often permit the teacher to withdraw from center stage and let the students push the discussion forward.

Teachers monitor their direct involvement in classroom discourse. They allow appropriate wait time after their own questions and after student responses to permit students time to think. They value all contributions to a discussion, even as they coach students to probe constantly the reasons that lie behind the opinion, and emphasize the need for credible evidence and consistency. They know when and how not to say too much. They encourage student-to-student interaction in discussion. Discourse in their classrooms is characterized by the kind of tentative, hypothetical, exploratory language scientists themselves use.

Accomplished science teachers understand that the acquisition of science inquiry processes by students takes time. They encourage this growth both by offering their students abundant practice and, when opportune moments present themselves, demonstrations and direct instruction. For example, they might take the opportunity to talk through a science question that came up in the course of a class discussion, “making public” the thought processes and strategies that an expert in science uses when faced with a new challenge. They are mindful that the long-term goal of science education is to cultivate lifelong learners. Accordingly, they take care to foster their students’ intellectual independence — at first, modeling and demonstrating the thinking processes of a scientist for their student-apprentices, but gradually stepping back to make way for increasingly self-directed student initiatives.

In pursuing an inquiry-based curriculum, accomplished science teachers show themselves to be risk-takers. They are willing to live with the sometimes unpredictable consequences of an activ-

## **The Standards**

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ity and student-centered pedagogy. They know that experiments and student interpretations of them won't always — or even very often — proceed exactly as planned. They tolerate temporary frustration on the part of students as a predictable aspect of the inquiry process because they know that the

conclusions students earn are lastingly their own, and because acquiring the processes of science implies experiencing all the sensations that scientists do — including, from time to time, confusion.



## 2. CHILE: EXAMPLE OF A PEDAGOGIC STANDARD IN THE AREA OF SCIENCE FOR SECONDARY TEACHERS

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### ADVANCING STUDENTS' LEARNING

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#### **The teacher is prepared to promote development of scientific skills and their use in daily life**

Graduate teachers understand that teaching science in secondary school aims to achieve basic scientific literacy and develop scientific reasoning. In this context, the teacher is capable of selecting, designing or evaluating pedagogic strategies in order to promote in students the development of attitudes such as curiosity, interest and respect in relation to the natural world. They also can design activities to promote students' capacity to support arguments with evidence, to question their previous ideas and explanations, to search for evidence to better understand their environment, and to participate in their communities making decisions in the light of evidence. They are able to design learning experiences to promote students' understanding of scientific knowledge as the result of a human endeavour that generates explanations and interpretations based on the available evidence, and not as an activity that generates incontrovertible truths. They are able to motivate students to discuss about either past or present social issues, through which they can recognise the impact of science on daily life, on the environment or on the development of health.

This is demonstrated when graduate teachers:

1. Design activities to foster and reinforce attitudes that are characteristic of scientific thought and endeavour, such as curiosity, sense of wonder, openness to new ideas and scepticism with respect to interpretations of natural phenomena.
2. Implement strategies to make good use of the intuitive explanations of natural phenomena offered by students, as hypotheses that may be challenged, complemented and tested.
3. Design activities to deliberately instigate the development of the cognitive abilities such as, make questions about the natural world, obtain data from systematic observation and measurement, classify information, analyse and interpret it.
4. Select or design activities to develop the communicative abilities that may allow their future students to describe their inquiry experiences and to communicate their results with precision and exactitude, using scientific and mathematical language.

5. Guide and motivate discussions on the appropriateness of an experimental design, predictions and observations, and conclusions obtained by students in an experiment.
6. Guide students in the examination of the relevance of a theoretical model with respect to its capacity to predict or explain phenomena.
7. Design activities that are suitable for students to analyse the process of improvement, modification or refutation of a theory or model,<sup>3</sup> to help them understand that scientific knowledge changes constantly through the reinterpretation of evidence or because of the availability of new evidence.
8. Motivate students to analyse cases of selective use of evidence to support biased judgements in controversial issues of public interest.
9. Plan and implement learning experiences where students analyse current scientific research or technological developments in areas that impact daily life.
10. Deliver different sources of information so that students may investigate or complement their studies and develop their capacity to select relevant information and discern its relevance.

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<sup>3</sup> By means of examples from the history of Physics where the capacity to carry out measurements or a specific experiment has contributed to it, such as when measuring the speed of light and its invariability.

