

Wānangatia te Putanga Taurira National Monitoring Study of Student Achievement

Key Competencies 2017

REPORT 1:

Developing a theoretical framework for
a retrospective analysis of achievement
in the key competencies



NMSSA Key Competencies 2017 – Report Series

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- Introduction: The NMSSA approach to assessment of key competencies
- Report 1: Developing a theoretical framework for a retrospective analysis of achievement in the key competencies
- Report 2: Disciplinary meaning making in science
- Report 3: Disciplinary meaning making of static visual images in English
- Report 4: Disciplinary meaning making in mathematics and statistics
- Report 5: Disciplinary meaning-making: Synthesis of findings from a retrospective analysis



Key Competencies 2017: Report 1:

Developing a theoretical framework for a retrospective analysis of achievement in the key competencies

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REPORT 1: Developing a theoretical framework for a retrospective analysis of achievement in the key competencies

Table of Contents

1. Introduction to the exploratory study of key competencies in NMSSA	5
Developing a framework for the retrospective analysis	6
2. An introduction to the ‘capabilities’ approach	7
How key competencies fit with subject-based planning	7
Capabilities as an idea to manage complex curriculum weaving	7
Scoping potential focus capabilities	8
Narrowing the focus to a small number of capabilities	10
An important limitation of our weaving approach	11
3. Perspective-taking as a focus capability	12
How perspective-taking brings aspects of the key competencies together	12
Perspective-taking across the curriculum	12
Making progress in perspective-taking	13
4. Capabilities for critical inquiry	14
Critical inquiry in different learning areas	14
Relationships between critical inquiry and the key competency of thinking	15
Aspects of critical inquiry related to <i>gathering and interpreting data</i>	16
Limitations to our approach	17
Making progress in critical inquiry	18
5. Making meaning in discipline-specific ways	20
Links between meaning-making and the key competencies	20
Meaning-making across the curriculum	20
Making progress in discipline-specific meaning-making	21
6. Thinking beyond the selected set of capabilities	22
Aspects of critical thinking related to deciding and acting	22
Positioning Deciding and Acting within our overall methodology	23
Appendix 1: Sources for critical thinking aspects	24

Tables

Table 1. Assessment framework for health and physical education, 2013	8
Table 2. Assessment framework for social studies, 2014	9
Table 3. Constructs for social studies, 2014	10
Table 4. Broad indicators of progress in building critical inquiry capabilities	18

1. Introduction to the exploratory study of key competencies in NMSSA

The National Monitoring Study of Student Achievement (NMSSA) is a light sampling study of the achievement of Year 4 and Year 8 students in New Zealand schools. The aim of the research programme is to provide information about student achievement, and trends over time, across the breadth of the *New Zealand Curriculum (NZC)*. As well as subject-specific guidance, *NZC* includes several high-level features that are intended to be woven into the curriculum approach taken in each school. One of these is a set of five key competencies, developed from those originally proposed by the OECD. From its inception, NMSSA has intended to provide information about the progress students are making in developing these key competencies. This report is the first in a series of four reports. It explains the approach adopted for a retrospective analysis of students' opportunities to demonstrate aspects of their key competencies in action.

The analysis approach, which evolved across the 2016 year, began with three broad aims:

1. to evaluate the extent to which NMSSA assessment tasks provide information about how and when students have been able to demonstrate aspects of the key competencies
2. to synthesise information from across assessments in the different learning areas to shape broad indicators of progression, i.e. to show how and when students are likely to progress in developing and strengthening their key competencies between Year 4 and Year 8
3. to use the insights generated by the analysis to provide some guidance about how opportunities to assess progress in key competency development might be addressed in a new cycle of NMSSA activity.

This is an exploratory study. Before the aims of the retrospective analysis could be addressed it was first necessary to design a methodology that could allow us to identify the contribution that key competencies made to the demonstrated learning. As the remainder of this theoretical overview report demonstrates, this was not straightforward.

Developing a framework for the retrospective analysis

The intended *role* of key competencies in the *NZC* provided the starting point for building the analysis approach. If key competencies are seen as essentially an *addition* to the traditional curriculum, then presumably a separate and parallel assessment process could run alongside traditional subject assessments. We argue that this is not the case however. Our starting assumption is that key competencies were one of the elements added to the front section of *NZC* to refocus *purposes* for learning, and that this refocusing should happen in ways that reflect *NZC*'s overall vision of educating young people to be and become "confident, connected, actively involved lifelong learners (*NZC*, p.8) .

A curriculum which integrates key competencies with traditional learning area knowledge - with specific future-focused learning purposes in mind - can be expected to lead to the development of new types of outcomes of learning. This obviously has implications for what is assessed and what we anticipate progress could look like. In this way, the new curriculum thinking embedded in *NZC* raises new challenges when seeking evidence of progress in key competency development.

The new (21st century) teaching, learning and assessment context is potentially fraught with complex uncertainties. When designing the methodology for the retrospective analysis it was important to find a way forward that provided a reasonable guide to action – one that acknowledged the new curriculum thinking but provided some concrete guidance for each learning area team as they went about designing their assessment frameworks. With such pragmatic considerations in mind, our approach draws a few important lines in the sand.

As we explain in Section 2, our approach focuses on a limited number of 'capabilities'. Each of these combines key competencies with learning area content to achieve outcomes that are essential for further learning and for life beyond school. This section briefly outlines the way in which our 'capabilities' approach evolved as we undertook a retrospective analysis of tasks used during the first round of NMSSA.

Sections 3-5 describe the three selected capabilities in more detail. There is an emphasis on how each selected capability might be used to inform both the retrospective analysis and the prospective design of assessment frameworks and tasks for the next round of NMSSA. The final section briefly outlines one important limitation to our approach, when we consider the full suite of key competencies in *NZC*.

This is the first report in a series of five. Three reports use the approach to analysis outlined here to explore students' disciplinary meaning-making capabilities in science (report 2 in this series); visual meaning-making in English (report 3 of this series) and mathematics (report 4 of this series). The final fifth report provides a synthesis of the overall findings from these learning area specific analyses.

2. An introduction to the ‘capabilities’ approach

The design of our retrospective study began with the assumption that key competencies were added to *NZC* to *change* the learning that students experience in some fundamental way. *NZC* explicitly positions them as part of a curriculum for the 21st century and they are defined collectively as “capabilities for living and lifelong learning” (*NZC*, p. 12). Furthermore, they are not “separate or stand-alone. They are the key to learning in every learning area.” (p.12). A clear implication is that they also should not be assessed as stand-alone separate entities.

The *NZC* ‘essence statements’ for the learning areas (summary version p.17, extended statements pp.18-33) provide indications of the sorts of outcomes envisaged when key competencies are woven together with subject-specific learning so that students develop their *capabilities* for living and lifelong learning. Our methodology assumes that the focus on outcomes produced by weaving together key competencies and subject-specific learning should be reflected in the NMSSA assessment frameworks for the different *NZC* learning areas.

How key competencies fit with subject-based planning

The first assessments took place in 2012, in two curriculum areas (science and English: writing). By 2016, when this retrospective study of key competencies began, a broad range of the *NZC* learning areas had been covered. As the first stage in every learning area study, an assessment framework is developed for the learning area to be assessed. Each development team discusses what they perceive to be the most relevant aspects of the key competencies in their learning area and these are then built into the assessment framework. The team then endeavours to design rich tasks that should provide opportunities for students to demonstrate their key competencies, as well as the targeted knowledge and skills relevant to the learning area, as they take part in the assessment event. The framework provides a guide for task design and for the development of the assessment schedule for that task.

Given the emergent nature of the integration of key competencies into specific learning areas, NMSSA’s approach to including them in the overall assessment programme needed to be tentative when the programme was initiated. Over time the different curriculum advisory teams have become more explicit about where and how key competencies are developed within the more holistic aims of their learning area and they have become more apparent in the assessment frameworks.

The design of assessment tasks is guided by the framework developed for a specific learning area. Ideally each task will require students to draw on concepts or big ideas from the learning area *and* appropriate aspects of all or most of their key competencies. In this way the different parts of *NZC* are woven together with a focus on ensuring that students are able to demonstrate what they can *already do* with their learning.

For any one learning or assessment task, various aspects of all five key competencies could be in play, and these aspects will be in interaction with each other, with the task context, and with the student’s knowledge and skills in the learning area. This is a complex mix of things to keep in mind, both during learning and during assessment activities. (In the classroom context, assessment for learning will bring both learning and assessment together – an even more challenging mix to manage.)

Capabilities as an idea to manage complex curriculum weaving

The idea of ‘capabilities’ is an adaptation of the *NZC* definition of key competencies as “capabilities for living and lifelong learning” (p.12). Capabilities are the really important things we want all students to show they can do. Any specific capability, provided it is sufficiently rich and challenging, will include aspects of all the key competencies as well as aspects of subject-based learning. In this way, the idea of capabilities has the potential to address complex curriculum weaving challenges in a simple, practical way.

Each key competency is itself a mix of many different aspects. Therefore the way in which specific aspects of the individual key competencies might be remixed in rich tasks is endlessly variable. Also, there are a great many different types of things we would like our young people to become capable of – more than it is possible to say or develop explicitly, let alone to assess. This complexity and endless potential variability has many implications for both learning and assessment. One specific challenge is to focus and strategically prioritise capabilities that are likely to be the most important to develop. When designing the NMSSA approach we saw that it would be helpful if both teachers and assessors could focus on a small number of capabilities that are readily seen to be centrally important to many aspects of learning and living. When considering which capabilities might best serve the purposes of the retrospective analysis the following rationale supported us to narrow down the possible choices:

- each type of capability should be widely applicable across the learning areas, albeit expressed differently, according to the purposes for learning highlighted by each learning area
- there is existing research information about challenges for ‘making progress’ in this specific type of capability
- most demonstrations of learning will require aspects of at least two of selected types of capability, but will also draw on other aspects of the key competencies

Scoping potential focus capabilities

Assessment tasks that students perform one-to-one with their assessor, or in small groups, are an important component of the overall NMSSA programme. Student responses are typically captured on video for subsequent analysis. Assessors are experienced teachers who are trained to undertake the work. We conducted an exploratory analysis of a range of these tasks to begin the process of narrowing our focus to several centrally important capabilities.

We began by making an initial selection of tasks from across the various rounds of NMSSA assessments. We looked for rich task contexts that could be expected to require students to draw on both curriculum knowledge and aspects of at least 2-3 key competencies. We then reviewed all these selected tasks and their marking schedules, looking for indications of the sorts of capabilities the assessment designers had anticipated. The following examples illustrate this preliminary analysis approach and its results.

Health and physical education

The assessment framework for health and physical education, published in 2013, described contextually relevant aspects of all five key competencies.

Table 1. Assessment framework for health and physical education, 2013

KEY COMPETENCIES	DEFINITIONS
○ Relating to others	• Understanding others’ perspectives and developing abilities to manage relationships and work together to engage in health promotion
○ Managing self	• Engaging in critical thinking and action in regard to developing strategies to manage personal wellbeing
○ Thinking	• Critical thinking, creative thinking, reflection
○ Using language, symbols, texts	• Understanding movement as a text or narrative; understanding how symbols, tools, and texts are used to communicate health information; derive meaning from different sources of information; communicate ideas
○ Participating and contributing	• Building health promotion strategies and a sense of belonging through engaging in critical action

These named aspects form a coherent whole: the nature of their contribution to the learning outcomes specified in the curriculum appears to have been carefully considered. Critical and creative thinking, along with reflection are all highlighted as aspects of the key competency of thinking. Critical thinking is mentioned again as an aspect of managing self when developing strategies to manage one’s own wellbeing. Understanding the perspectives of others is highlighted for relating to others, as is developing the abilities to manage relationships and work with others to engage in health promotion – which itself is the focus of the key competency participating and contributing. The latter also suggests that engaging in critical action (an aspect of health promotion) will help students build a sense of belonging [at school].

The weaving anticipated by the framework is illustrated by the task titled *Fair play*. This task involved a group discussion. Students were shown photographs and heard a brief summary of the manner in which New Zealand shot put champion Valerie Adams was initially cheated out of winning the gold medal at the 2012 London Olympic Games. They then discussed a series of questions about cheating and the consequences – both for the person who cheats and for others. The marking schedule specified that evidence of critical thinking could include the following: “identifies the main problem and subsidiary, embedded or implicit aspects, can identify relationships between aspects, identify the issues and nuances.” The question-specific parts of the schedule highlighted clear evidence of perspective-taking as the difference between a superficial response and a deep one.

Social studies

The social studies assessment plan was published in 2014. While all five key competencies were named on the plan, their definitions seem somewhat limited compared to the Health and PE example above.

Table 2. Assessment framework for social studies, 2014

KEY COMPETENCIES	DEFINITIONS
○ Relating to others	• collaboration, working together, how children see themselves learning together
○ Managing self	• Self-assessment, how well did you think you participate in this task?
○ Thinking	• Children examining/challenging assumptions and perceptions
○ Using language, symbols, texts	• how ideas represented, visualised and constructed – how info mapped, tables, timelines, info graphed
○ Participating and contributing	• How much do you think you participated? – how do you know that? – beyond classroom to society

The actions and perceptions captured in the right-hand column seem very classroom-focused and rather superficial. Yet the designers of this framework clearly did hold much more nuanced expectations about how students might demonstrate key competencies in social studies. These expectations appeared with greater depth and more nuanced clarity under the part of the framework labelled “constructs”. The three constructs elaborated in the framework are shown in the box below. There is a stark contrast between seeing managing self in terms of assessing one’s own participation in class (box above), and recognising how one’s own identity impacts social decision-making (box below). Aspects of critical thinking and perspective-taking are also much more apparent in the constructs to be assessed than in the actual key competencies definitions.

Table 3. Constructs for social studies, 2014

CONSTRUCTS	DEFINITIONS
Conceptual Understanding	Connecting concepts eg roles and responsibilities, conceptual thinking, conceptual understanding, what constitutes knowledge, social knowledge as ideas, builds on perspectives. e.g. context of sustainability – fishing – apply sustainability to another concept
Social decision making and participation	Critical participation, informed, citizenship, responsible, communities, contribution to society, social action/processes, social decision making, inquiry skills
Values Perspectives	Personal and social values and perspectives -significance of the ideas – knowing about self – identity - ‘so what’ part of social inquiry, cultural identities, what is important to the person –affect, empathy (connect with KC) Critical thinking about values and perspectives - critical thinking, different perspectives, my position and why I think this way – justification – my view and views of others, exploring differences and similarities, empathy

The assessment of these constructs is now illustrated in the task titled *Graffiti*. In a one-on-one conversation with the assessor, students were shown some images of graffiti and asked if it was OK to create graffiti in public places and why they thought that. They were shown an image of graffiti on a school building and told that some people in the school community liked it and some wanted it gone. They were asked to give possible reasons for both positions. The final two questions asked each student to suggest two different processes that could be followed to arrive at a decision about whether or not to remove graffiti and to explain why each solution might be a good way to decide – i.e. they needed to justify their proposed solution. The marking schedule identified the overall assessment focus as being about values and perspectives. Students needed to draw on and explain different values positions as they thought critically about reasons that might motivate people to make the graffiti, or to appreciate graffiti vs. wanting it gone if it had been made by others.

Narrowing the focus to a small number of capabilities

In both the tasks outlined above, and in others that we analysed in the same manner, *perspective-taking* stood out as a capability students were required to demonstrate. The importance of perspective-taking had also come to our attention during an earlier project called “Key Competencies and Effective Pedagogy”.¹ This research resulted in the publication of rich stories about the sort of learning teachers envisaged when they wove learning area content and key competencies together. (These stories provided the genesis of the idea that key competencies are typically deployed in *rich combinations*.) The extant research literature also suggested that perspective-taking is centrally important to participation in addressing personal and societal life challenges (see next section). For all these reasons we chose it as one of the focus capabilities for both retrospective and prospective analysis.

We could also see that the NMSSA tasks we analysed demanded critical thinking, assuming this was framed broadly. To support our design process, we carried out an analysis of a range of critical thinking frameworks that all claimed to highlight aspects of critical thinking needed for ‘citizenship’ (see section 4). This supplementary analysis revealed a lack of clear consensus about the centrally important aspects of critical thinking, although the general sensibility was clear. To describe the more expansive construct that emerged across these different frameworks we settled on the term ‘critical inquiry’. Again an earlier research project provided support for this approach. Our design thinking had already been informed by a small prototype set of ‘science capabilities’ that were developed to show how to weave: science learning area content; the Nature of Science strand; the key competencies; and the science learning area statement

¹ <http://nzcurriculum.tki.org.nz/Key-competencies/Key-competencies-and-effective-pedagogy>

(which foregrounds active and informed citizenship as the overarching purpose for learning science). Three of these science capabilities had a specific inquiry sensibility (gather and interpret data; use evidence to support ideas, critique evidence). Merging all this work, we eventually settled on the name ‘critical inquiry’ for this rich capability set.

Disciplinary meaning-making became our third choice of capability, for several reasons. Any discipline-based critical inquiry will require students to draw on the knowledge-building (epistemic) practices of the relevant discipline and we were keen to draw attention to this neglected aspect of the key competency Using language, symbols and texts. Age-appropriate experiences of using the languages and texts of the discipline can be comparatively straightforward to assess and we could see that several of the Group Administered Tasks from the first NMSSA round potentially did so. We could also see professional learning value in presenting an analysis of both similarities and differences in meaning-making across the different discipline areas of NZC. Furthermore, this capability creates continuity with another of the science capabilities called Interpret representations.

An important limitation of our weaving approach

Students will and should develop many different capabilities. It is important that the set we have settled on for the retrospective analysis is not seen as a substitute for the many important outcomes sought across the breath of the curriculum. To reiterate the points already made, this is a set we can manage for our analysis purposes, and that we think teachers could also manage for planning and assessment purposes. When students are asked to use their learning in ways that require them to demonstrate these capabilities, we can be confident that different aspects of the key competencies will be needed. In this way, evidence of the development of these capabilities stands as a strong proxy for development of key competencies per se.

In the three next sections we outline the scope of each of these three capabilities within the overall NMSSA analysis.

3. Perspective-taking as a focus capability

Perspective-taking refers to the ability to ‘see’ an idea or a challenge from the perspective of one or more other people. Empathy and perspective-taking are closely related concepts. Some people see perspective-taking as a sub-set of empathy. Others see them as overlapping concepts, with both similarities and differences. The most important thing to note is the *emotional* dimension that empathy brings to perspective-taking. Perspective-taking requires critical thinking, but to this it can add awareness of *feelings*.²

How perspective-taking brings aspects of the key competencies together

Capable perspective-takers can put their own thoughts and feelings to one side, so that they are able to consider a challenge, situation, or action sequence from a different point of view. In this way, perspective-taking requires self-discipline (an aspect of managing self) and awareness of one’s own thinking (i.e. metacognitive reflection). If the perspective in question is that of another person or group it also requires the ability and willingness to put yourself in another’s shoes (an aspect of relating to others).

Our perspectives are culturally framed and grounded in our shared values. This is one reason that different people might interpret the same situation in differing ways. Awareness that values or cultural perspectives can differ, or that there are discipline-specific ways of making knowledge claims, are just some of the ways students might draw on their own and other’s funds of knowledge for critical and considered perspective-taking.

Effective collaboration also requires individuals to contribute in considered ways. Each person needs to be able to take the perspective of others in a group when shaping their responses. They need to think critically about which aspects of their own knowledge and skills will contribute productively to the group’s agenda. In this way, perspective-taking brings together aspects of managing self, relating to others and participating and contributing.

Perspective-taking has been shown to be essential to understanding complex issues in our world. Again, doing so makes a contribution to building and strengthening the key competency of participating and contributing. It supports the NZC vision of educating our young people to be and become actively engaged members of society.

Perspective-taking across the curriculum

Perspective-taking is an important *social* capability (e.g. for making and keeping friends, or working within different groups). However it is also integral to a range of *learning* challenges. The following examples are just a few of the many ways in which perspective-taking could be seen to underpin successful learning:

- Writing for a specific audience and/or purpose
- Exploring an author’s ideas and agenda in a literary text (and understanding why different readers might infer different things from this text)
- Appreciating differences in how people understand the world (e.g. people in the past; people in different societies and cultures today; science vs. everyday ways of explaining events)
- Employing design processes to achieve a product or technological solution that meets a specific user’s need
- Understanding why people might hold different points of view on an issue (or place, event, activity, way of communicating etc.)
- Considering what has been included and what has been overlooked when an inquiry was designed (for example a social inquiry, or a statistical inquiry).

² This short discussion explains why perspective-taking is an essential capability for every child, and provides some simple tips for supporting its development: <https://www.psychologytoday.com/blog/the-parents-we-mean-be/201007/how-do-we-help-children-take-other-perspectives-conversation>

Making progress in perspective-taking

Recently published research has provided a synthesis of ideas about why perspective-taking is demanding for young learners.³ This particular synthesis is based on research from the field of cognitive psychology first published in the 1980s, and includes a summary of levels or stages that show qualitative differences in young people's perspective-taking abilities. The following criteria paraphrase this work for purposes of the NMSSA analysis.

- Very young children are not able to clearly differentiate between social (intentional) perspectives of self and others
- As they develop, children come to understand that other people have their own subjective thoughts and feelings. However they think that different perspectives come from different information.
- During middle childhood most children learn to reflect on how another person might see them. By now they are able to take another person's point of view.
- In the next step up students are able to reflect on how a third person might view them, and at the same time how that third person might view another person different from them. This stage is associated with preadolescence.
- As they mature many students develop the ability to reflect on ways society as a whole might influence individuals' perspectives. While this stage is associated with adolescence, some adults cannot do this.

These broad developmental stages interact with conceptual growth in the learning areas.

Some New Zealand research has recently begun to describe patterns of progress in a specific perspective-taking context. One example is social inquiry, where conceptual understanding of how and why people hold differing values is integral to developing more nuanced and insightful perspective-taking. As outlined in Section 2, this type of curriculum thinking informed the design of the Graffiti task and mark schedule. In late 2016, after the methodology in this report had been designed and confirmed, we became aware of a post-graduate study had recently investigated evidence of perspective-taking in the Graffiti task. The graduate student who did this work had re-viewed a sample of the recorded conversations between students and teacher assessors.⁴ At the time of finalising this report the finished thesis has yet to be published.

³ Kahn, S. & Zeidler, D. (2016) Using our heads and HARTSS: Developing perspective-taking skills for socioscientific reasoning. *Journal of Science Teacher Education*, 26 (8). DOI: 10.1007/s10972-016-9458-3 (NB: HARTSS = Humanities, Arts and Social Sciences)

⁴ For more information about the NMSSA methodology see <http://nmssa.otago.ac.nz/about-us.htm>

4. Capabilities for critical inquiry

The science capabilities that served as precursors for this NMSSA retrospective analysis were developed via a synthesis of the nature of science literature. The three that we discuss in this section (gather and interpret data; use evidence to support ideas; critique evidence) were deliberately shaped with a succinct inquiry focus that could help teachers build bridges from familiar to new practice.⁵ For the NMSSA work we needed to find a transparent way to broaden this thinking so that these capabilities could be seen to be applicable to many different types of critical inquiry, not just science inquiries, and so that their underlying coherence as a specific *type* of multifaceted capability could also be brought into view.

Critical inquiry demands both critical and creative thinking. A focus on gathering and interpreting data; using evidence to support ideas; and critiquing evidence, can help build students' awareness of how new knowledge claims are made and justified. Different discipline areas have their own specific inquiry practices so it is important that students experience critical inquiry in a range of learning areas. Inquiry capabilities are cross-cutting with perspective-taking and disciplinary meaning-making. Any rich inquiry will require students to draw on their capabilities in all of these aspects, and hence on all of their key competencies.

Critical inquiry in different learning areas

Inquiry capabilities support students to learn how knowledge is made in different learning areas. For example, when students gather and interpret data like an historian, they learn about the important practices of *historical thinking*. When working with historical sources, historians think critically about *when* a source was produced, *who* wrote it, and for *what* purpose. By contrast, when students gather and interpret data in a science investigation they learn about the importance of carefully controlling variables, so that a convincing explanation can be made. They also learn how core concepts and theories of science guide the investigation plan and the way data are interpreted.⁶

Supporting their ideas with evidence is another aspect of critical inquiry that plays out somewhat differently according to the 'rules' about what counts as evidence in a specific discipline area. When students are asked to think like literary critics in English, they look for specific passages of text that support their interpretation and justify their argument by drawing on established literary conventions.⁷ When they are working like statisticians they carefully gather and organise quantitative data following established statistical processes (such as those that account for variability in sampling), then use this data to make claims that they can support with evidence.⁸

The research literature suggests that critiquing evidence is the hardest aspect of critical inquiry to develop. With practice and support, students learn to keep an open mind as they set aside their own ideas to consider other possible explanations. Doing so requires both critical thinking and perspective-taking, which takes self-discipline and self-awareness (both aspects of managing self). In learning areas like health/PE and social studies critiquing evidence could involve students in identifying their own assumptions and values, and then comparing them with those of others.

⁵ For an account of this development see Hipkins, R. & Bull, A. (2015) Science capabilities for a functional understanding of the nature of science. *Curriculum Matters*, 11, 117-133.

⁶ A set of eight *science practices* was recently developed for the 'Common Core' standards in the USA. In this short article well known science educator Rodger Bybee briefly compares and contrasts science and engineering practices. The engineering versions are similar to what we might call a technological inquiry in New Zealand: http://nstahosted.org/pdfs/ngss/resources/201112_framework-bybee.pdf

⁷ At the primary school level, this report gives something of the flavour of this type of activity. Note that this research was carried out before the development of the idea of capabilities <http://www.nzcer.org.nz/research/publications/lifelong-literacy-integration-key-competencies-and-reading>

⁸ This website outlines progression in statistical thinking from Level 1 to level 8 of NZC. Explicitly supporting claims with evidence first appears in the description for level 3: <http://new.censusatschool.org.nz/key-ideas/statistical-investigations/>

Sometimes the ‘evidence’ to be critiqued is the student’s own work. This is centrally important the production of original work in the Arts for example⁹ but is an important part of self-assessment in any subject. Again this sort of critique demands self-awareness and self-discipline.

Perhaps the most common form of classroom-based inquiry is informational. Rather than directly learning about how knowledge is created in a discipline area, students use aspects of their inquiry capabilities to learn to be more discerning about knowledge sources. They gain practice in such challenges such as dealing with conflicting evidence (which is about both interpretation and critique). In this way the inquiry capabilities can also build towards “information literacy”.

Relationships between critical inquiry and the key competency of thinking

The key competency ‘thinking’ is so broad that it risks being everywhere and nowhere. Of course students need to think in order to learn! Critical thinking (sometimes called higher order thinking or HOT) is a centrally important component of critical inquiry. In contrast to everyday thinking, effort and deliberate attention are required. Some people define critical thinking quite narrowly and restrict it to very ‘academic’ contexts. Others perceive a much broader nature for critical thinking and apply this to a wide range of contexts. When it is broadly defined, critical thinking has the potential to work with and support other types of thinking. It is also an essential component of critical reflection on how all of the key competencies are being developed.

Considerable creativity is also likely to be involved in critical inquiry and this is another aspect of the key competency of thinking. Other aspects of thinking needed for inquiry might include caring/ethical thinking, systems thinking, and metacognitive reflection – to name just three possibilities.¹⁰

Analysis of frameworks for critical thinking

On the internet it is easy to find many different frameworks that ‘unpack’ critical thinking. Those selected for this NMSSA study had several characteristics in common: they all came from sources that should be able to be trusted (e.g. academic websites) and the purpose for which they claimed a need for critical thinking was made explicit.

Given the definition of key competencies as capabilities for living and lifelong learning, frameworks that claimed to classify aspects of critical thinking needed in everyday life or in academic learning were sought. (A full list of sources can be found in the Appendix.) We then grouped common themes from the selected critical thinking frameworks into the three types of capability signalled by the science inquiry work. In some cases the choices may seem somewhat arbitrary – for example critique is implied in a number of the actions listed under gathering and interpreting data, or using evidence to support ideas. This is only an issue at the level of initial classification of aspects, which we have done so that we could be clear about the broad scope of the overarching capability. In rich assessment tasks we would expect various combinations of these aspects to be present simultaneously.

⁹ See for example <http://nzcurriculum.tki.org.nz/Curriculum-stories/Media-gallery/Learning-to-learn/Feedback-and-critique-in-art>

¹⁰ Other possibilities can be found at: <http://nzcurriculum.tki.org.nz/Key-competencies/Key-competencies-and-effective-pedagogy/Insights-into-the-key-competencies>

Aspects of critical inquiry related to *gathering and interpreting data*

Seeking information/asking questions

It is common for students to seek information as part of their learning. Ideally they are also supported to ask the questions that underpin such activity (i.e. not just find answers to questions posed by others). Critical thinking is needed to shape and answer questions using various information sources, especially when these convey different answers to the same question. When that is the case, students need to think critically about likely points of view and/or values, potential agendas and so on. Students might be using their knowledge and skills to:

- shape critical questions pertinent to an issue or puzzle
- find information and justify the selection of the source
- identify information that is relevant to the question or argument (and recognise instances when information is deliberately distracting or biased)
- compare similarities and differences in ideas
- understand information and convey that understanding to others in their own words
- look beyond the face value of a situation or argument to ask critical questions about the stated argument or position being taken
- ask questions to check the accuracy of claims.

Making and justifying inferences

The various frameworks all included making and justifying inferences as an important aspect of critical thinking. One framework described doing this as being able to “read between the lines” of the meaning being conveyed.

Students show they can make and justify inferences when they:

- distinguish between an observation and an inference (what they observe and what they think these observations mean)
- combine previous experience and new observations to explain inferences
- connect different representations to arrive at the key idea being conveyed
- describe how existing ideas influence new observations and inferences
- outline how inferences can be tested via ongoing inquiries.

Knowledge and skills from the various learning areas are integral to making and justifying inferences. Conceptual understanding is a key aspect of inferencing because what we already know influences what we can ‘see’ in new contexts. Also, specific types of practices may be used for making inferences in different discipline areas. For example making inferences from literary texts is supported by awareness of ways in which the author has used specific conventions of written and visual texts. Similarly, inferences drawn from science observations rely on careful attention to systematically gathered empirical evidence. In these ways, inferencing has strong overlaps with the capability of discipline-specific meaning making (see Section 5).

Aspects of critical inquiry related to using evidence to support ideas*Evidence-based reasoning*

Learning to justify arguments with recourse to evidence has now become a common focus for learning in a range of learning areas. Critical thinking frameworks that emphasise disciplinary processes for knowledge building, or those that address ‘citizenship’ skills (such as those needed for thinking through controversial issues for example) tended to emphasise the aspects summarised here:

- describe the evidence that supports a case
- look for counter-evidence with an open mind
- identify when evidence is missing, incomplete, or inconclusive
- distinguish between evidence and conclusions
- weigh conflicting evidence to justify a conclusion
- change views when evidence points to the need to do so (again being open-minded).

Being logical

Working with evidence demands logical reasoning, which was variously described as encompassing being able to:

- break an argument into parts
- draw logical conclusions from those parts
- recognise fallacious reasoning (the argument is not logically developed, the person putting the argument has jumped to a conclusion based on too small a sample, etc.)
- identify ‘gaps’ where part of an argument has been left out
- avoid tautologies (circular arguments)
- recognise logical inconsistencies (e.g. when reasoning points in different directions)

Aspects of critical inquiry related to critique of evidence

In addition to the need for critique implied in some of the above aspects, we found another cluster with a distinct set of metacognitive characteristics (i.e. they demand critical thinking about thinking).

Identifying assumptions

Students who can name and explain assumptions might show they are able to do one or more of the following:

- detect vagueness or ambiguity in an argument
- recognise instances when bias or personal prejudice (own or others) influence thinking
- be aware of the thinking they are doing (including their own assumptions)
- evaluate strengths and shortcomings of their own thinking
- clarify the values that underpin different positions.

Limitations to our approach

We do not presume that the above lists constitute the last word on aspects of capability needed for critical inquiry. For our purposes they have served as a good-enough guide to what to look for in rich assessment tasks – and in students’ responses to those tasks. One very obvious limitation to a retrospective analysis is that *dispositions* can only be inferred from observed behaviours. Even to undertake an actual analysis of behaviours would require us to reanalyse the videotapes of the assessments in action, which would be prohibitively expensive. However, one reassuring aspect of our suggested aspects is that it is possible to infer certain dispositions from many of the described actions. For example students would not be able to demonstrate many aspects of capability without being open-minded or thoughtful in the various ways implied. This is an important qualifier to note because key competencies are explicitly defined as combining knowledge, skills, attitudes and values.

Making progress in critical inquiry

Some of the aspects listed above will almost certainly be easier to do than others. Some are clearly expecting too much of young children. The nature of the context for the task will have an impact on the degree of difficulty of the aspect being demonstrated. Furthermore, as we have already noted, several of the above aspects are highly likely to be used in combination in any specific context. All of these possibilities imply challenges for determining what making progress in critical inquiry might look like across different curriculum contexts and in widely varying tasks. To help inform our thinking about this challenge, we drew on several studies that have a focus on making progress in various of the aspects outlined above. Sources for our analysis included: research on making progress in argumentation¹¹; research on students' demonstrations of their science capabilities in several New Zealand schools¹²; 'progress maps' from resource materials that support the national curriculum in Northern Ireland (which is not dissimilar to NZC)¹³; and a NEMP probe study that included a literature review of how children's investigative skills in science develop.¹⁴ The table below synthesises ideas from these sources to create four broad sets of indicators of progress.

Table 4. Broad indicators of progress in building critical inquiry capabilities

INDICATIVE NZC LEVEL	SOME INDICATIVE CRITICAL INQUIRY BEHAVIOURS
Level 1 (Year 1-2)	<p>"Look and know"</p> <ul style="list-style-type: none"> • Students are just beginning to realise that what they think is different from why they think it. They can give their opinions and reasons • They can describe what they observe (parts/whole; same/different/ groups) • They make simple predictions, ask different types of questions and actively search for answers
Level 2 Year 3-4	<p>"Thinking and explaining"</p> <ul style="list-style-type: none"> • Students look for evidence to test simple predictions. They can devise and explain simple inquiry methods and marshal evidence to support a case. • They can sequence, order and rank on different dimensions, identify similarities and differences and make simple comparisons • They can suggest more than one cause for an event and/or possible solutions to problems • They can shape their opinions, and give their reasons for choices and actions.
Level 3/4 Year 5-7	<p>"Knowledge testing"</p> <ul style="list-style-type: none"> • Students can use different types of questions systematically and with purpose. They identify and order patterns and relationships in a range of ways. • They recognise that more than one explanation could be plausible, which means that alternatives have to be tested against the available evidence. • They are willing to try alternative problem-solving solutions and approaches • They think more critically about their own ideas and understand there might be more than one point of view. They examine options and weigh up pros and cons • Discriminate between fact and opinion and question the reliability of evidence.
Level 5 Year 8-10	<p>"Open-minded reasoning"</p> <ul style="list-style-type: none"> • One key development is that students now recognise and address disconfirming evidence. They consider and eliminate alternative explanations more systematically, and they are beginning to identify bias and errors in arguments. • They engage with a range of problem-solving methods and evaluate solutions. They are beginning to understand that interactions between variables can make deciding and/or explaining more complex. • They examine pros and cons of a decision, predict likely consequences and evaluate outcomes from a range of perspectives

¹¹ <http://scientificargumentation.stanford.edu/project/>

¹² <http://www.nzcer.org.nz/research/publications/capabilities-living-and-lifelong-learning-whats-science-got-do-it>

¹³ http://www.nicurriculum.org.uk/curriculum_microsite/TSPC/what_are_tspc/progress_maps/index.asp

¹⁴ <http://www.nzcer.org.nz/research/publications/using-nemp-inform-teaching-science-skills>

There are two important caveats to this analysis. Each band on the table has a coarse grain size. These are indications that *illustrate* what aspects of capability might look like. They are not detailed progressions, but they could be used as a framework when building specific progressions from evidence of what students can actually do.

The demands of a task will influence students' ability to demonstrate their capabilities. This table is really just one face of the coin. It is also important to gather information about the learning context and/or assessment task(s) used to generate achievement data.

Summing up, it is evident that critical inquiry is a complex and multi-faceted capability. However several readily identifiable characteristics should provide useful signposts to the likely difficulty of the different tasks we examine in the retrospective analysis. These include the number of elements involved in the thinking needed, whether the task involves critique or not, and whether there might be more than one possible explanation for the phenomenon being scrutinised.

5. Making meaning in discipline-specific ways

Each discipline area has its own specific ways of conveying meanings. These are sometimes called its ‘discourses’. NZC specifically mentions the key role these play in learning:

Each learning area has its own language or languages. As students discover how to use them, they find they are able to think in different ways, access new areas of knowledge, and see their world from new perspectives. (Ministry of Education, 2007a, p. 16)

As students learn to use these languages (or discourses) teachers might encourage them by saying they are “reasoning like statisticians”, “thinking like historians”, “investigating like scientists”, and so on. The cited excerpt, short as it is, links this type of meaning-making to both critical inquiry and perspective-taking. It could be seen as the third leg of the stool in our NMSSA analysis.

Links between meaning-making and the key competencies

Sometimes the term ‘literacy’ is attached to a discipline area to convey its specific type of meaning-making. The above examples would be called demonstrations of statistical literacy, historical literacy and science literacy respectively. However the use of the term ‘literacy’ is problematic because it can be conflated with the similar-sounding phrase ‘literacy across the curriculum’. This type of misunderstanding risks limiting the scope of the intended learning. The focus is likely to be on ways to make sense of texts that convey information understandings *about knowledge products* of the disciplines. The ways in which discipline-specific conventions and certain types of texts are part of the actual meaning-making is likely to be overlooked. Another challenge with the use of the term literacy is that being ‘scientifically literate’ (for example) is sometimes used to convey the sense that the person can reason and speak as an expert might. This is clearly an unrealistic aim for young learners.

When NZC was being developed the key competency now called Using Language, symbols and texts was initially called Meaning-making. With hindsight it is a pity this title was not retained because many teachers still understand the scope of this key competency as limited to literacy-across-the curriculum. One important aim for this NMSSA study was to illustrate the discipline-specific depth and scope of this key competency.

Some close links between discipline-specific meaning-making and critical inquiry have already been described in Section 4. For example drawing inferences from different types of disciplinary texts requires an understanding of the practices used to build meaning into the texts in the first place. Another example might entail understanding the types of claims that can ‘count’ as evidence in different learning areas. English teachers sometimes use the term ‘critical literacy’ to describe the capability to be a more active and discerning meaning-maker when reading different types of texts.

Meaning-making across the curriculum

There is much more to disciplinary meaning-making than the words used or the way they are assembled, i.e. the *grammar* of the written texts of a discipline. All of the following can have discipline-specific differences:

- Conventions for organising data (as graphs, tables etc.)
- How ‘models’ of reality are created and used as thinking supports (actual models, diagrams, maps, plans, metaphors etc.)
- What symbols convey, and who says so – e.g. how arrows are used can have very different meanings in different disciplinary contexts, even sometimes within the same broad discipline area. For example, an arrow on a food chain means something quite different to an arrow on a light ray diagram, but both come under the science umbrella.
- How visual images are constructed – e.g. how colour, perspective and symbolism are used to convey meaning in literary texts.

In some discipline areas body language is important for communicating meaning – dance and drama are obvious examples. Sometimes conventions for how gestures are used convey specific meanings non-verbally. As well as in the arts, control of games and physical activities often involve this sort of meaning-making.

Simulations, 3D visualisations and other types of multimodal texts are further examples of texts that require complex meaning-making capabilities.

Making progress in discipline-specific meaning-making

A recent meta-analysis investigated findings from all the completed TLRI projects that have focused on the development of students' literacy capabilities¹⁵, including the discipline-specific capabilities we have chosen to call meaning-making in the current study. This study is important because all the projects analysed are New Zealand based whereas much of the research in this area comes from other countries. McDowall's analysis found evidence that even very young children can communicate using the language and conventions of a discipline when given age-appropriate opportunities to learn to do so. There was a collective sense that students are making progress. However she also reported that many of the researchers were concerned that the traditional assessment tools available in New Zealand do not capture the disciplinary literacies they were researching. The overall conclusion was that more research is needed to explore the nature and pace of learning progress, and that different research instruments will need to be designed in order to do this. NMSSA has the potential to begin to fill this gap.

Some learning areas included NMSSA Group Administered Tasks (GAT) in the overall assessment mix. Where this happened there was an explicit focus on disciplinary meaning-making. GAT assessments include pencil-and-paper tasks that are analysed using standard psychometric approaches. While many aspects of key competencies could not be captured by such an approach, certain important discipline-specific conventions can be assessed in this mode. For example the features of disciplinary meaning-making in science targeted in the science GAT, undertaken in 2012, were:

*Communicating in science using visual texts (writing, diagrams, photographs), numeric texts (graphs, tables) and mixed texts (visual and numeric)*¹⁶

The assessments in the science GAT were subjected to deeper scrutiny than was able to be reported in the relevant overview document. Considerable 'value-added' analysis was undertaken by a primary science expert to determine the specific types of knowledge and skills that enable or constrain progress in meaning-making in the science learning area. This work was not published and we have drawn on it to enhance the analysis described in the second report of this series.

The GAT component of the mathematics and statistics assessment programme, undertaken in 2013, did not differentiate as clearly between a focus on meaning-making and a focus on using and applying relevant mathematical knowledge. However the scale descriptors include many aspects of meaning-making that overlap with the aspects targeted in the science GAT. Examples include such things as knowing how to read a scale, and interpreting different representations such as pictographs and bar charts.

In 2015 a GAT was conducted as part of the assessment of students' *Knowledge and Application of Viewing in English* (KAVE). Again the scale descriptors emphasise meaning-making in complex combinations with both critical inquiry and perspective-taking.

The analysis of GAT assessments allows for psychometric modelling of aspects of capability against curriculum levels. Therefore an important part of the current study has been to search for evidence of alignment (or not) between similar aspects of meaning-making in the different learning areas. This analysis is discussed in the final synthesis report in the series.

¹⁵ McDowall, S. (2015) *Literacy research that matters: A review of the school sector and ECE literacy projects*. Wellington, Teaching and Learning Research Initiative (TLRI).

¹⁶ NMSSA Report 1: Science 2012, p.15.

6. Thinking beyond the selected set of capabilities

Three broad types of capability have been introduced and discussed in this report. Each demonstrably weaves together knowledge and skills with aspects of the key competencies. Thinking features prominently in the analysis, as does Relating to others. Many aspects of Managing self are implicated in the dispositional and metacognitive challenges which have also been noted. The disciplinary conventions needed for critical inquiry implicate the fourth key competency - Using language, symbols and texts (see also next section). Less visible in this account is the fifth key competency Participating and contributing. It is important that we briefly discuss the contribution that this key competency might make to subject-based learning, and hence – at least potentially - to our assessment framework.

Critical inquiry is inquiry for a purpose. Perspective-taking is similarly undertaken to achieve a specified purpose. In this way, both are important antecedents to critical action. Our analysis of the critical thinking frameworks (see Section 4) revealed a cluster of aspects that do not fit neatly under either critical inquiry or perspective-taking. Rather they weave aspects of both in complex ways that point to critical action. These aspects can apply even if the actual action is not undertaken. This is an important consideration, given our focus on retrospective analysis of time-limited and discrete NMSSA assessment events. As we outline below, we have called this cluster of aspects “deciding and acting”.

Aspects of critical thinking related to deciding and acting

From the analysis of critical thinking frameworks, the following aspects emerged. Students might show that they can do one or more of the following:

- describe possible outcomes/ implications of a decision or action
- choose between alternatives and justify the decision
- describe steps to enact a decision
- link cause and effect
- search for negative as well as positive implications
- weigh the likelihood of different potential outcomes from different decisions or actions
- analyse risk
- reason on the basis of probabilities

Note the inclusion of risk analysis and probabilistic reasoning. These are important aspects of capability for engaging with complex issues and deciding on possible courses of action. ‘21st century’ critique of current learning experiences is often critical of the absence of risk-taking so we have included it as part of deciding and acting.

When we were developing our approach to the retrospective analysis we did not find any specific discussion of progression in students’ ability to demonstrate aspects of capability for critical action. This is not surprising given its rather marginalised position in the enacted curriculum.¹⁷ Also, as already noted, the limitations of NMSSA assessment tasks preclude actual action-taking so the best we can hope to achieve is to inform potential progress in developing antecedents to action – specifically within critical inquiry and/or perspective taking.

¹⁷ A recently completed TLRI study makes an important new contribution to our knowledge in this area. The team led by Brownyn Wood from Victoria University investigated teachers’ curriculum thinking and support for their students to take critical action as part of their learning in social studies: <http://www.tlri.org.nz/tlri-research/research-completed/school-sector/creating-active-citizens-interpreting-implementing>

Positioning Deciding and Acting within our overall methodology

Aspects of capabilities for Deciding and Acting emerge from the overall learning programme when students show that they can take their learning into contexts beyond school and are willing to do so. They need to draw on all the other sets of capabilities (in all the ways outlined in this report) to respond to matters that concern them, or where they see a chance to make a difference in the world and to be good citizens. Aspects of different learning areas are likely to come together here because real world issues typically transcend curriculum divisions. There are obvious limitations for reporting on progress in these areas via the NMSSA assessment programme. The division of assessments into specific learning areas makes sense for most purposes but does not allow for the sort of cross-curriculum synthesis that might be useful here.

There is however one final part of the NMSSA programme that has the potential to contribute to any retrospective analysis of aspects of Deciding and Acting. Reading an increasingly demanding range of texts for pleasure and leisure constitutes a specific instance of sustaining and extending capabilities built in school. This has already been assessed via self-report surveys.

Other personal and collective actions that could potentially be self-reported include: practising and extending specific techniques such as those learned in the arts, technology, or PE; using growing communication skills in another language; and finding out more about questions and issues of personal interest; taking personal action for wellbeing; and demonstrating personal responsibility where there is a choice of ways to act, such as making more sustainable choices; exercising safe and ethical digital practices; and being respectful of appropriate practice in a different cultural context.

At the moment these types of choices and actions are beyond the scope of NMSSA assessments but they need not remain so if learning area teams choose to prioritise them in future rounds.

Appendix 1: Sources for critical thinking aspects

Note that the following sources were not selected by following a disciplined literature review process. Criteria for inclusion included that the advice provided made an attempt to frame critical thinking in practical terms and for a specific purposes related to everyday life (e.g. study, employment, participatory citizenship, changing teacher pedagogy etc.).

P21: Partnership for 21st Century learning: Framework for critical thinking and problem solving

<http://www.p21.org/about-us/p21-framework/260-critical-thinking-and-problem-solving>

This simple framework was developed by one of several high-profile consortia that explore so-called 21st century learning. It is hyperlinked to multiple resources to support the development of critical thinking. It is undated.

Elements of Critical Thinking

https://www.csun.edu/science/ref/reasoning/critical_thinking/elements.html

This resource was posted on the Internet in 2007 to support changes in science teachers' pedagogy. It was developed by Prof Norman Herr of California State University

The website of the Foundation for Critical Thinking

<https://www.criticalthinking.org/ctmodel/logic-model1.htm>

There are many different pages and resources here – a model that identified eight “elements of thought” was selected for inclusion in the synthesis.

The Paul-Elder model of critical thinking

<http://louisville.edu/ideastoaction/about/criticalthinking/framework>

This resource was posted by the Delphi Centre of the University of Louisville in early 2016. The framework is based on the following paper: Paul, R. and Elder, L. (2010). The Miniature Guide to Critical Thinking Concepts and Tools. Dillon Beach: Foundation for Critical Thinking Press.

(Note that Richard Paul is also a key driver of the Foundation for Critical Thinking)

Pamphlet developed by Queen Margaret University, Edinburg

<http://www.qmu.ac.uk/ELS/docs/Critical%20thinking.PDF>

Developed by the Learning Support centre at this UK university, the target audience are students working on assignments that require them to demonstrate evidence of critical thinking

6 Critical Thinking Skills You Need to Master Now

<http://www.rasmussen.edu/student-life/blogs/main/critical-thinking-skills-you-need-to-master-now/>

Similar but more expansive than the QMU resource, this was written by Grant Tilus in 2012 and hosted on a USA college website.

Seven Key Features of Critical Thinking

<http://everydaylife.globalpost.com/seven-key-features-critical-thinking-27635.html>

This list of features was developed by Susan Harlow, who works for an American company called Demand Media. It was posted on the website of a media outlet called Global Post. She appears to be a writing coach (her other posts relate to challenges such as writing to audience for example).

Standards of critical thinking

<https://www.psychologytoday.com/blog/ethics-everyone/201206/standards-critical-thinking>

Written by Dr. Michael Austin in 2012 and hosted by the website of the journal Psychology Today, the point of difference of this framework is that it emphasises quality in philosophical/academic reasoning and ethical thinking. While this might be seen as rather removed from the concerns of school students, it points to the disciplined critical thinking skills that are the hall mark of mature adult thinkers. (Note the Paul-Elder framework has a simpler version of standards and they cover similar territory – 7 of Austin’s 8 characteristics are also in the Paul-Elder framework.)