Scotland's Curriculum Framework
curriculum improvement cycle

Curriculum Improvement Cycle (CIC)

Towards an Evolved Technical Framework

A Discussion Paper

December 2024

Contents

Purpose

This is the second of three discussion papers which have emerged from the findings, key messages and learning from a series of pilot curriculum reviews established by Education Scotland (ES) over session 2023/24. The reviews were planned and carried out in response to the 2021 Organisation for Economic Co-operation and Development (OECD) report Scotland's Curriculum for Excellence: Into the Future.

The first paper - Background and A Case For Change : Findings from the Pilot Curriculum Reviews 2023/24 - set out the context for the pilot reviews and discussed the early thinking and conclusions from these. It also began to outline how the technical framework could be evolved to address the issues highlighted by participants in the pilot reviews and elsewhere.

This second paper also reflects on feedback from co-design sessions (May 2024 - present) which focused on cross-curricular expectations (or core competencies).

This second paper seeks to:

- Build on the findings identified in the first discussion paper - Background and A Case For Change : Findings from the Pilot Curriculum Reviews 2023/24 - which looked at the case for changes to be made to the current technical framework
- Focus on how we can evolve the technical framework to help clarify the role and position of knowledge and skills
- Identify criteria for the evolution of the technical framework
- Reflect on the use of a Big Ideas approach within an evolved technical framework
- Make the case for evolving the technical framework to a 'Know - Do - Understand' model
- Explore how an evolved technical framework might help with issues such as the positioning of cross-curricular expectations and alignment between the broad general education (BGE) and the senior phase.

The third discussion paper **'Working Together to Make Change Happen'** will be published in March 2025 and will set out proposals for how the changes outlined in papers one and two will happen.

Language matters: definitions

Co-design is a collaborative approach to designing and creating services (in this case the curriculum). Service users (e.g. educators) and other stakeholders work together through a facilitated design process. Co-design methodology values the expertise and perspectives of all involved, ensuring solutions are tailored to meet real needs. Aligned with the Scottish Approach to Service Design, co-design emphasises inclusivity, empathy, and a shared understanding, aiming to create services that are effective, accessible, practical and sustainable for everyone involved.

A **concept** is a main idea or sequence of ideas that help to shape understanding. It clarifies meaning and is underpinned by knowledge. Concepts can be grouped or sequenced to develop schema that, for example, allow for the building of relationships in an area such as science.

A **Big Idea** captures the core understanding children and young people will develop in a particular area of the curriculum from early learning and childcare onwards. It will set out overarching ideas and concepts and have relevance and meaning for learners. It will support progression and guide the selection of content.

Knowledge refers to things that an individual can know. In curriculum, it includes substantive knowledge (knowing that) and procedural knowledge (knowing how). Substantive knowledge refers to the understanding of concepts that explain the world, for example, and individual facts. Procedural knowledge is the knowledge of how to do something, for example, balancing an equation.

The terms **'pilot study'** or **'pilot review'** refers to a mini version of a full-scale study (Teijlingen & Hundley, 2001). Pilot studies are useful to refine research instruments such as questionnaires and interview schedules, as well as for highlighting research gaps and identifying issues such as research validity (Sampson, 2004; Teijlingen & Hundley, 2001). It is important to emphasise that the pilot reviews carried out by ES and described in this document were not intended to be full reviews of any of the curriculum areas.

Skills is an overarching term used to describe a wide variety of behaviours and practices that can be acquired, developed and improved with guidance, reflection and practice. A variety of skills frameworks are used across Scotland to develop children and young people's understanding of their skills.

The **technical framework** within a curriculum is used by educators to plan what children and young people will learn. In Scotland, this would include guidance such as the experiences and outcomes (Es&Os), benchmarks and progression frameworks, as well as approaches to moderation. This technical framework is designed to support educators in developing and implementing a curriculum which fully captures the skills, knowledge and learning which every learner should experience and attain. In Scotland, the technical framework sits alongside the statutory framework, policy framework and qualifications framework.

1. Developing criteria for an evolved technical framework

As illustrated below, the overarching framework for Scotland's curriculum can be considered in three parts – the 'why', 'what', and 'how'. The 'why' sets the purpose: the curriculum is designed to enable all our children and young people to develop as individuals, contributors, learners and citizens. The technical framework underpins the 'what' and will be discussed in greater detail in this second paper. The 'how' identifies the features that need to be in place for effective curriculum making to happen. This will be discussed in paper three.

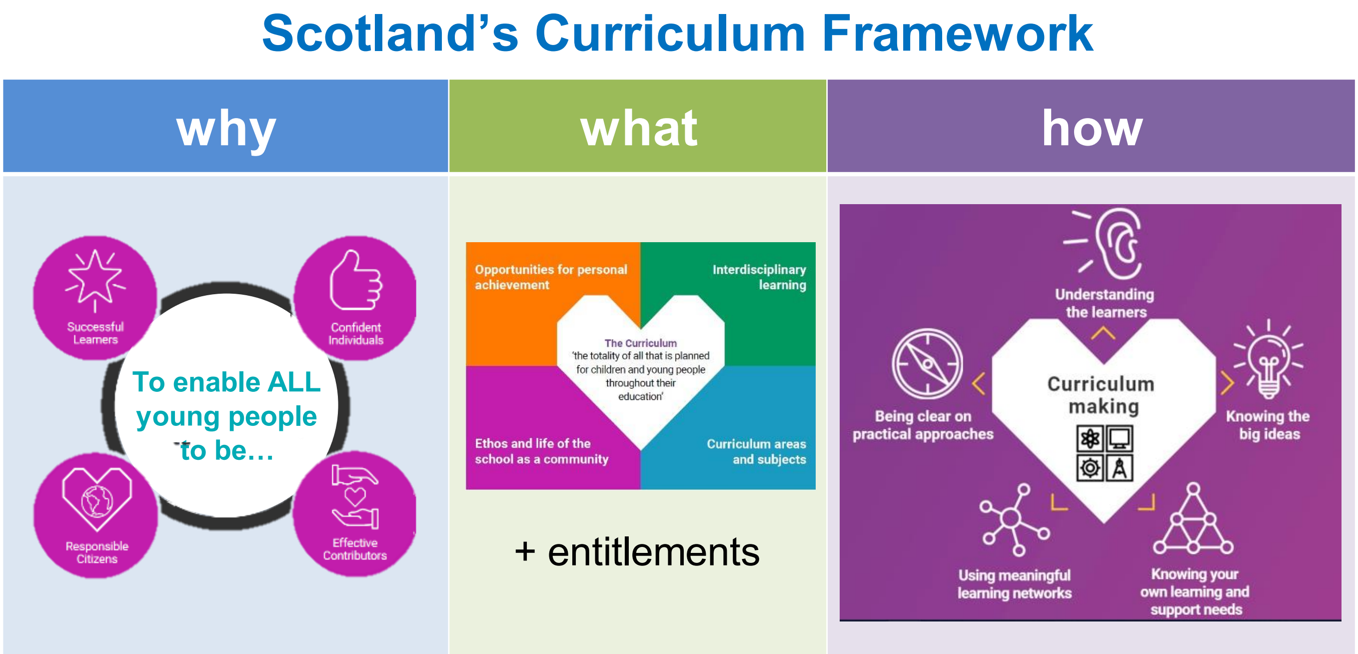


Figure 1.0: Scotland's Curriculum Framework (Source: Education Scotland 2019).

One main outcome of the pilot curriculum reviews held over session 2023/24 was the consensus amongst teachers and practitioners that the current technical framework should be evolved as part of the planned developments in the Curriculum Improvement Cycle (CIC). During the reviews, participants identified issues to be addressed and made the link between potential changes to the technical framework alongside meaningful implementation approaches as a way of addressing these issues.

1.1 The case for change

The concluding section of the first paper in this series - Background and a Case for Change summarised the findings from the reviews as noted below:

- Participants involved in the CIC collaboration groups should be recruited in an open fashion, seeking to ensure a diversity of perspectives and representation from educators at all levels

- ES and the Scottish Government (SG) should be cognisant of the practical challenges, such as the availability of practitioners and difficulties local authorities may have in releasing practitioners to fully participate

- Future guidance must provide clarity and simplify processes, with guidance replacing previous texts rather than adding to the volume of documents currently associated with the curriculum

- There was strong consensus from those who participated in the pilot reviews that Curriculum for Excellence (CfE) should be evolved and not replaced, and that there is continued support for the central purposes of the curriculum, particularly the four capacities, which aligns with the 2021 OECD review

- The vagueness of Es&Os must be addressed as must the disconnect between BGE and the senior phase

- There appears to be a strong desire and need to de-clutter[1] the curriculum and clarify the position of knowledge whilst being mindful of the nuanced requirements of differing curricular areas

- The redefinition of cross-curricular knowledge and skills, perhaps as part of a new framework, could provide the means to streamline curriculum development (by replacing extant guidance, for example) and better support the core ambitions of CfE

- On the role of knowledge specifically, practitioners should have greater clarity through the technical framework on what knowledge learners should have at each stage, and benefit from an understanding of what is meant by knowledge and its purpose in the context of CfE

- Any evolved technical framework for the curriculum must address the tensions between autonomy and prescription with sufficient flexibility to appreciate the differences between curriculum areas

- Difficulties in tracking and monitoring progress, as well as onerous moderation processes, particularly in the early phases of secondary, must be addressed to offer a coherent and practical approach which does not overburden practitioners and teachers.

It should be noted that these findings are reflected in many of the points identified in the 2021 OECD report and in other related reports such as those that emerged from the National Discussion of Scottish Education (2023)[2] and the Independent Review of Qualifications and Assessment (2023)[3].

1.2 Criteria for an evolving technical framework

Based on the above findings, the following success criteria were considered to help evolve the technical framework. Review points on each of these are summarised in section 7.

The technical framework should provide:

- Clarity on the role and purposes for knowledge and skills
- Greater clarity on the knowledge and skills learners should have at key points in their learning

[1] Streamline and re-align with purpose.
[2] Scottish Government (2023), All Learners in Scotland Matter – national discussion on education: final report.
[3] Scottish Government (2023), It's Our Future – Independent Review of Qualifications and Assessment.

- Clarity on progression from early learning and childcare onwards
- A clear and coherent position on cross-curricular expectations
- Appropriate flexibility and autonomy for teachers and practitioners
- Parameters for the selection of content and a process for prioritising and de-prioritising
- Adaptability to the realities of the different nature of sectors and subjects
- 3-18 alignment and consistency with the senior phase.

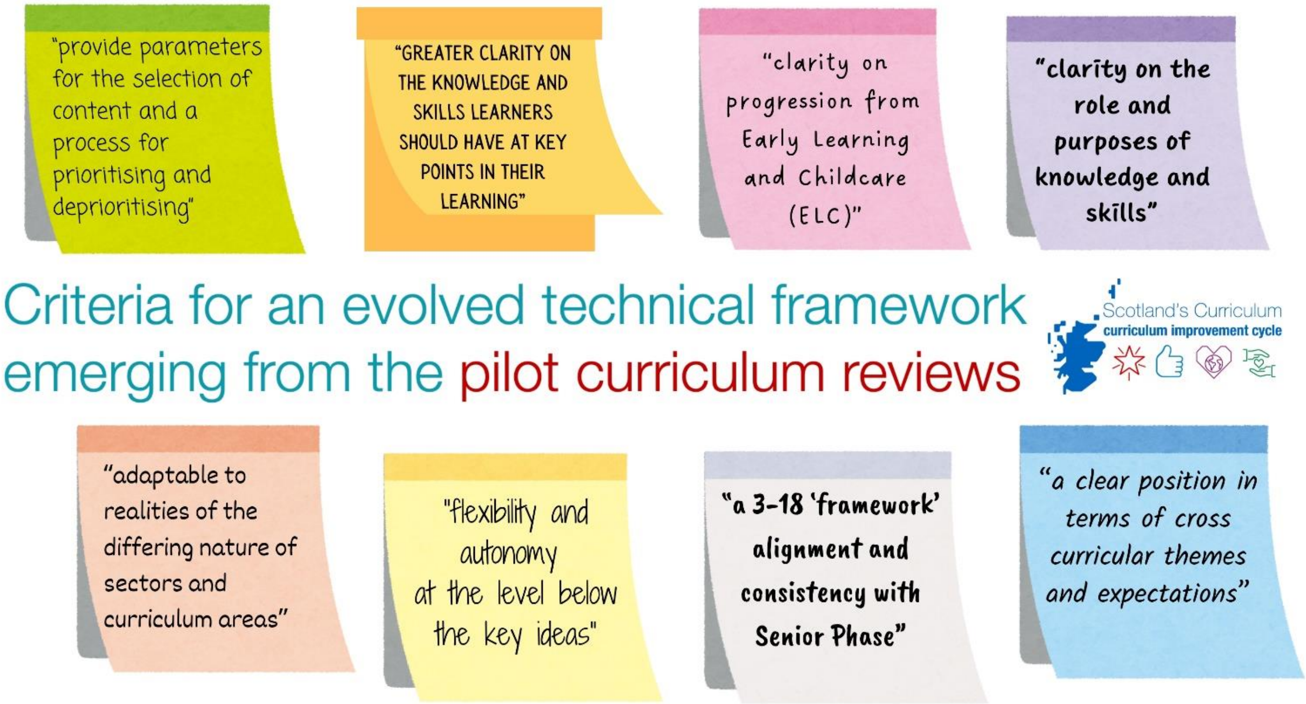


Figure 2.0: Criteria for an evolved technical framework (Source: Education Scotland 2024).

To understand and contextualise the emerging findings from the pilot reviews and to ascertain what would work best in Scotland, ES undertook a range of different activities. These included desk-based research, discussions with educators and officials in other nations who were also engaged in their own curriculum review cycles, and ongoing discussions with key partners and stakeholders in Scotland (including members of the Curriculum and Assessment Board[4]). Learning and observations from this work are shared in section 2.

In conclusion, the CIC is an opportunity to address and resolve some of the issues identified in the curriculum area pilot reviews. This means evolving the technical framework to provide, for instance, greater clarity on knowledge and what constitutes progression.

[4] **Membership of the Curriculum and Assessment Board (CAB) includes:** Association of Directors of Education, Association of Headteachers and Deputes in Scotland, College Development Network, Colleges Scotland, Community Learning and Development Man ager Group, Convention of Scottish Local Authorities, Early Years Scotland, The Educational Institute of Scotland, Education Scotland, Professor Mark Priestley, University of Stirling, Professor Louise Hayward, University of Glasgow, National Association of Schoolmasters Union of Women Teachers, School Leaders Scotland, Scottish Council of Independent Schools, Scottish Funding Council, Scottish Government, Scottish Secondary Teachers Association, Scottish Qualifications Authority, Skills Development Scotland and Universities Scotland.

2. Understanding what works

During discussions with colleagues in Scotland and other nations, it became apparent that it was useful to consider the different curriculum types of other countries and to identify similarities with Scotland's typology (Priestley et al., 2023). This enabled follow-up discussions with relevant colleagues in different international education systems, or led to the further study of published materials, with the focus on where these different systems were in relation to curriculum review and/or the redesign of their own technical frameworks.

The features of high performing systems were also revisited (including OECD, 2022; Masters, 2023) to consider how they could support the shaping of an evolved technical framework for Scotland.

2.1 Curriculum typologies

The work done by Schiro (2013) on the purposes of curriculum provided different lenses for viewing curriculum types. He identified four visions for the curriculum, centred around different curriculum 'ideologies':

> **The Scholar Academic Ideology** sees education as a means of transmitting the accumulated knowledge and intellectual traditions of academic disciplines. Its primary goal is to induct students into the culture and ways of thinking of disciplinary experts. Characteristics include: the importance of mastering disciplinary content and methodologies; [practitioners and] teachers as subject matter experts guiding students toward intellectual rigour; a curriculum organised by traditional subject areas (Schiro, 2013, p. 4).
>
> **The Social Efficiency Ideology** views education as a tool for preparing individuals to function efficiently in society. It emphasises designing a curriculum that develops specific skills, behaviours, and competencies required for societal and economic roles. Characteristics include: a focus on clear, measurable learning outcomes; curriculum development based on scientific and technical principles; preparing students for workforce roles and societal productivity (Schiro, 2013, p. 5).
>
> **The Learner-Centred Ideology** prioritises the needs, interests and growth of the individual learner. Education is seen as a process of self-actualisation and personal development. Characteristics include: emphasising student experiences, interests and developmental stages; flexible curricula that adapt to the learner; encouraging creativity, autonomy, and intrinsic motivation in students (Schiro, 2013, p. 5-6).
>
> **The Social Reconstruction Ideology** sees education as a means to create a better, more just society. It focuses on using the curriculum to address social problems and empower students to become agents of social change. Key characteristics include: curriculum content that engages with real-world issues such as inequality and environmental challenges; encouraging critical thinking, collaboration, and active citizenship; promoting social justice, equity, and transformation (Schiro, 2013, p. 7-8).

While these ideologies appear to provide distinct frameworks, most education systems blend elements from multiple categories, with the balance often reflecting the unique priorities and contexts of each country. For instance, in Scotland, the secondary curriculum remains predominantly organised around traditional subjects, reflecting a Scholar Academic approach (Scottish Government, 2010). At the same time, current guidance encourages the promotion of learner-centred approaches, as seen in the emphasis on personalised learning and flexibility in the CfE framework (Education Scotland, 2019). The major policy focus on addressing socio-economic inequalities through aiming to close the poverty-related attainment gap suggests elements of a Social Reconstruction ideology, particularly through initiatives like the Scottish Attainment Challenge (Scottish Government, 2015). However, the key drivers and the central features of the curriculum are more closely aligned with the Social Efficiency model, emphasising competency-based outcomes (Scottish Government, 2004).

The dominant direction of travel in transnational curriculum policy over the last twenty years has been the move from traditional academic frameworks, where the acquisition of knowledge was seen as the central purpose of education, to one where *"more attention is placed on competencies that prepare a student for life, for personal development, and for the world of work (with appreciated options for vocational directions and apprenticeships)"* (OECD 2021).

Scotland, through the introduction of CfE in 2004, could be said to have been an early participant in this wider transnational direction of travel towards the development of competency-based frameworks.

2.2 An enhanced competency framework

Over time, the move to a competency-based curriculum have generated criticism (Young & Muller, 2010; Priestley & Sinnema, 2014) in relation to the role and importance of knowledge. This was identified as an issue by the OECD who stated in the 2021 report that [in Scotland] *"there is no clear model of how knowledge, skills and attitudes, capabilities and attributes contribute to learning. In the absence of clarification on what is expected in terms of knowledge as part of the learning process, the role of knowledge appears somewhat fragmented and left to interpretation at the school level, although it is an essential component of learning in CfE's framework."* It then goes on to state that the current technical framework *"seems to create ambiguity on the role of knowledge and its balance throughout CfE from ages 3-18".*

The findings from the pilot reviews appear to strongly suggest that teachers and practitioners have no desire to move to a framework that over-prescribes **content,** that is, the specific topics or details to be covered. Participants emphasised the importance of maintaining flexibility to design a curriculum that reflect the unique contexts of their learners and the communities they serve. However, there was also a clear call for greater clarity regarding the expected **knowledge** learners should acquire, such as the key concepts, principles, and understanding that underpin learning. As Deng (2022) highlights, knowledge provides the conceptual depth necessary for intellectual progression, while content represents its specific instantiation within a curriculum. This distinction and clarity were seen as crucial for addressing persistent challenges, such as progression, improving primary-secondary transition and ensuring continuity between the BGE and the senior phase (Education Scotland, 2023).

Current developments in curriculum typology for countries such as Scotland, which are considered to have adopted a competency-based model, have led to the exploration of an 'enhanced' or 'post-competency' model (Priestley et al., 2023). This approach seeks to address critiques by clarifying the role and position of knowledge within the learning process, ensuring that it is given prominence alongside the development of essential skills and attributes (OECD, 2021). Such a model would seek to balance knowledge and skills while drawing on aspects of Social Reconstruction ideology. This approach positions education as a means to address societal challenges, promote equity, and support learners in developing the skills and understanding needed to contribute positively to their communities while becoming become active agents of change (Schiro, 2013). This evolution would create a curriculum that is both rigorous and responsive to the complexities of the modern world.

For clarity, the key features of an academic, competency and an enhanced competency focused curriculum are listed below:

	Scholar Academic focus	Competency-based focus	Enhanced competency-based focus
Relationship between knowledge and skills	Knowledge is central and regarded as the foundation for intellectual development, focusing on the transmission of academic disciplines (Schiro, 2013; Young, 2013).	Focus on skills, behaviours, and competencies rather than detailed disciplinary knowledge (Schiro, 2013; Spady, 1994).	A hybrid approach that retains core elements of competencies but places greater emphasis on knowledge, understanding, and application in varied contexts (Rychen and Salganik, 2001; Haste, 2009).
Content and organisation	Curriculum content is fixed, sequenced, and heavily specified to ensure depth and progression within disciplines (Schiro, 2013; Hirsch, 2016).	Content is secondary to the mastery of predefined competencies, which are often context-neutral and transferable (Schiro, 2012; Rychen and Salganik, 2001).	Learning standards articulate what students should know, understand, and do, but with greater flexibility to accommodate deep conceptual understanding and interdisciplinary connections (Pellegrino and Hilton, 2012).
Cross-curricular connections	Focus is on subject-specific knowledge and skills with limited attention to cross-curricular connection. (Young, 2013; Muller, 2009)	Focus on clearly defined cross-disciplinary competencies (e.g. communication, collaboration, problem-solving) as central outcomes (Rychen and Salganik, 2001; Pellegrino and Hilton, 2012).	Cross-curricular competencies and knowledge are integrated into the framework, aligning with broader purposes such as global citizenship and critical thinking (Erickson, 2007).
Curriculum structure	Subjects are organised around traditional disciplines with minimal interdisciplinary content (Young, 2013).	Curriculum is often organised around real-world tasks or outcomes rather than traditional subjects (Spady, 1994).	Curriculum content is structured around Big Ideas or enduring understandings to unify and contextualise knowledge across disciplines. (Erickson, 2007; Wiggins and McTighe, 2005).

Figure 3.0: Features of academic, competency and enhanced competency models.

While a Scholar Academic focus offers depth and rigour, it risks neglecting the real-world applicability and interdisciplinary connections essential for preparing learners to navigate the complexities of contemporary society. Conversely, the purely competency-based model has been criticised for diminishing the role of disciplinary knowledge, leading to potential gaps in intellectual progression and coherence. An enhanced competency-based model would ensure the curriculum remains both rigorous and responsive through the development of deep conceptual understanding, interdisciplinary connections, and practical application of learning. It has the potential to address the evidenced issues relating to CfE (for example: Priestley & Sinnema, 2014; OECD, 2015; OECD, 2021; Shapira et al., 2023; Education Scotland, 2024) while maintaining its core principles.

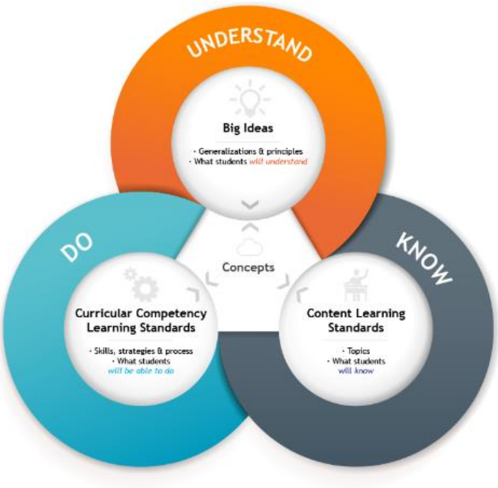
Additionally, an enhanced competency-based model aligns with Scotland’s commitment to equity and societal transformation. By recognising education’s potential to address challenges that matter most to children and young people, such as the climate emergency, equality, and technological advancement (Campbell & Harris, 2023) it empowers learners to develop the knowledge, skills, and attributes needed to thrive as individuals, contributors, citizens, and learners.

2.3 A Know-Do-Understand model

A common feature of systems that have transitioned to an enhanced-competency-based model is the adoption of a technical framework which combines the notion of Big Ideas within a Know-Do-Understand framework. This approach seeks to address the challenges outlined above by explicitly addressing and clarifying the position of knowledge whilst also maintaining the benefits of developing wider competencies. In British Columbia, Canada, this approach is described as both a concept-based (knowledge) and a competency-driven curriculum (British Columbia, Ministry of Education, 2013: p3).

Several systems have deployed variants of such an approach, with the common aim of providing greater clarity on the position of knowledge. Illustrations from British Columbia and New Zealand are included below. It is important to recognise that both the British Columbia and New Zealand models have been designed to build on their respective early years frameworks - British Columbia's Early Learning Framework (Government of British Columbia, 2019) and Te Whāriki in New Zealand (Ministry of Education, 2017). These frameworks provide strong and developmentally appropriate foundations for learning and supporting continuity and coherence for children from the age of three. It is also worth noting that both illustrations use diagrams which reflect the intertwined nature of the different elements identified: know, do and understand. The use of the term 'Know-Do-Understand' does not imply a linear order for how children and young people will engage with knowledge. This will vary across developmental stages and in differing curricular areas.

Illustration 1:
Know-Do-Understand/Big Ideas.
In the British Columbia (Canada) Curriculum (OECD, 2021).

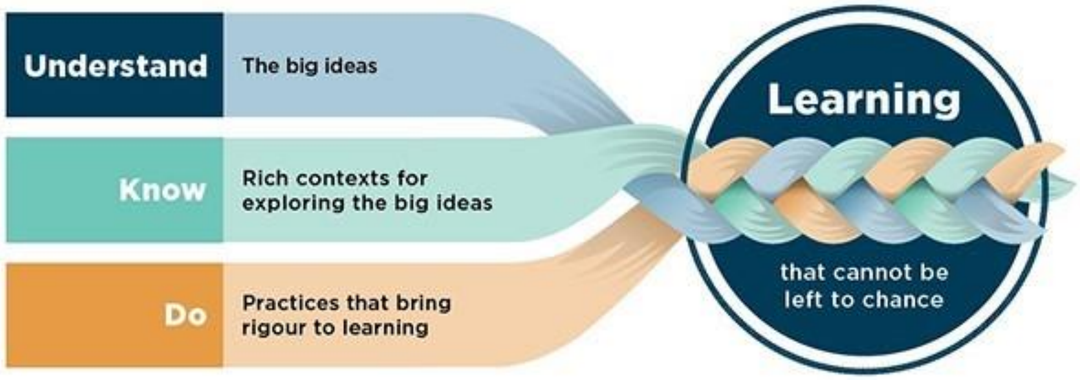


British Columbia re-designed its curriculum framework for school education in the 21st century, building on a concept-based approach to learning and driven by the development of competencies to foster deeper, more transferable learning. The curriculum approach emphasises the deeper understanding of concepts and the application of processes, rather than memorising isolated facts and information. The learning standards and Big Ideas for each area of learning identify what is essential — what students are expected to know, be able to do, and understand at each grade.

The curriculum model **Know-Do-Understand** pulls together the best from modern learning theories and British Columbia teachers' advice. The curriculum model is made up of three elements-content, curricular competencies, and Big Ideas. "Content (Know)" defines what students are expected to know; "Curricular Competencies (Do)" sets out what students are expected to do; and "Big Ideas (Understand)" indicates what students are expected to understand. Teachers combine the three elements in ways they see fit to personalise learning in their classrooms. The content learning standards — the "know" of the Know-Do-Understand model of learning — detail the essential topics and knowledge at each grade level.

Source: Government of British Columbia (Canada), (2016), Curriculum Redesign. [Retrieved: 29 March 2021].

Illustration 2:
The Understand-Know-Do (UKD)/Big Ideas structure of Te Mātaiaho
in the refreshed New Zealand Curriculum.



The "Understand, Know, Do" framework is a central component of New Zealand's curriculum design. This framework comprises three interconnected elements. **Understand:** The Big Ideas that provide overarching themes and concepts. **Know:** Rich contexts for exploring these Big Ideas, offering detailed knowledge and content. **Do:** Practices that bring rigour to learning, emphasising the skills and actions in which learners engage in to deepen understanding and apply knowledge meaningfully.

These elements are not separate or sequential; instead, they are woven together to ensure that student learning is deep and meaningful. Teachers design learning experiences that integrate these components, facilitating a holistic educational approach.

Source: Ministry of Education. (n.d.). Aotearoa New Zealand's histories content structure. New Zealand Curriculum Online. [Retrieved: November 23, 2024].

2.4 A Big Ideas approach

As well as British Columbia and New Zealand, other education systems have adopted a Big Ideas approach, including South Korea and Singapore. There are, however, significant variations across different education systems and jurisdictions as to the form Big Ideas can take.

For instance, in British Columbia, Big Ideas are defined as generalisations and principles and the key concepts important in an area of learning. They reflect the "Understand" component of the Know-Do-Understand model of learning. The Big Ideas represent what learners will understand at the completion of the curriculum for their grade.

In New Zealand, however, the Big Ideas remain the same across year levels and learners gradually deepen their understanding of them as they grow their knowledge of national and local contexts. They can be viewed as summations of conceptual understanding with key concepts embedded within them.

In South Korea, Big Ideas are overarching concepts that frame and connect knowledge across all subjects and are integrated into all disciplines (Ministry of Education of the Republic of Korea, 2023). In Singapore, the curriculum framework incorporates Big Ideas to help learners to develop a deeper understanding in individual subjects. They specifically identify Big Ideas relevant to individual subjects to help build a coherent understanding across different levels within a subject (Ministry of Education, Singapore, 2021).

As part of the pilot reviews, practitioners and stakeholders within various curriculum areas, as well as those in the CIC core mathematics group have explored technical frameworks used by other systems. Feedback suggests that the Know-Do-Understand model combined with the use of Big Ideas would appear to offer a solution to making the position of knowledge more explicit as part of an evolved technical framework. This combination would have the advantage of clarifying the expected knowledge that learners should have and do so in a way that does not overly limit the autonomy and flexibility around the context for learning that teachers and practitioners highlight as particularly significant and desirable.

The following sections 3 and 4 take a closer look at both Big Ideas and the use of the Know-Do-Understand model to better understand how they could work together to evolve the technical framework within a Scottish context.

3. What are Big Ideas?

The concept of Big Ideas has a long-standing history in education. Mitchell, et. al. (2016) trace its origins to early educational theorists such as Dewey (1902) and Whitehead (1929) who recognised the importance in fostering meaningful and connected learning. In more recent years, Wiggins and McTighe (2005) have revitalised the focus on Big Ideas, emphasising their role in curriculum design to deepen understanding.

In the UK, the significance of Big Ideas in science education was highlighted with the publication of Principles and Big Ideas of Science Education (Harlen, 2010), which has guided the integration of these principles into science teaching. More recently, the Institute of Physics (IOP) launched its fundamentals of 11 to 19 physics documentation (IOP, 2024) which revealed the "big physics ideas everyone should know". The application of Big Ideas has also extended to other domains. For instance, Cush (2019) points to Big Ideas for Religious Education (Wintersgill, 2016) as a framework for curriculum development in Religious Education.

There are, however, significant variations across education systems as to the content, use, positioning and breadth of Big Ideas (effectively how big they are). There are also other differences, such as the applicability across the totality of levels, relation to stages and the validity of their integration across every subject.

A selection of examples from one jurisdiction (British Columbia, Canada – using maths (number) as an example and two further domains (science and religious education) and are offered below for discussion.

Example 1: A selection of Big Ideas in maths (number)
(Source: British Columbia, Ministry of Education, 2019).

The chart below shows an example of the progression of *number* from Kindergarten through Grade 9 in: number represents and describes quantity	
Big Idea: Number represents and describes quantity	
K	Numbers represent quantities that can be decomposed into smaller parts.
1	Numbers to 20 represent quantities that can be decomposed into 10s and 1's.
2	Numbers to 100 represent quantities that can be decomposed into 10s and ones.
3	Fractions are a type of number than can represent quantities.
4	Fractions and decimals are types of numbers. Then that can represent quantities.
5	Numbers describe quantities that can be represented by equivalent fractions.
6	Mixed numbers and decimal numbers represent quantities that can be decomposed into parts and wholes.
7	Decimals, fractions, and percent are used to represent and describe parts and wholes of numbers.
8	Number represents, describes, and compares the quantities of ratios, rates, and percents.
9	The principles and processes underlying operations with numbers apply equally to algebraic situations and can be described and analysed.

Example 2: A selection of Big Ideas for science
(Source: Harlen, 2010).

1. All material in the universe is made of very small particles. Atoms are the building blocks of all materials, living and non-living. The behaviour of atoms explains the properties of different materials. Chemical reactions involve rearrangement of atoms in substances to form new substances. Each atom has a nucleus containing neutrons and protons, surrounded by electrons. The opposite electric charges of protons and electrons attract each other, keeping atoms together and accounting for the formation of some compounds.
2. Objects can affect other objects at a distance. Some objects have an effect on other objects at a distance. In some cases, such as sound and light, the effect is through radiation which travels out from the source to the receiver. In other cases, action at a distance is explained in terms of the existence of a field of force between objects, such as a magnetic field or the universal gravitational field.
3. Changing the movement of an object requires a net force to be acting on it. Objects change their velocity of motion only if there is a net force acting on them. Gravity is a universal force of attraction between all objects, however large or small, keeping the planets in orbit around the sun and causing terrestrial objects to fall towards the centre of the Earth.

Example 3: A selection of Big Ideas for religious education
(Source: Wintersgill, 2016)

BIG IDEA 1 CONTINUITY, CHANGE AND DIVERSITY Religions and non-religious worldviews involve interconnected patterns of beliefs, practices and values. They are also highly diverse and change in response to new situations and challenges. These patterns of diversity and change can be the cause of debate, tension and conflict, or can result in new, creative developments.
BIG IDEA 2 WORDS AND BEYOND Many people find it difficult to express their deepest beliefs, feelings, emotions and religious experiences using everyday language. Instead, they may use a variety of different approaches, including figurative language and a range of literary genres. In addition, people use non-verbal forms of communication such as art, music, drama, and dance that seek to explain or illustrate religious or non-religious ideas or experiences. There are different ways of interpreting both verbal and non-verbal forms of expression, often depending on a person's view of the origin or inspiration behind them. The use of some non-verbal forms of communication is highly controversial within some religious groups, particularly their use in worship or ritual.
BIG IDEA 3 A GOOD LIFE Many religions and non-religious communities strive to live according to what they understand as a good life. Their members share an understanding as to the sort of characteristics and behaviours a good person will seek to achieve, as well as dealing with what is, or is not, acceptable moral behaviour. People have different ideas about how and why we should lead a good life. The ideal is usually presented in the lives and character of exemplary members. There may be considerable agreement across different religions and non-religious worldviews on some matters, and considerable differences on others. Also, there are often major disagreements over the interpretation and application of moral principles between members of the same religion or worldview.

3.1 The case for a Big Ideas approach

Harlen (2010) and Wintersgill (2016) identify several benefits of adopting a Big Ideas approach. Harlen (2010) highlights that Big Ideas can promote greater coherence in learning by acting as conceptual “pegs” on which children and young people can organise and make sense of their educational experiences. This approach helps address the challenge of some learners struggling to see the relevance of studying topics that appear to them as isolated, disconnected facts. Similarly, Wintersgill (2016) emphasises that Big Ideas *“provide a* *structure which enables students to understand the 'big picture' behind the content which otherwise too often seems disconnected."*

In addition to providing a purpose for learning and helping learners make connections across their experiences, Big Ideas can also enhance the relevance of learning by focusing on how a discipline explains the world around them. Mitchell et al. (2016) support this view, arguing that *"organising teaching of a topic around a small number of Big Ideas has been argued by many to be important in teaching for deep understanding, with Big Ideas being able to link different activities and to be framed in ways that provide perceived relevance and routes into engagement."* Big Ideas establish a coherent framework that helps learners identify connections and understand underlying relationships. This supports deeper learning and minimises the risks associated with over-prescription of content, which often leads to rote learning and memorisation. This emphasis on understanding over memorisation ensures that learning remains meaningful and applicable to real-world contexts.

Harlen (2010) and Wintersgill (2016) advocate for a more expansive conceptualisation of Big Ideas than suggested by their use in British Columbia. Wintersgill defines Big Ideas as *"generalisations and principles and the key concepts important in an area of learning,"* focusing on their role as organisers within disciplines. In contrast, Harlen adopts a broader perspective, suggesting that Big Ideas are key ideas that collectively enable learners to understand events and phenomena relevant to their lives, both during and beyond their time at school. Wintersgill (2016) also describes them as *"generalised summaries of what we want students to understand"* by the conclusion of their educational journey. Together, these definitions highlight the flexibility of Big Ideas as a framework.

Building on the above, there is significant value in combining both approaches to shape discipline-specific learning and foster broader, lifelong understanding within an enhanced competency-based technical framework for Scotland. This combined approach not only provides opportunities to redefine the understanding we expect learners to achieve but also establishes clear parameters for prioritising knowledge and skills. By doing so, it supports more purposeful curriculum design decisions, guiding the selection of conceptual knowledge and skills and enabling a coherent process for streamlining and future-proofing Scotland's curriculum.

Such an approach can also promote flexibility and autonomy for practitioners. Wintersgill (2016) identifies this when she states that Big Ideas are, *"common destinations, which can be reached by many alternative routes. Because Big Ideas describe what we want children to understand, they frame the questions that lead to this understanding. They are unable to do this without contexts provided by content".*

There are many existing strengths to build on. These include our collective understanding of child development and its relation to how we plan for learning from 3 - 18:

- The Big Ideas approach builds upon the way human beings naturally make sense of the world from birth. A baby's first encounters with the Big Ideas of the world are explored within their immediate environment through their movements and interactions with those around them. Babies and very young children develop understandings and build the foundations of their brain architecture through making meaningful connections, especially through play (Harvard Centre on the Developing Child, 2024)

- In the early years, early learning and childcare (ELC) settings and early primary classes build upon this and offer a young child's first experience of Scotland's curriculum. In ELC, children explore Big Ideas through play and meaningful real-life experiences in interesting, relevant interdisciplinary contexts both outdoors and indoors. Practitioners and teachers support learning through responsive and intentional planned interactions, experiences and spaces

- Primary schools can expertly cultivate a Big Ideas approach through interdisciplinary experiences. Big Ideas at the primary stage are explored through thematic approaches, which help make sense of disciplinary learning by connecting concepts in meaningful and interesting contexts

- These ideas are extended as lower secondary school students develop their capacity for abstract thinking, enabling them to see connections between more complex events or phenomena. As exploration of the world deepens in secondary education, finding patterns and links allows students to understand relationships and models that can make sense of a wide range of new and prior experiences (Harlen, 2017).

Big Ideas can outline the essence of a curriculum area or disciplinary area. As such, they provide the larger intellectual frame (or schema) for learning within a discipline. As Wintersgill outlines, Big Ideas can determine the nature and scope of learning in a subject or discipline and provide the parameters for prioritising knowledge and skills. For example:

- Taken together, they express the core, essence or central concerns of the disciplinary area
- They act as lenses which, when used to 'view' content, help to clarify it
- They provide coherence and make sense of what might otherwise be confusing information or disconnected facts, highlighting the big picture and interconnections between learning
- They are transferable to real-world contexts and help relate disciplinary learning to wider relevance.

Big Ideas require consistency in planning and encourage development in curriculum design. Learning can be organised around opportunities to address and revisit the Big Ideas, promoting depth of understanding. Revisiting these ideas through increasingly complex information - moving from the specific to the abstract, making connections to other ideas, and applying learning in new and unfamiliar contexts - addresses a key challenge: the relationship between curriculum areas and cross-curricular expectations or competencies.

Ongoing work involving practitioners and other stakeholders, including the mathematics collaboration group, suggests support for an approach centred around Big Ideas as part of an evolving technical framework.

In particular:

- Establishing Big Ideas for each curriculum area as a key part of the process of reviewing and strengthening the curriculum
- Making explicit links within any narrative to specific overarching concepts that would then form the basis for guidance on the position of knowledge within each curriculum area.

In conclusion, a strong case has been made that a Big Ideas approach should form the foundation of an evolving technical framework for Scotland and establishing the Big Ideas for a curriculum area should be an initial objective for those involved in the Curriculum Improvement Cycle. These Big Ideas should encompass epistemic knowledge[5] and inform

[5] **Epistemic knowledge** involves knowing how to think and act like a practitioner (e.g. think like a mathematician, historian or scientist). It shows the relevance and purpose in student learning and helps deepen their understanding (OECD, 2018: 5).

the parameters for identifying key concepts for each curriculum area. This alignment will, in turn, provide clear guidance for determining what learners should **know** and **be able to do**, and by when, ensuring a progressive, cohesive and future-oriented framework.

4. How a Know-Do-Understand model can clarify the position of knowledge.

The need to clarify the position of knowledge was a feature of recommendations made by the OECD in its review of Scotland's Curriculum in 2021[6]. This need for clarification was echoed in messages from the pilot reviews where participants thought that structural barriers had developed because of a lack of clarity on what learners need to know. This was due to vague wording of Es&Os and benchmarks or a lack of reference, either explicitly or implicitly, to the knowledge that learners should have in guidance documents. Specific consequences of this could be seen in the backwash effect of the senior phase on the BGE, and barriers to effective progression between ELC and primary, primary and secondary and between the BGE and the senior phase (Education Scotland, 2023).

4.1 The position of knowledge

Some key questions were also raised regarding the position of knowledge during the pilot reviews such as:

- What do we mean by knowledge? Do we have a shared definition and understanding?
- What knowledge should learners have at key points in their learning?
- What are the purposes for knowledge in the curriculum? Is it to enable children and young people to thrive and make sense of the world as they grow and learn? Is it to provide progression solely into National Qualifications? Is it to prepare learners for the transition into the workforce or society?
- What should constitute a common base of knowledge? Is there 'important' knowledge all learners should have access to as an equity issue?

These points were summarised in the concluding section of the first paper in this series.

Addressing these issues requires a response which looks at the design of the technical framework that underpins the 'what' of the curriculum and makes explicit the position of knowledge. As outlined in section 2 of this paper, other systems that previously adopted competency-based models have faced similar challenges. In response, they have developed frameworks that aim to provide greater clarity on the knowledge learners should have along with what they are expected to understand and be able to do. In doing so they have maintained the development of competencies and skills and avoided the risks associated with the over-prescription of knowledge.

[6] **OECD Recommendation 1.1 - Re-assess CfE's aspirational vision against emerging trends in education to take account of evolutions in education and society:** Scotland should consider updates to some of its vision's core elements and their implications for practice, in particular, the role of knowledge in CfE; and define indicators aligned to the vision to help understand students' progress across all four capacities set out in CfE.

OECD Recommendation 1.2 - Find a better balance between breadth and depth of learning throughout CfE to deliver Scotland's commitment to providing all learners with a rich learning experience throughout school education: Scotland could consider how the design of CfE can better help learners consolidate a common base of knowledge, skills and attitudes by the end of BGE, and nurture and hone this base for them to progress seamlessly through the senior phase and the choices its offers.

(OECD, 2021)

4.2 A Know-Do-Understand approach to developing conceptual knowledge

In addition to the desk-based research undertaken as part of the pilot reviews in the curriculum areas, core groups of practitioners and stakeholders have explored how technical frameworks are used by other systems to view their appropriateness through the lens of a specific curriculum area for example, in mathematics and in expressive arts.

By its very nature, a Know-Do-Understand model offers a solution to making the position of knowledge more explicit as part of an evolved technical framework. It also offers a way to clarify the knowledge that learners should have and does so in a way that does not overly limit the autonomy and flexibility that practitioners highlight as particularly significant and desirable.

Central to this approach is a focus on developing **conceptual knowledge**[7]. This enables children, young people and practitioners to have the freedom to choose the contexts that would be most suitable. This was a significant message from across the pilot reviews: practitioners want greater clarity but do not want over-specification or prescription. Participants in the pilot reviews also stressed the importance of 'place-based' approaches to curriculum design.

As already stressed in section 3, there is a risk that a move that might lead to over-specification would promote rote learning and memorisation. This concern is consistent with findings from the OECD (2021) report Curriculum for Excellence into the Future, which critiques the limitations of overly content-dominated approaches in education. Additionally, Stobart (2021) highlights similar risks in his analysis of the qualifications phase in Scotland, noting that the current assessment model often emphasises factual recall over deeper understanding.

Prioritising the development of conceptual understanding is a common feature of high-performing systems. In his comparative study of five such systems, Masters (2023) identifies a focus on developing understanding of disciplinary concepts and some shared features in the positioning of knowledge across these systems:

- Curriculum is structured around traditional disciplines such as national language and literature, mathematics, science, and the social sciences
- High priority is given to developing learners' deep understandings of essential disciplinary concepts, principles and methods which may be relatively few in number
- Opportunities are in place for learners to develop deeper conceptual understandings and apply their learning to a variety of meaningful, often real-world, contexts.

Knowledge itself does not equate to understanding if it lacks connection to other knowledge, cannot be transferred to new contexts or lacks meaning for learners. If this is the case, then such knowledge can undermine understanding and, effectively, be reduced to isolated and disconnected facts which results in rote learning and memorisation.

---

[7] **Conceptual knowledge** involves understanding the relationships between key ideas and concepts within an area of study. It enables individuals to see how various concepts are interrelated and how they fit into broader frameworks, facilitating deeper learning and the application of knowledge in meaningful contexts (Ausubel, 1963; Bransford, Brown, & Cocking, 2000; Hattie, 2008).

Understanding involves making connections, linking to prior learning, and developing the ability to apply knowledge in new contexts. Disciplinary concepts offer the opportunity to make connections between knowledge and factual information. Content and factual information play key roles in supporting the development of conceptual understanding. In order to promote deeper learning, the purpose of teaching should be to encourage learners to build on their knowledge, make connections and links and apply their knowledge in new ways.

This suggests a role for the practitioner to guide thinking from the factual to the conceptual and enable learners to make these connections. It also suggests a key role for an evolving technical framework to promote and make this explicit.

The role of the practitioner in enabling learners to make links in their learning is further supported by the recent (November 2024) HMIE national thematic inspection titled Enhancing the quality of mathematics education in Scotland. The report concludes that, to improve the quality of mathematics education "teachers should link knowledge, concepts and skills across the mathematics curriculum more effectively. This will help children to understand and apply links between distinct aspects of the mathematics curriculum". It further states "where mathematics is connected to real-life contexts, children and young people demonstrate higher engagement" and that "teachers should consider how they balance factual knowledge, procedural fluency, conceptual understanding and skills development in their teaching".

4.3 Designing the technical framework

An evolved technical framework, focusing on developing deeper learning (an original ambition of CfE), should suggest what we want learners to know how to support the development of conceptual understanding.

The work of Erickson and Laning is useful here. Laning (2016) argues that a conceptual structure is important, and content therein should act as an activator to conceptual understanding, whereas designing around core knowledge alone would not necessarily induce deep learning. Erickson (2012) states that, *"quality teaching is supported by quality curriculums"* and that, *"Curriculum statements need to make clear what children should Know factually, Understand conceptually and be able to Do in different disciplines".*

We are currently living through a period of rapid social and technological change, where the ability to make connections to new and evolving contexts is increasingly essential for life in the 21st century. This reinforces the case for focusing on conceptual knowledge, as opposed to prescribing content, in an evolved technical framework. Such an approach not only equips learners with the adaptability required for a rapidly changing world but also ensures they develop a common base of conceptual knowledge at key points in their learning. By doing so, it promotes more effective progression and continuity, particularly during key transitions in their educational journeys.

The formulation of the relevant Big Ideas for a curriculum area, with clear links to the purposes or the 'why' of Scottish education (the capacities - see figure 2.0), would then support the selection of key conceptual knowledge. For the 'what', which is the technical framework, the following layers begin to emerge:

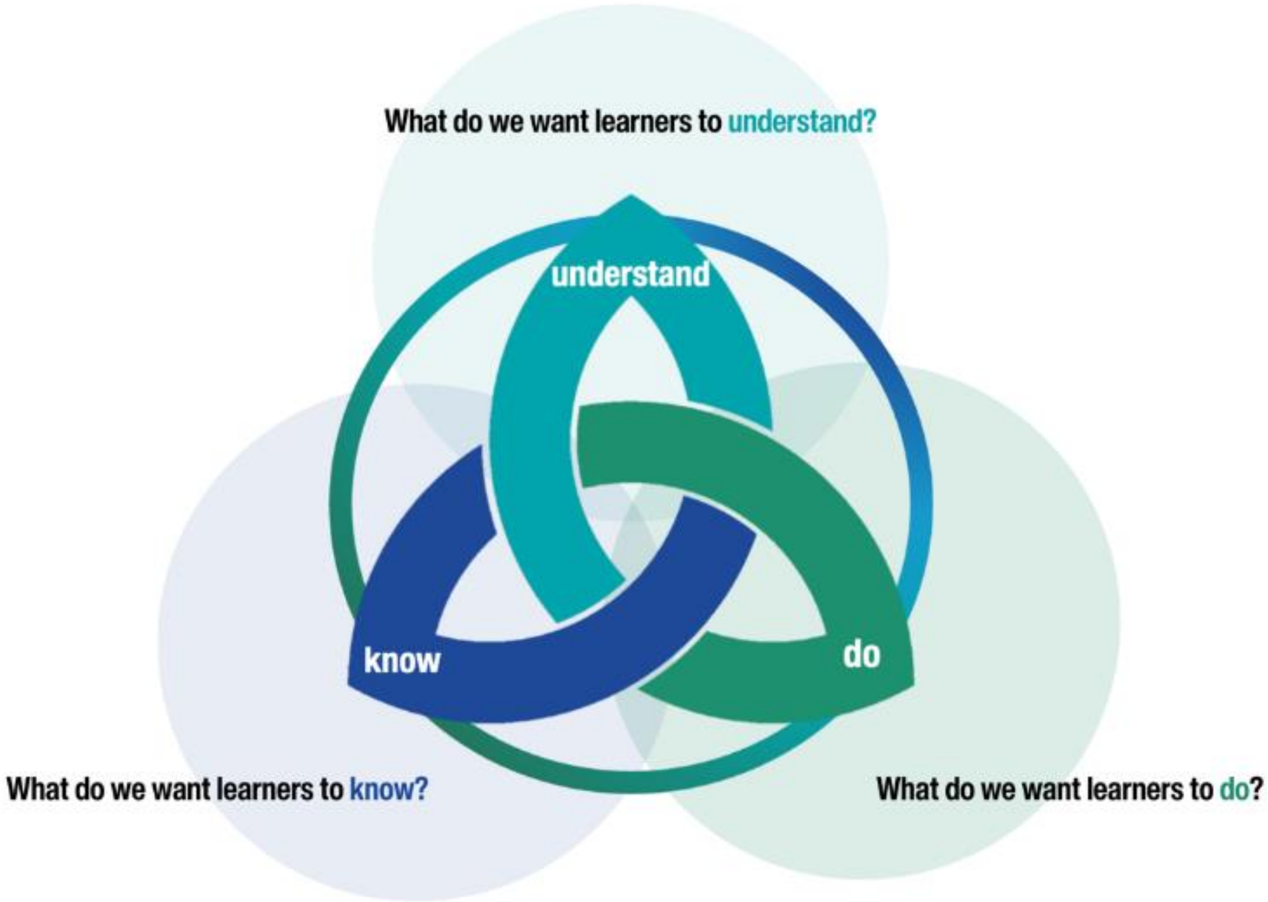


Figure 4.0: Know-Do-Understand (Source: Education Scotland 2024).

- Establishing what we want learners to **understand** (the Big Ideas)
- From this, establishing what we want learners to **know** and be able to **do** to develop this understanding
- More detail indicating the expected knowledge and skills at different points in the learning journey could be provided at the next layer to clarify what **progression** looks like as learners move through a level and between levels. This could support the establishment of a common base of knowledge.

There are potential challenges, particularly for the progression layer. By seeking to provide greater clarity on progression there is a risk this becomes a checklist of content that promotes rote learning, due to accountability and performability pressures. However, without such clarity there is a risk of failing to resolve an issue identified in the pilot reviews (Education Scotland, 2023) of *"vague and woolly statements".* The result of this so far has been the creation of a plethora of local progression frameworks. It has also led to practitioners falling back on instrumental factors when selecting content, this being seen more prominently in the backwash from the senior phase into the upper BGE (Shapira et al., 2023)

Discussions about progression in the national mathematics collaboration group (4th November 2024), considered if this would identify minimum expected knowledge. Similarly, early consultation with practitioners and teachers identified particularly strong support for greater clarity on progression from practitioners in the primary sector.

Early work to develop this area will focus on appropriate approaches to the articulation of knowledge, the level of detail or specification and the expression of progression. The evolved technical framework should be flexible to recognise the natural differences between sectors and curricular areas and be based on stages within a level or on broad levels, as appropriate to the developmental stage of learners or structure of knowledge, within a curriculum area. This could be seen as a continuum along which learners progress.

As outlined earlier, the technical framework concentrates on the 'what' of the curriculum and as such does not prescribe 'how'. Decisions on how best to design and organise learning experiences should be left to the professional judgement of the practitioner. This would also include how disciplinary knowledge is taught. As Priestley and Sinnema (2014) state, *"It is perfectly possible to conceive alternative rigorous approaches to teaching disciplinary knowledge that are interdisciplinary in nature, rather than being framed as traditional subjects".*

An outline structure which reflects the layers discussed above is set out below.

What do we want learners to **Understand?**

- Identify Big Ideas and key conceptual understanding

What we want learners to **Know and Do**?

- Identify what we want learners to Know and be able to Do at key points in their learning

What does **progress** in the **Know** and the **Do** look like?

- What we would expect learners to Know and what we would expect learners to be able to Do at key points in their learning and indications of how this will develop conceptual understanding across the different curriculum areas.

Early examples showing what the key features identified above might look like can be found in Annexes A to D. <u>These examples are for illustration only and should be seen as work currently in progress</u> which will develop as CIC groups proceed with their work. This will be an iterative process and will include sense checking with stakeholders including children and young people, teachers, practitioners, industry, academics and curriculum specialists.

4.4 Strengthening the emerging model

In seeking to evolve and strengthen the technical framework for Scotland's Curriculum, it was useful to revisit and reflect on some of the early work carried out on systematic curriculum review as part of the Scottish Government OECD Action Plan. As part of this work in 2022 the following key features of the frameworks of high performing systems were identified:

A core output which sets out:

- **Overall vision of the curriculum**, its core values and main goals or objectives- the rationale
- The guiding design principles and **high- level messages** and often lists **key competencies to be achieved**

In addition, often:

- There is a more detailed document providing **content guidance;** and
- **There are minimum standards or desired learning outcomes for each specific subject**

Outputs sometimes include:

- **Supporting materials** for teachers
- **Guides and examples** of how to prepare and organise lessons (e.g. pedagogical suggestions on how learning for young people might be organised and supported).

Figure 5.0: Key Features of Curriculum Frameworks in High Performing Systems (source: OECD, 2022).

Scotland's ongoing commitment to the original purposes of CfE embodied in the four capacities provides a clear purpose for shaping the evolved technical framework. Any identified Big Ideas and key conceptual understandings should align with the purpose of enabling **all** children and young people to develop as individuals, contributors, citizens and learners from the early years onwards.

To achieve this, children and young people must develop key conceptual knowledge and skills at developmentally appropriate stages, supported by opportunities to acquire expected knowledge and skills through a thoughtfully structured framework of progression. This progression should be facilitated through carefully organised teaching and learning approaches, based on meaningful interactions, experiences and spaces, as well as the four contexts for learning. **To ensure these approaches are effective, capacity building, professional learning and supporting materials must be in place to empower practitioners and support high-quality approaches to learning, teaching and assessment.**

The narrative outlined above could be expressed as a series of interconnected layers that align to the 'why', the 'what' and the 'how' of Scotland's overall curriculum framework, where the 'what' represents the technical framework discussed throughout this section.

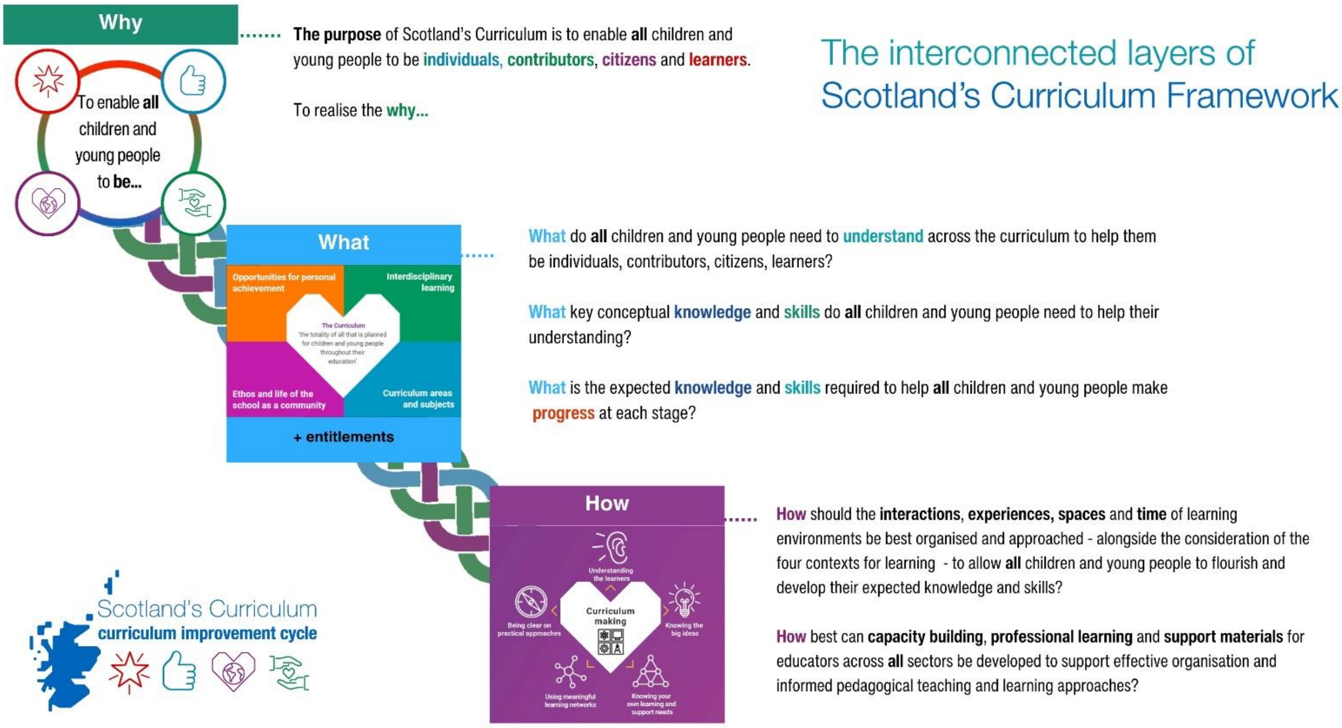


Figure 6.0: The interconnected layers of Scotland's Curriculum Framework (Source: Education Scotland 2024).

The conceptual strength of the overall curriculum framework lies in the interdependence of the following layers (also shown in figure 6.0). Each layer plays a unique and essential role and omitting any one of them undermines the integrity of the curriculum.

The Why

- If the **purpose of the curriculum** is absent, the curriculum, learning, teaching and assessment lack direction and fail to align with clear goals

The What

- Without a focus on **understanding**, learning can become superficial and fragmented, overwhelmed by an increasingly crowded and cluttered curriculum
- Understanding requires **key conceptual knowledge and skills**
- Missing **expected knowledge and skills** at each stage of the journey can result in uneven **progression**

The How

- If effective learning and teaching are compromised without well-considered **approaches**, this will create inconsistencies in practice
- Finally, neglecting **capacity building and resources for educators** presents significant challenges to implementation.

Each layer safeguards against critical gaps and, when combined, enables purposeful, progressive, and impactful learning experiences.

4.5 Skills, strategies and procedures

The focus in this working paper has been on discussion of how the Know-Do-Understand model can clarify and strengthen the role and place of knowledge. Further discussion is needed on how the “Do” of the model captures skills and other procedures and processes related to the application of knowledge.

While the curriculum pilot reviews were established to explore thinking in response to the focus that was placed by the 2021 OECD review on clarifying the position of knowledge, the significance of skills featured prominently in discussions. Much of the discussion during the pilot reviews was focussed specifically on skills related to the relevant curriculum area and in particular ‘subject specific’ skills. The articulation of Es&Os as ‘I can’ statements were felt to place an emphasis on ‘doing’ which have contributed to wider concerns or perceptions about the downgrading of knowledge and the consequences of that for developing sound conceptual understanding. At the same time, however, there was recognition of the significance of preparing learners with key skills, sometimes referenced as skills for learning, life and work, as legitimate objectives of the curriculum.

Since the publication of Building the Curriculum 4: Skills for learning, skills for life and skills for work (2009), a variety of skills frameworks have been developed and are used nationally and locally, to identify and define skills. Work is ongoing as part of the overall CIC to capture and analyse what is currently in use, but also to look ahead to what may emerge from a new SG Universal Skills Framework (a key recommendation of James Withers’ 2023 Review of the Skills Delivery Landscape) and what the implications of this would be for the evolution of the technical framework. Initial analysis suggests three categories of skills: subject specific, professional/technical and holistic (examples include ‘21st Century Skills’, The Youth Work Outcomes and Skills Framework and meta skills). There is variation nationally and internationally as to what these categories might include. As an example, the holistic skills category can include skills, competencies, capacities, values, traits, attributes or dispositions. Most OECD countries prioritise social and emotional skills and do so either through distinct courses or through embedding these in disciplinary areas.

In conclusion, a Know-Do-Understand model provides an opportunity to explicitly identify and clarify what learners should know and be able to do at key points in their learning. It should also allow for the inclusion of a wide range of skills and it is important that the work of the CIC fully aligns with any future SG Universal Skills Framework.

5. Redefining the relationships between curriculum areas and cross-curricular expectations

There was a clear message from across the pilot reviews that the current position of cross-curricular expectations had to be reviewed. Issues raised by practitioners included a lack of coherence, overly complex guidance, and a lack of clarity about what was meant by a cross-curricular area as well as questions around where responsibility for implementation of these lay. Some cross-curricular expectations are known as Responsibilities of All (RoA), others are national entitlements, while others were perceived as little more than aspirations. For example, there was confusion between health and wellbeing as both a curricular area and health and wellbeing as a RoA. Guidance on numeracy was seen as confusing as this was currently intertwined with mathematics. A particular challenge was how cross-curricular expectations align with wider messages to streamline the curriculum.

The importance of cross-curricular expectations, or 'competencies' as they are sometimes labelled, has been recognised in curriculum review initiatives in other education systems (Masters, 2023). For instance, the current review in England has received calls to focus on cross-curricular areas such as digital literacy, dealing with disinformation, and sustainability (Department for Education, 2024). A range of other countries has established similar priorities as objectives for their curriculum, sometimes framed as cross-curricular topics, and designed to develop attributes or competencies.

The Finnish curriculum, for instance, identifies wellbeing, political literacy, sustainability, digital literacy, and entrepreneurship as competencies it seeks to develop across the curriculum (Finnish National Agency for Education, 2016). Similarly, Estonia's curriculum emphasises digital literacy and entrepreneurship as essential competencies embedded across subjects (OECD, 2020). Norway's curriculum prioritises values such as human dignity, critical thinking, respect for nature, and environmental awareness as cross-curricular competencies (OECD, 2020). In South Korea, cross-curricular priorities include competencies that address societal challenges, reflecting a global trend of aligning education with emerging needs (OECD, 2021).

The importance and position of cross-curricular expectations have been emphasised from a variety of sources. For example, as identified in several recent independent reviews of Scottish education (Muir, 2022; Campbell and Harris, 2023), feedback from learners in Scotland highlights the value they place on learning about sustainability and the climate emergency. Furthermore, a 2024 consultation in North Lanarkshire, involving pupil representatives from each school in the authority, revealed the significance learners attach to financial literacy, sustainability, mental health and wellbeing and careers.

Cross-curricular learning can also provide practical means to realise the development of the four capacities. For instance, would becoming politically and digitally literate, while fostering a commitment to sustainability and social justice, embody the aspirations of developing as a responsible citizen and as an effective contributor in the 21st century? This learning not only aligns with the four capacities but also equips learners with the tools to engage with societal challenges, make informed decisions and act with integrity and purpose in an increasingly complex world.

This thinking was reinforced at the first meeting (February 2023) of the National Mathematics Pilot Curriculum Review Group, and in subsequent work by its Core Group (May 2023 - February 2024), with the importance of adopting a modern approach to financial literacy emerging as a key focus. Financial literacy was identified as an essential component for both future-proofing the mathematics curriculum and demonstrating how a specific curriculum area can meaningfully contribute to the development of the four capacities.

In May 2024, and in response to messages from the curriculum area pilot reviews, Education Scotland extended its exploratory work on political literacy, social justice, inclusion, and equalities to include a number of other cross-curricular areas. This is discussed in section 5.4 in the first paper of this series. This work has involved a large number of practitioners and stakeholders in the exploration of current cross-curricular expectations including careers education, creativity, digital literacy, entrepreneurship, financial education, health and wellbeing, learning for sustainability, literacy, numeracy, political literacy and social justice.

Initial work points to the features needed in an evolved technical framework which could support a redefinition of the relationship between curricular areas and cross-curricular expectations where, for example, natural opportunities for alignment are obvious. That redefinition could offer greater coherence with the aspiration to develop sound conceptual disciplinary understanding and the application of knowledge in real-world and relevant contexts.

To date, this work has identified some potential challenges and opportunities.

Challenges include:

- The number of cross-curricular areas and their relevance
- Establishing a more consistent approach to cross-curricular learning
- A risk of further cluttering the curriculum if the relationship between curricular and cross-curricular is not redefined
- The position of these areas in the senior phase
- Ensuring that these areas are not ignored
- Avoiding adding complexity to the system by creating additional levels of guidance.

Opportunities include:

- Natural alignments between cross-curricular areas and specific curriculum areas
- Making connections between cross-curricular and curriculum areas to deepen conceptual understanding
- Providing relevant contexts for disciplinary and IDL to deepen conceptual understanding in which to apply disciplinary knowledge
- Providing relevant contexts for IDL project learning in the senior phase.

Although the relationship between curricular and cross-curricular areas will continue to be explored in greater detail through ongoing work, preliminary discussions have already highlighted potential parameters for redefining this relationship. A key part of this process has been the establishment of Big Ideas that clarify the understanding represented by the eleven cross-curricular areas currently being discussed (see section 3). Feedback and analysis of these Big Ideas suggest that there are natural alignments between cross-curricular expectations, curriculum areas, personal achievement, interdisciplinary learning and the ethos of the school or setting.

This work also suggests that learning in cross-curricular areas can support conceptual understanding by providing relevant and meaningful contexts for the application of disciplinary concepts. For example, the recent IOP report (see Section 3) identifies the significance of ‘the application of’ and ‘the context for learning’. Some educational systems prioritise the application of knowledge in real-world contexts and, as the comparative study by Masters (2023) indicates, this is a feature common to high-performing education systems. For instance, Estonia places a strong emphasis on the application of disciplinary knowledge in real-world contexts through cross-curricular projects.

The early exploratory work also revealed some interesting insights into how Big Ideas can help future-proof the curriculum. One notable example emerged during the political literacy exploration, where the process of formulating Big Ideas helped broaden the discussion. Initially, political literacy was understood by some in a narrow sense, focusing on topics such as 'voting' or 'how government works.' However, the process expanded the view of political literacy to include understanding and being able to identify disinformation, thus aligning more closely with the overarching aim of the development of the four capacities, particularly in fostering responsible citizens. This shift positions political literacy as a key competency in preparing learners to engage meaningfully with society as informed citizens.

Another emerging example comes from the work on numeracy as a cross-curricular expectation and its current positioning within the mathematics curriculum area and as a RoA. Early definitions of Big Ideas for numeracy point to the possibility of a redefinition which would position 'numeracy' as the practical application of mathematics for everyday life and work and thus the development of mathematical knowledge and skills through real life contexts.

This redefined approach also addresses a long-standing aspiration of CfE. Building the Curriculum 1 (Scottish Executive, 2006) recognised that curriculum areas, such as mathematics, can contribute to the development of the four capacities. For instance, the guidance explicitly states that mathematics can enhance understanding of numeracy, financial literacy, sustainability, creativity, and careers, while implicitly fostering political literacy through activities like making informed choices based on mathematical reasoning.

Updating the technical framework provides the opportunity for practitioners involved in the CIC to redefine and establish a more effective and coherent position for cross-curricular expectations. This will include a close look at the relationship between curricular areas and cross-curricular areas and where responsibilities for teaching and learning should sit. It will look at the role of the four contexts in supporting cross-curricular learning; opportunities for personal achievements; the ethos and life of the setting/school community; the curriculum areas and interdisciplinary learning.

6. 3-18 alignment and consistency with the senior phase

Throughout the curriculum area pilot reviews, the issue arose of a disconnect between the BGE and senior phase. Key challenges identified include:

- A perception that there were effectively two separate technical frameworks: between the BGE (CfE documentation) and the senior phase (Scottish Qualifications Authority (SQA) course specifications) and that these frameworks ‘talk a different language’
- A disconnect and lack of clarity on progression between the BGE and senior phase: this was often associated with wider processes on the initial development of Es&Os and course specifications and the perception of a lack of practitioner engagement in these processes at a strategic level
- Overly complex and confusing terminology: where there were shared terms such as ‘moderation’ these often had different meanings
- The backwash effect of the senior phase: there was a lack of clarity on what learners should know, due to vagueness in the Es&Os, particularly over knowledge
- Consequently, secondary practitioners were making decisions on knowledge, based on requirements of SQA courses. This was seen as a rational response given accountability pressures. This also extended to a lack of clarity on the purposes of knowledge
- An over focus on content in the senior phase: as above, this was seen to drive decision making in the BGE and promoted memorisation and rote learning at the expense of understanding and deeper learning.

Similar findings were also identified in the 2021 OECD report. The children and young people interviewed spoke about the challenges they faced in making the transition from BGE into senior phase when they had not consolidated the basic knowledge required for the deeper learning underpinning the senior phase. They also reported an emphasis on formulaic teaching to the test, rote learning and memorisation, which they described as “boring”, and on preparing to succeed in the tasks required for qualifications.

Ensuring alignment between the BGE and the senior phase must therefore be a high priority for the development of the technical framework. It would also address another key priority identified in the pilot reviews: a lack of clarity on progression.

There are clear implications for the senior phase in relation to the cross-curricular expectations. Participants involved in the exploration of current cross-curricular expectations have identified that understanding in these areas cannot be limited to the BGE. It has also emerged from these discussions that some of the understanding required by some of the cross-curricular learning may only be accessible or relevant to learners in the senior phase. This then has implications for how the technical framework can be developed for use at the senior phase stage.

ES and SQA have worked closely during the curriculum area pilot reviews. This has extended, for example, to even greater collaboration between ES subject specialists and SQA qualification managers in the joint delivery of professional learning, and with senior leaders, to consider a single 3-18 framework as part of an evolved technical framework. There has been a consensus in these discussions that the evolution of the framework should support personalisation and choice in the senior phase, along with clarifying progression and addressing the disconnect between the BGE and senior phase.

An evolved 3-18 technical framework would offer the opportunity to reduce complexity and confusion over the use of terminology, clarify progression between the BGE and senior phase and would offer the chance to focus learning on the development of conceptual understanding, whilst maintaining the range of pathways available to learners in the senior phase. Examples to illustrate this based on the current SQA National 5 Mathematics course is included in **Annex D.**

This could see a Know-Do-Understand framework applied from early level to SCQF Level 7 courses. Within the senior phase, this framework would then identify what we want learners to understand conceptually and what we want learners to know and be able to do. This could sit above SQA course specifications, which would outline the assessment approaches for each individual qualification associated with this level.

There are technical issues that will have to be explored further as part of the evolution of the technical framework. This would include the position of all SCQF credit rated courses, including those which do not sit in the National Qualification portfolio and the position of work-based learning and technical qualifications. Underpinning any development there should be a reconsideration of the position of fourth level within the current framework. This has included its lack of alignment with the progression onto SCQF Level 5 (including National 5) qualifications and what has been viewed as a confused relationship with SCQF Level 4 (including National 4) qualifications. The CIC should be viewed as an opportunity to address this. This may include a redefinition of the relationship between Fourth Level and SCQF Level 4 and this may be achievable though a Know-Do-Understand framework. In addition, this should involve greater clarity on the conceptual understanding required at Fourth Level and clarity on where it sits in the lower secondary curriculum, which may include specific reference to S3.

In conclusion, a Know-Do-Understand approach should be used across the BGE and senior phase. This should not be a single unified and linear framework but should ensure the diversity of pathways be maintained. This approach will provide clarity on progression and address existing tensions within the current technical framework.

7. Reviewing the criteria

This section revisits the criteria for an evolved technical framework set out in section 1 1 and considers some of the challenges/tensions and opportunities that need to be addressed as the work progresses.

The technical framework should provide:

- Clarity on the role and purposes for knowledge
- Greater clarity on the knowledge and skills learners should have at key points in their learning
- Clarity on progression
- A clearer position on cross-curricular expectations
- Flexibility and autonomy for teachers and practitioners
- Parameters for the selection of content and a process for prioritising and de-prioritising
- Adaptability to the realities of the different nature of sectors and subjects
- 3-18 alignment and consistency with the senior phase.

As we reflect on these criteria, it is important to consider the potential of the Know-Do-Understand framework to address them. Each criterion aligns with themes discussed throughout this document, providing a clear roadmap for the evolution of the technical framework.

7.1 Clarity on the role and purposes of knowledge

Clarity on the role and purposes of knowledge and how these can be realised through the evolution of the technical framework is discussed in some detail in sections 3 and 4 of this paper and in section 5 of the first paper in this series. Establishing a shared understanding of the role of knowledge is central to ensuring a cohesive curriculum, addressing issues of fragmentation and aligning with the broader purposes of CfE.

7.2 Greater clarity on the knowledge and skills learners should have at key points in their learning

Ensuring clarity on what learners should know and be able to do at key stages is essential to support progression and equity across the curriculum. Sections 4.3 and 4.5 explore how the Know-Do-Understand framework can provide a scaffold for articulating expected knowledge and skills while maintaining flexibility for practitioner autonomy. A structured approach to progression can also help address challenges related to transitions, particularly between BGE and senior phase.

7.3 Clarity on progression

As the work to evolve the technical framework progresses, it will be important to ensure that clear indications of progress in expected knowledge and skills, aligned with the development of understanding are set out. Section 4.3 and section 6 highlight how progression can be articulated in ways that avoid over-prescription while providing sufficient clarity for both practitioners, learners and their parents or carers. A focus on conceptual knowledge can ensure that progression supports deeper learning and meaningful connections.

7.4 A clearer position on cross-curricular expectations

Updating the technical framework provides the opportunity to redefine and establish a more effective and coherent position for cross-curricular expectations. This will involve a redefinition of the relationship between the expectations and the four contexts: opportunities for personal achievements; the ethos and life of the setting/school community; the curriculum areas; and interdisciplinary learning. These ideas are explored in sections 5.4 and 5.6 of the first paper in this series which emphasised the need for coherence leveraging natural alignments with curriculum areas.

7.5 Flexibility and autonomy for teachers and practitioners

If statements are framed based on conceptual knowledge as opposed to prescribing content, decisions about content and contexts for learning would be made by practitioners. This approach, discussed in sections 4.2 and 4.5, ensures that practitioners retain the professional autonomy needed to design learning experiences that are responsive to their learners' unique needs and contexts while maintaining consistency in key expectations. It is acknowledged (see figure 6.0) that support will need to be offered to practitioners in the form of capacity building, professional learning and resources to help inform the approach.

7.6 Parameters for the selection of content and a process for prioritising and de-prioritising

A key challenge is determining how best to prioritise and de-prioritise content, both within individual curriculum areas and across the totality of the curriculum. During the pilot reviews, practitioners highlighted the difficulty of reaching consensus on what knowledge and skills should be deprioritised, even when there was agreement on what should be emphasised. The use of Big Ideas, as discussed in sections 3.2 and 3.6, offers a constructive approach to address this challenge. By identifying the overarching concepts and essential learning that define a curriculum area, Big Ideas provide a framework for evaluating the inclusion of content based on its relevance to deeper understanding and progression. This approach ensures that curriculum decisions focus on quality and coherence, rather than quantity, helping to streamline or 'declutter' the curriculum while maintaining its purpose and integrity.

7.7 Adaptability to the realities of the different nature of sectors and curriculum areas

The evolution of the technical framework should allow for flexibility of use across levels from early level to senior phase, variations in the sectors and within the different curriculum areas and subjects. This should be recognised at what is currently emerging as the progression layer (progression in expected knowledge and skills) of the framework discussed in section 4.3 - where progression could be framed as broad levels or broken down into more detailed stages, depending on the nature of the individual curriculum area.

7.8 3-18 alignment and consistency with the senior phase

A Know-Do-Understand approach should be used across the BGE and senior phase. This should not be a single unified and linear framework but should ensure the diversity of pathways is maintained. Sections 4.4 and 6.0 discuss how this approach can address existing tensions, clarify progression and foster deeper learning while supporting a seamless transition between stages. Findings from the pilot reviews have emphasised the importance of aligning these phases to ensure coherence and consistency.

As the criteria for an evolved technical framework take shape, they provide a foundation for addressing the key challenges identified by independent reviews (OECD, 2021; Stobart, 2021; Muir, 2022; Campbell & Harris, 2023; Withers, 2023; Hayward, 2023) and reinforced during the curriculum pilot reviews. The proposed Know-Do-Understand framework, underpinned by Big Ideas, offers a way to clarify the role of knowledge, streamline progression, and balance coherence with flexibility. This evolving framework holds the potential to declutter the curriculum, strengthen transitions, and provide better support for practitioners in meeting the aspirations of CfE. A vision for the next steps for the technical framework is explored in detail in the concluding section.

8. Conclusion: the evolving technical framework

The key issues that were identified by practitioners during the pilot reviews that took place over session 2023-24 provided potential criteria for the evolution of the technical framework for CfE. These have aligned with issues identified in other reviews and reports, such as the OECD review in 2021 and the National Discussion. Chapter 7 provides brief reflections against each of these criteria.

Since the pilot reviews, work to evolve the technical framework has developed at pace. This iterative work will continue to develop during session 2024/25 as the CIC progresses. The following observations are offered in conclusion to support and guide the ongoing work.

Key features of an evolving technical framework

A Big Ideas approach that identifies the understanding we would expect learners to develop in each curriculum area. These Big Ideas should provide the rationale for the conceptual understanding that each area seeks to develop:

- A Know-Do-Understand model that uses the Big Ideas to identify the conceptual knowledge that we would expect learners to develop at key points as they move through the 3-18 curriculum. This would support the development of a common base of knowledge as they progress between levels and their transitions across sectors. This should also identify what we would expect learners to be able to do to develop this understanding. This would include the skills, procedures or strategies learners should know and develop and would be focused on 'subject-specific' skills, professional and technical skills, and a range of holistic skills

- Agreed knowledge and skills that would be expected as learners proceed on their journey through the curriculum. This could be based on levels or stages within a level to recognise the different structures of knowledge across different curriculum areas. These could be thought of as minimum expectations at these points in a learner journey. For knowledge, these should identify what we would want learners to know at points in their journey to develop and deepen conceptual understanding

- Specific cross-curricular expectations that will be developed within each individual curriculum area. This should be based on natural links between both, where for instance 'content' aligns closely with a curriculum area. This should also indicate contexts that can be used to develop conceptual understanding by applying disciplinary knowledge in these contexts

- Statements that seek to clarify, for those planning and organising the curriculum, what we want learners to **Know** and **be able to Do.** As far as possible these should focus on conceptual knowledge and avoid indicating content and contexts: the choices of these should be left to practitioners. This aims to provide clarity on progression and what we want learners to **Understand, Know** and **Do** at key milestones in the learning journey and support the development of a common base of knowledge to support points of transition. Links and contexts for the development of cross-curricular learning should be identified

- A unified framework from 3-18 making use of a Know-Do-Understand approach to support progression between the BGE and senior phase

- Flexibility to adapt to the realities of different curriculum areas and potentially different sectors or levels within a curriculum area

- Autonomy for practitioners and teachers by not prescribing experiences for learners to develop the knowledge and understanding

- Avoidance of overly prescribed content, as throughout the pilot reviews practitioners have indicated they want greater clarity but do not favour over-specification or prescription

- New guidance (in place of and not in addition to) and a commitment to simplify what is currently thought of as overly complex national documentation.

As already highlighted in section 4, and using mathematics, health and wellbeing and science as an example, these ideas have been developed for illustration purposes in annex A - D to help demonstrate what an evolved technical framework **might look like** in practice. **It is important to note that at this stage the content has been drawn from the current Es&Os and SQA course specifications to create these illustrations.**

As the CIC progresses the content of the evolved technical framework will be co-created by the relevant CIC groups. This work is, and will be, an iterative process and will be further developed and tested with practitioners, stakeholders, academics and curriculum specialists during the remainder of the academic year 2024/2025.

The third discussion paper **'Working Together to Make Change Happen'** will be published in March 2025 and will discuss proposals for how curriculum change will happen in Scotland. This will include how we will go about co-creating the evolved curriculum as well as sharing early thinking around the '**how'** of adoption and implementation.

References

Ausubel, D. P., (1963). The Psychology of Meaningful Verbal Learning. New York: Grune & Stratton.

Bransford, J. D., Brown, A. L. and Cocking, R. R., (2000). How People Learn: Brain, Mind, Experience, and School. Washington, DC: National Academy Press.

British Columbia Ministry of Education. (2013). *Exploring Curriculum Design*. Retrieved from: https://www.bced.gov.bc.ca/irp/docs/exp_curr_design.pdf. (Accessed: 20 November 2024).

British Columbia Ministry of Education. (2019). *Mathematics K-9 – Big Ideas*. Retrieved from https://curriculum.gov.bc.ca/sites/curriculum.gov.bc.ca/files/curriculum/continuous-views/en_math_k-9_big_ideas.pdf (Accessed: 20 May 2024).

Cush, D. (2019). Barbara Wintersgill's Big Ideas for Religious Education and the National Entitlement to the Study of Religions and Worldviews in England. Nordidactica – Journal of Humanities and Social Science Education. Nordidactica 2019:4. Available at: Nordidactica (diva-portal.org) (Accessed: 13 September 2024).

Department for Education (2024). Government launches Curriculum and Assessment Review. Available at: https://www.gov.uk/government/news/government-launches-curriculum-and-assessment-review (Accessed: 24 November 2024).

Deng, Z. (2022). Powerful knowledge, educational potential and knowledge-rich curriculum: pushing the boundaries, Journal of Curriculum Studies, 54(5), pp. 599–617. Available at: https://doi.org/10.1080/00220272.2022.2089538 (Accessed: 20 November 2024)

Education Scotland. (2019). *Curriculum Design Toolkit*. Retrieved from: Curriculum Design Toolkit | Resources | National Improvement Hub (education.gov.scot) (Accessed: 20 November 2024)

Education Scotland. (2023) Background and A Case For Change : Findings from the Pilot Curriculum Reviews 2023/24. Retrieved from: New Curriculum Improvement Cycle discussion paper – Background and A Case For Change – Curriculum Improvement Cycle (glowscotland.org.uk)

Education Scotland. (2024) Enhancing the quality of mathematics education in Scotland. Retrieved from: Enhancing the quality of mathematics education in Scotland | National thematic inspections | HM Chief Inspector reports and guidance | Inspection and review | Education Scotland (Accessed: 3rd December 2024).

Elnimer, M. (2018) Learning, Understanding and the 21st Century: The Need for Concept Based Teaching and Learning. Retrieved from (PDF) Learning, Understanding and the 21 st Century: The Need for Concept Based Teaching and Learning | Maey Elnimer - Academia.edu

Erickson, H. L. (2007) Concept-Based Curriculum and Instruction for the Thinking Classroom. Thousand Oaks, CA: Corwin Press.

Finnish National Agency for Education (2016). National Core Curriculum for Basic Education 2014. Helsinki: Finnish National Agency for Education. Available at: New national core curriculum for basic education: focus on school culture and integrative approach | Finnish National Agency for Education (oph.fi) (Accessed: 24 November 2024).

Geiger, V., Goos, M. & Forgasz, H (2015). A rich interpretation of numeracy for the 21st century: a survey of the state of the field. ZDM Mathematics Education 47, p531–548.

Government of British Columbia (2019) *British Columbia Early Learning Framework*. Available at: https://www2.gov.bc.ca/assets/gov/education/early-learning/teach/earlylearning/early_learning_framework.pdf (Accessed: 29 November 2024).

Harlen, W. (2010). *Principles and Big Ideas of Science Education*. Association for Science Education. Available at: Principles and Big Ideas of Science Education | www.ase.org.uk (Accessed: 13 September 2024).

Harvard Center on the Developing Child (2024). *The Science of Early Childhood Development*. Available at: Brain-Building Through Play: Activities for Infants, Toddlers, and Children - Center on the Developing Child at Harvard University (Accessed: 24th November 2024).

Haste, H. (2009) 'What is Competence and How Should Education Incorporate New Technology's Tools to Generate Competence?', in Voogt, S. and Knezek, G. (eds.) International Handbook of Information Technology in Primary and Secondary Education. New York: Springer, pp. 29–42. Available at: (PDF) What is 'competence' and how should education incorporate new technology's tools to generate 'competent civic agents' (researchgate.net) (Accessed: 20 November 2024).

Hattie, J., 2008. Visible Learning: A Synthesis of Over 800 Meta-Analyses Relating to Achievement. New York: Routledge.

Hirsch, E. D. (2016) Why Knowledge Matters: Rescuing Our Children from Failed Educational Theories. Cambridge, MA: Harvard Education Press.

Institute of Physics. (2024). *The fundamentals of 11 to 19 physics*. Retrieved from https://www.iop.org/sites/default/files/2024-10/The-fundamentals-of-11-to-19-physics.pdf. (Accessed: 26th November 2024).

Laning, L. (2016) *What You Need To Know About The Structure Of Process, Teaching Methods*, Corwin Connect Available at Http://Corwin-Connect.Com/2016/11/Need-Know-Structure-Process/

Lanning, L.A. (2016). Designing a Concept-Based Curriculum for English Language Arts: Meeting the Common Core with Intellectual Integrity, K–12. Thousand Oaks, CA: Corwin.

Ministry of Education (2017) *Te Whāriki: He whāriki mātauranga mō ngā mokopuna o Aotearoa – Early Childhood Curriculum*. Wellington: Ministry of Education. Available at: https://assets.education.govt.nz/public/Documents/Early-Childhood/Te-Whariki-Early-Childhood-Curriculum-ENG-Web.pdf (Accessed: 23 November 2024).

Erickson, H.L. (2007). *Concept-Based Curriculum and Instruction for the Thinking Classroom*. Thousand Oaks, CA: Corwin.

Erickson, H.L., Lanning, L.A., & French, R. (2017). *Concept-Based Curriculum and Instruction for the Thinking Classroom*. 2nd ed. Thousand Oaks, CA: Corwin.

Masters, G.N. (2023). *Building a world-class learning system*. Centre for Strategic Education. Available at: https://research.acer.edu.au/tll_misc/40/ (Accessed 24 Nov. 2024).

Ministry of Education of the Republic of Korea. (2023, January 2). *2022 Revised National Curriculum for primary, secondary and special schools announced*. Retrieved from: 2022 Revised National Curriculum for primary, secondary and special schools announced (moe.go.kr) [Accessed 24 Nov. 2024].

Ministry of Education, Singapore. (2021). *Primary Mathematics Syllabus (Primary 1 to 6)*. Retrieved from: moe.gov.sg/-/media/files/primary/mathematics_syllabus_primary_1_to_6.pdf [Accessed 24 Nov. 2024].

Mitchell, I., Keast, S., Panizzon, D., & Mitchell, J. (2016). Using Big Ideas to enhance teaching and student learning. Teachers and Teaching. 23. 1-15. Available at: (PDF) Using Big Ideas to enhance teaching and student learning (researchgate.net) (Accessed: 20 November 2024).

OECD (2015) *Improving Schools in Scotland: An OECD Perspective*. Paris: OECD Publishing. Available at: https://web-archive.oecd.org/temp/2015-12-16/380875-improving-schools-in-scotland.htm (Accessed: 20 November 2024).

OECD (2018), OECD Learning Framework 2030. Available at: PositionPaper.pdf (oecd.org) [Accessed 24 November 2024].

OECD (2020a). Curriculum Overload: A Way Forward. Paris: OECD Publishing. Available at: Curriculum Overload | OECD (Accessed: 24 November 2024).

OECD (2020b). What Students Learn Matters: Towards a 21st Century Curriculum. Paris: OECD Publishing. Available at: What Students Learn Matters : Towards a 21st Century Curriculum | OECD iLibrary (oecd-ilibrary.org) (Accessed: 24 November 2024).

OECD (2021a) Scotland's Curriculum for Excellence: INTO THE FUTURE. OECD, Paris. Scotland's Curriculum for Excellence : Into the Future | Implementing Education Policies | OECD iLibrary (Accessed 4/12/24).

OECD (2021b). Education in Korea: Highlights. Paris: OECD Publishing. Available at: https://www.oecd-ilibrary.org/education/education-at-a-glance-2021_9869bdbf-en(Accessed: 24 November 2024). (Accessed: 24 November 2024).

OECD (2022). Informing the development of a systematic approach to curriculum review in Scotland: A reflection on international examples [Presentation]. Edinburgh, 27th January 2022.

Pellegrino, J. W. and Hilton, M. L. (2012) Education for Life and Work: Developing Transferable Knowledge and Skills in the 21st Century. Washington, DC: National Academies Press.

Priestley, M. and Sinnema, C. (2014). 'Downgraded curriculum? An analysis of knowledge in new curricula in Scotland and New Zealand', *The Curriculum Journal*, 25(1), pp. 50–75. 18621258.pdf (Accessed: 4/12/24).

Priestley M, Angier C, Schuler B & Smith J (2023). Towards a typology of curriculum policy approaches. UNESCO. Geneva.

Rychen, D. S. and Salganik, L. H. (eds.) (2001) Defining and Selecting Key Competencies. Göttingen: Hogrefe & Huber.

Schiro, M. S. (2013). *Curriculum Theory: Conflicting Visions and Enduring Concerns*. 2nd ed. Thousand Oaks, CA: SAGE Publications. Available online: schiro-m-2013-introduction-to-the-curriculum-ideologies.pdf (wordpress.com) (Accessed: 25 May 2024).

Scottish Executive (2006) *Building the Curriculum 1: The Contribution of Curriculum Areas*. Available at: https://education.gov.scot/media/kxugralx/btc1.pdf (Accessed: 25 November 2024).

Scottish Government. (2009) Building the Curriculum 4: Skills for learning, skills for life and skills for work. Retrieved from: https://education.gov.scot/media/tcnk33qn/btc4.pdf

Scottish Executive. (2004). *A Curriculum for Excellence*. Retrieved from: https://www.education-uk.org/documents/pdfs/2004-scottish-curriculum-review.pdf

Scottish Government. (2010). *Building the Curriculum 3: A Framework for Learning and Teaching*. Retrieved from https://education.gov.scot/media/0cvddrgh/btc3.pdf

Scottish Government. (2015). *Scottish Attainment Challenge*. Retrieved from Scottish Attainment Challenge - 2022 to 2023 – 2025 to 2026: fairer Scotland duty assessment - gov.scot (www.gov.scot)

Scottish Government (2023a), All Learners in Scotland Matter – national discussion on education: final report. All Learners in Scotland Matter - national discussion on education: final report - gov.scot (Accessed: 4 September 2024)

Scottish Government (2023b), It's Our Future – Independent Review of Qualifications and Assessment. It's Our Future - Independent Review of Qualifications and Assessment: report - gov.scot (Accessed: 4 September 2024)

Shapira M, Priestley M, Barnett C, Peace-Hughes T & Richie M (2023), Choice, Attainment and Positive Destinations: Exploring the impact of curriculum policy change on young people. The Nuffield foundation. London. Available at: https://www.nuffieldfoundation.org/project/exploring-the-impact-of-curriculum-policy-on-choice-attainment-and-destinations (Accessed: 26 September 2024).

Stobart, G (2021) Upper-secondary education student assessment in Scotland: A comparative perspective. OECD, Paris.

Spady, W. G. (1994) Outcome-Based Education: Critical Issues and Answers. Arlington, VA: American Association of School Administrators. Available at: https://eric.ed.gov/?id=ED380910

Sweller, J., Ayres, P. and Kalyuga, S. (2011) Cognitive Load Theory. New York: Springer.

Wiggins, G. and McTighe, J. (2005) Understanding by Design. Expanded 2nd edn. Alexandria, VA: ASCD.

Wintersgill, B. (2016). *Big Ideas for Religious Education*. University of Exeter. Available at: R1-Big_Ideas_for_RE.pdf (bigideasforre.org) (Accessed: 13 September 2024).

Young, M. (2013) ‘Powerful Knowledge: An Analytic Tool for Curriculum Design’, The Curriculum Journal, 24(3), pp. 297–316.

Young, M. and Muller, J. (2009) ‘Three Educational Scenarios for the Future: Lessons from the Sociology of Knowledge’, European Journal of Education, 45(1), pp. 11–27. Available at: https://www.jstor.org/stable/40664647 (Accessed: 14 October 2024).

Annex A:

What do we want learners to **Understand?**

(The Big Ideas and key conceptual understanding)

This example illustrates key features that might be included when identifying what we want learners to **understand**. The example included here for mathematics sets out purpose and identifies the Big Ideas. It sets out the concepts needed to develop the understanding captured in the Big Ideas and includes definitions of the concepts.

These examples are for **illustration only** and should be seen as work currently in progress which will develop as CIC groups proceed with their work. It is important to note that at this stage the content from the current Es&Os and SQA course specifications have been used for the purposes of these illustrations.

As the CIC progresses, the content of the evolved technical framework will be co-created by the relevant CIC groups. This work is, and will be, an iterative process and will include sense checking with practitioners, children and young people, industry, academics and curriculum specialists.

Mathematics

Purpose: to develop children and young people as *mathematical thinkers* - individuals who can use precise reasoning, critical analysis, and connected understanding to make informed decisions, solve problems, and appreciate the patterns and mathematical relationships that shape the world.

Big Idea 1: Using Mathematical Language and Notation	Big Idea 2: Thinking Critically	Big Idea 3: Making Decisions	Big Idea 4: Building Connections
Mathematics has its own language and symbols, offering clear and precise ways to communicate complex ideas. By mastering **counting**, understanding **types of number**, and recognising the **structure of number**, learners build a foundation for mathematical expression. Through **expressions, equations, and inequations**, they gain tools to represent relationships and solve problems. Mathematical **operations on number** and the study of **shapes and solids** reveal **patterns** and relationships that are foundational to spatial reasoning. The language of mathematics supports logical thinking, enabling people to model real-world situations and communicate ideas with clarity and precision.	Mathematics encourages critical thinking by guiding individuals to analyse information, recognise **patterns**, and evaluate logical arguments. Skills like **estimation**, assessing **error**, and an understanding of **accuracy**, prompt learners to question assumptions and refine their thinking. The concept of **proof** allows for rigorous validation of ideas and thorough reasoning. Skills in **data interpretation** and **comparison** can equip individuals to address complex challenges in both mathematical and real-world contexts.	Mathematics equips individuals with tools to make informed, rational decisions by using data**,** performing calculations, and assessing risk**.** By mastering methods for **data collection**, **data organisation**, and **data representation**, individuals learn to process information effectively. Skills in **data interpretation** and concepts of **chance** and **measures** empower them to evaluate possible outcomes with precision, supporting choices that are well-reasoned, and evidence based. This approach to decision-making helps people balance risks and make sound judgements in a variety of contexts.	Mathematics reveals a network of interconnected concepts, creating a framework for learning and application. Through exploring **functions and relationships** and identifying **patterns**, learners can see how mathematical ideas connect to each other. Concepts such as **position and movement** and **measures** create links between abstract concepts and practical applications, while an understanding of **proportional reasoning** and **comparison** build flexibility for applying mathematical ideas across different fields. This interconnectedness enriches problem-solving skills, empowering individuals to apply mathematics to everyday scenarios and other fields of study or employment.

Mathematical Concepts

Counting & Unitising	Types of Number	Structure of Number	Comparison	Operations on Number	Estimation, Error and Accuracy	Unknowns, Variables and Constants
Proportional Reasoning	Pattern	Functions and Relationships	Position and Movement	Shapes and Solids	Types of Data	Data Collection
Data Organisation	Data Representation	Data Interpretation	Chance	Measures	Expressions, Equations and Inequations	Proof

Mathematical Concepts: Definitions

A **concept** is a main idea or sequence of ideas that help to shape understanding. It clarifies meaning and is underpinned by knowledge. Concepts can be grouped or sequenced to develop schema that, for example, allow for the building of relationships (or connections). 'Mathematical concepts' are the underpinning interconnected bodies of knowledge which help us make sense of the more discrete content. They form the basis of mathematical thought and practice.

Concept	Definition
Counting and Unitising	Counting forms part of the earliest engagement with mathematics. Counting begins with the sequence of natural numbers, initially by enumerating individual objects and then subitising (recognising small quantities without counting). This develops into more sophisticated strategies such as unitising, where quantities are grouped and counted in quantities that differ from one.
Types of Number	As mathematical development progresses, new types of numbers are needed to solve increasingly sophisticated problems. Whole numbers, integers and rational numbers are commonly used within everyday contexts. Further mathematical study includes applying irrational and complex numbers.
Structure of Number	Numbers can be represented and partitioned in various ways, such as through place-value, multiples, powers and roots. This can enable flexible, effective, and efficient manipulation of numbers.
Operations on Number	Additive and multiplicative strategies (linking to subtraction and division) are developed as they are applied to a greater range of numbers. These operations range in complexity from developing early number bonds to creating multi-step solutions to problems in everyday and mathematical contexts.
Estimation, Error and Accuracy	Numerical calculations and measurements can be approximated using numbers that are easier to compute mentally, helping to develop a sense of reasonableness. Approximations introduce errors, which can be measured and expressed with a degree of tolerance, ensuring appropriate levels of accuracy for the context.
Comparison	Recognising that quantities and measurements are either equal or unequal. If quantities are unequal, then one quantity is greater than the other. In a range of contexts, decisions are often based on comparisons.
Unknowns, Variables and Constants	An unknown is a variable whose value, or range of values, may be determined by solving (an) equation(s) or inequation(s) within a given context. Variables are quantities that can take on a range of values and these are also represented by a symbol or letter. Some symbols, often Greek letters, are used to represent specific numbers that do not change, for example π, and these are known as constants. The use of variables allows generalisations to be made about numbers, patterns and mathematical relationships.
Proportional Reasoning	Proportional reasoning involves recognising and applying the relationship between two or more quantities that change in proportion to each other. This is often represented using ratios, fractions, percentages or equations, enabling predictions to be made, problems to be solved, and logical conclusions to be drawn.
Pattern	Mathematical relationships, both in natural and human-created systems, can be described and generalised in situations where numbers, shapes or objects repeat in predictable ways. Known elements can be used to establish a rule describing a pattern and to predict other elements within that pattern.
Functions and Relationships	Operations on numbers can be described by giving the relationship between a number (input) and the corresponding number after the operations have been carried out (output). A function is a relationship where there is exactly one output for every input. Not all relationships are functions. Functions and relationships can be described in different ways, for example by using arrows mapping inputs to outputs, algebraically using function notation and graphically using Cartesian axes.
Position and Movement	The location of an object or point can be communicated using appropriate language or notation. Movements and directions can be described using appropriate language and measurements. A locus of points on a cartesian plane can be used to define algebraically a geometric entity.

Measures	Length, area, volume, mass, time and temperature can be described and measured using appropriate language, scales and units of measurement. These measurements can be used to perform associated calculations.
Shapes and Solids	Two-dimensional shapes and three-dimensional objects can be described, classified and analysed by their geometrical properties. These properties have relevance to their use in everyday and mathematical contexts. Some shapes or combinations of shapes can be put together without overlapping to cover completely the plane (tesselate).
Expressions, Equations and Inequations	Expressions are mathematical "phrases" which include variables. They can be simplified by collecting like terms and can be evaluated when the variable quantities are assigned. Equations are mathematical "sentences" that state the equality between two expressions. They can be solved to find a solution – the value(s) of the unknown(s) for which the equation is true. Inequations are mathematical statements indicating that one expression is greater than, less than, or not equal to, another.
Proof	Mathematical statements may be true in all cases, true in some cases, or never true. It can be demonstrated that such a statement is true in all cases through a logical, mathematical argument. To show that such a statement is not always true, just one counterexample is needed. A proof can be expressed by using physical objects, creating appropriate diagrams or algebraically using mathematical notation.
Types of Data	Data can be classified as *qualitative* (categorical) or *quantitative* (numerical). Qualitative data can be *nominal* (cannot be ordered e.g. breeds of dogs) or *ordinal* (can be ordered e.g. standard clothing sizes – Small, Medium, Large). Quantitative data can be *discrete* (separate values that can be counted as whole numbers) or *continuous* (can take any value within a given range).
Data Organisation	Raw data can be classified, grouped, ordered and counted to prepare it for analysis. Data may be grouped into intervals, sorted in ascending or descending order, or categorised based on shared characteristics.
Data Collection	Data can be collected in a number of ways such as surveys, observations, interviews and experiments. Care should be taken to avoid bias and sample size should be considered in terms of representation and practicality. Technology plays an ever-increasing role in the collection of data.
Data Representation	Data can be represented using a range of tables, graphs and charts, the choice of which depends on the type of data collected. Technology plays an important role in the creation of these graphs and charts. Visual representations can become misleading, for example, by truncating scales in graphs, differences and trends can be exaggerated.
Data Interpretation	On sets of data, averages and measures of spread can be calculated, trends and outliers can be identified, and conclusions can be drawn about what the data shows or does not show. This may include comparing data sets with one another.
Chance	Chance helps us predict the behaviour of events where the outcome is uncertain. Appropriate language and notation can be used to describe or calculate the likelihood of an event happening, to make informed decisions and predictions.

Annex B:

What we want learners to **Know and Do**

The examples in this annex illustrate a way of **presenting** what learners need to **know** and be able to **do** in order to develop understanding.

The examples included here are early level science, third level science and mathematics at SCQF Level 5.

These examples are for **illustration only** and should be seen as work currently in progress which will develop as CIC groups proceed with their work. It is important to note that at this stage the content from the current Es&Os and SQA course specifications have been used for the purposes of these illustrations. As the CIC progresses, the content of the evolved technical framework will be co-created by the relevant CIC groups. This work is, and will be, an iterative process and will include sense checking with practitioners, children and young people, industry, academics and curriculum specialists.

Overview: What we want learners to KNOW and DO

<table>
<tr><th>Know: What do we want
learners to know?
(Conceptual Knowledge)</th><th>Do: What do we want
learners to be able to do?
(Skills/ Procedures/ Strategies)</th></tr>
<tr><td colspan="2">Science – Early level</td></tr>
<tr><td>Planet Earth
Biodiversity and interdependence
Processes of the planet
Energy sources and sustainability
Space

Forces, electricity and waves
Forces
Electricity
Vibrations and waves

Biological systems
Body systems and cells

Materials
Properties and uses of substances

Topical science</td><td>Inquiry and investigative skills
• Explore and observe through play
• Ask questions
• Make simple predictions and investigate
• Use senses to acquire information
• Measure, using simple equipment
• Present and sort information
• Provide oral descriptions
• Discuss, with support, how experiments could be improved.

Scientific analytical thinking skills
• Demonstrate natural curiosity through asking questions, experimenting and making predictions
• Demonstrate creative thinking by offering suggestions and solutions to problems
• Explain choices and decisions

Scientific literacy
• Talk about science, including science encountered in everyday experience, and listen to the views of others
• Explore how science is used in a variety of jobs</td></tr>
</table>

Know: What do we want learners to know? (Conceptual Knowledge)	**Do**: What do we want learners to be able to do? (Skills/ Procedures/ Strategies)
Science – Third level	
Planet Earth Biodiversity and interdependence Processes of the planet Biodiversity and interdependence Energy sources and sustainability Space **Forces, electricity and waves** Forces Electricity Vibrations and waves **Biological systems** Body systems and cells Inheritance **Materials** Properties and uses of substances Earth's materials Chemical changes **Topical science**	**Inquiry and investigative skills** • Formulate aims and predictions • Design procedures to test a hypothesis and identify dependent, independent and control variables • Demonstrate increased levels of collaboration and initiative in decision making about samples, measurements, equipment and procedures • Collect increasingly complex data using a range of methods • Interpret and analyse data to establish relationships between the independent and dependent variable • Draw conclusions based on results gathered and in relation to the aim • Evaluate investigations and suggest two improvements • Present data in a range of ways, in appropriate formats for different audiences **Scientific analytical thinking skills** • Apply scientific analytical thinking skills to less familiar contexts • Apply understanding of an increasing range of science concepts to solve problems **Scientific literacy** • Express informed views about scientific issues, including those featured in the media, based on evidence • Demonstrate understanding of the impact of science on society and debate and discuss the moral and ethical implications of some scientific developments, demonstrating respect for the views of others • Relate scientific skills to an increasing range of careers and occupations

<table>
<tr><th>Know: What do we want
learners to know?
(Conceptual Knowledge)</th><th>Do: What do we want
learners to be able to do?
(Skills/ Procedures/ Strategies)</th></tr>
<tr><td colspan="2">Mathematics – SCQF Level 5
(based on current National 5 Mathematics)</td></tr>
<tr><td>Number & Algebra:
• Types of Number
• Structure of Number
• Operations of Number
• Estimation, Error and Accuracy
• Proportional Reasoning

Geometry & Trigonometry:
• Proportional Reasoning
• Shapes and Solids
• Position and Movement
• Measures
• Functions and Relationships
• Expressions, equations and inequations
• Proof

Statistics:
• Data Representation
• Data Interpretation</td><td>Reason and model:
• Explore, analyse and apply mathematical ideas using reason, technology, and other tools
• Estimate reasonably and demonstrate fluent, flexible, and strategic thinking about number
• Model with mathematics in situational contexts
• Think creatively and with curiosity and wonder when exploring problems

Understand and solve:
• Develop, demonstrate, and apply mathematical understanding through inquiry, and problem solving
• Apply flexible and strategic approaches to solve problems
• Solve problems with persistence and a positive disposition

Communicate processes and solutions:
• Explain, justify and prove mathematical ideas and decisions in many ways
• Represent mathematical ideas in concrete, pictorial, and symbolic forms
• Use mathematical vocabulary and language to contribute to discussions in the classroom</td></tr>
</table>

Annex C:

What does **progress** in the **Know** and the **Do** look like?

This annex illustrates how **progress** across and within levels could be presented. The examples used illustrate progression in knowledge only.

The two examples included here for health and wellbeing and mathematics (geometry and measure) vary in their presentation to illustrate how the differences between curriculum areas could be recognised and presented.

> These examples are for **illustration only** and should be seen as work currently in progress which will develop as CIC groups proceed with their work. It is important to note that at this stage the content from the current Es&Os and SQA course specifications have been used for the purposes of these illustrations.
>
> As the CIC progresses, the content of the evolved technical framework will be co-created by the relevant CIC groups. This work is, and will be, an iterative process and will include sense checking with practitioners, children and young people, industry, academics and curriculum specialists.

Health and Wellbeing
(Expected Knowledge at First and Second Level)

Level	PSE	HE	PE
First Level	**Risk taking** Medicines can help with health problems and help us feel better. Using too much or using the wrong kind of medicine can be harmful. An emergency is when something serious happens and you need to get help quickly. Emergency services can help keep people safe. **Relationships** All living things, like people, animals, and plants, start small and grow bigger with time and care. Everybody is unique and has similarities and differences. Some people in our lives take care of us, like parents, grandparents, or other adults who help us. Babies need special care to make sure they are safe and comfortable. There are names for different parts of the body, and they all do different things. There are different ways people can be hurt, and it is important to know when something feels wrong and to ask a trusted adult for help. **Career & Pathways** There are many different jobs that people can do.	**Food and Nutrition** Food has a journey from source to consumer. There are different types of foods that can keep us healthy. People need different types of food as they grow to help keep them healthy. Babies can get their nutrition from milk through breastfeeding. A recipe or set of instructions can help create a balanced meal. **Safety & Hygiene** Washing hands with soap keeps germs away and helps prevent getting sick. Regularly brushing teeth keeps them healthy and strong.	**Active & Healthy Lifestyles** Sleep is essential for growth, development, and overall health. Rest helps the body recover from physical activity. Food helps to give the body energy it needs to do different things. Physical activity is important for health and wellbeing. **Fitness and Wellbeing** Being active helps keep you healthy and gives you energy to do different things. **Tactics and strategies** Rules in games/activities help keep it safe and fair for everyone. **Movement Body and Performance** Different types of movements help improve performance. Getting better at games and activities takes time and practice. Feedback can help improve performance.

Level	PSE	HE	PE
Second Level	**Risk taking** Substances can have both a positive and negative impact on the human body. Substance misuse has consequences for mental and emotional wellbeing. Substance misuse can affect decision making and life choices. There are actions that can help others in trouble who have misused substances. **Choice and Decision-making** Attitudes to the use of substances can be influenced by culture, peers and the media. **Relationships** The body undergoes changes during puberty, and this helps to understand what happens as the body grows. Sexuality is part of life and should be respected. Parenthood requires caring for others and involves patience, responsibility, and empathy. Respecting personal space and setting boundaries helps build healthy relationships. Different types of abuse exist, and it is important to recognise and prevent harmful situations. **Career & Pathways** Different jobs and careers have different responsibilities and require different skills. Individuals can access training to help prepare them for different jobs and careers.	**Diet & Nutrition** Food has a journey from source to consumer. Nutritional needs can be met by healthy eating guidelines. Food labelling can help us make more informed and healthier choices. Life stages may affect dietary requirements and with personal preferences can result in dietary restrictions. Food allergies and cultural practices can influence food choice. Access to food is a basic human right. **Safety & Hygiene** Food handling and preparation requires safe and clean practices. **Choice and Decision-making** Consumer behaviour is influenced by advertising and media techniques.	**Active & Healthy Lifestyles** Sleep is essential for growth, development, and overall health. Rest helps the body recover from physical activity and mental exertion. Healthy choices can have a positive impact on your mental, emotional, social and physical health and wellbeing. Physical activities can benefit health and wellbeing. **Fitness** The body uses different energy systems for different types of activities. Stamina is the ability to sustain physical activity over time. Flexibility is the range of motions in joints and muscles. Strength is the ability of muscles to exert force. **Tactics and strategies** Team tactics and formations can be used to improve performance. Tactics can respond to the strengths and weaknesses of opponents. **Movement, Body and Performance** Skills and strategies impact on performance. Feedback can help plan improved performance.

Mathematics: Expected Knowledge - Geometry and Measure

Concept	Early	First			Second		
Position and Movement	My body can move in different directions and be in different positions. Objects can move in different directions and be in different positions. There are words that help us to describe the position of a person or object (up, down, on, off, under, on top of, in, out). Further words that help us to describe the position of a person or object (in front, behind, on, above, below, left, right). There are words that help us to describe the direction a person or object is moving (forwards, backwards). Further words that help us to describe the direction a person or object is moving (left, right). Directions can be given or followed. Direction tells us the position a person or object moves towards or faces. Objects can look taller or smaller, longer, or shorter, higher, or lower, closer, or further away depending on the position (angle, height, and distance) that we are in. Robot toys can be programmed to follow directions. Directions can be used to give instructions to make an online avatar move around the screen. Symmetrical items can be found in the world around us. A shape, object or design has line symmetry if one side of it is a mirror image (a reflection) of the other side.	Types of turn: full turn, half turn. Patterns, pictures, designs and 2D shapes can have more than one line of symmetry.	Types of turn: quarter turn, right, left, clockwise and anticlockwise. A right angle is 90°. The meaning of horizontal and vertical within everyday contexts.	The four compass points (North, South, East and West) can be used to describe, follow and record directions. Location can be identified using a two-figure grid reference (for example A2, C3, D4).	Angles can be classified as acute, obtuse and straight. The minor compass points (North-East, North-West, South-East and South-West) points can be used to describe, follow and record directions.	Complementary angles add up to 90° and supplementary angles add up to 180°. A protractor can be used to measure and draw angles whose sizes are multiples of 5 degrees. The coordinate (Cartesian) grid has two axes. The horizontal axis is called the x-axis and the vertical axis is called the y-axis. Coordinates (whole number ordered pairs) give the position of points plotted on a Cartesian grid. The point (0,0) is called the origin. Navigation is an integral part of a number of careers including maritime, Search and Rescue and aviation roles *(Careers Education).*	A protractor can be used to measure and draw angles whose sizes are given in degrees. Angles can be classified as reflex.

Concept	Early	First			Second		
Proportional Reasoning						A scale is the relation between the real size of something and its size on a map, model or diagram.	Speed is the rate at which distance is travelled with respect to time (for example, if 45 km is travelled in one hour, the average speed is 45 km per hour).
Shapes and Solids	We can find three-dimensional (3D) objects and two-dimensional (2D) shapes in the world around us. A solid is a 3D solid object. Shapes are 2D, they cannot be picked up. There are words that can be used to help sort shapes and objects (straight, round, flat, curved). 2D shapes can be drawn, created digitally or printed. Names of common 2D shapes: circle, triangle, square.	Names of common 2D shapes: rectangle, semi-circle. Names of common 3D solids: cube, cone, sphere.	Names of common 2D shapes: kite, rhombus. Names of common 3D solids: cuboid, cylinder. Mathematical language: face, edge, vertex and angle can be used to describe properties of 2D shapes and 3D solids.	Names of common 2D shapes: pentagon, hexagon. Some 2D shapes (pentagon, hexagon) can be regular or irregular. 3D objects can be represented as 2D drawings. In any 2D representation of a 3D solid some parts of the 3D object will not be visible.	Perimeter is the distance around the boundary of a 2D shape. A polygon is a closed, straight sided, 2D shape. Polygons can be regular or irregular. A regular polygon has equal sides and angles. A diagonal joins two non-adjacent vertices in a polygon.	A quadrilateral is a four-sided polygon. Properties of quadrilaterals: square, rectangle, kite, rhombus, parallelogram.	A circle has a circumference, radius and diameter and the radius is half the length of the diameter. The faces of 3D solids can be arranged into two dimensional nets. Particular shapes and objects are used because of their properties (for example, cubes and cuboids are used in packaging design as they can be stacked easily).

Annex D:

How could a **Know-Do-Understand** Framework be used in the senior phase.

The example in this annex illustrates how the use of the know-do-understand structure can be used in the senior phase. The example below is based on the current SQA National 5 (SCQF Level 5) mathematics course specification.

These examples are for **illustration only** and should be seen as work currently in progress which will develop as CIC groups proceed with their work. It is important to note that at this stage the content from the current Es&Os and SQA course specifications have been used for the purposes of these illustrations.

As the CIC progresses, the content of the evolved technical framework will be co-created by the relevant CIC groups. This work is, and will be, an iterative process and will include sense checking with practitioners, children and young people, industry, academics and curriculum specialists.

SCQF Level 5 mathematics – Relevant concepts highlighted in bold

Counting & Unitising	**Types of Number**	**Structure of Number**	Comparison	**Operations on Number**	**Estimation, Error and Accuracy**	Unknowns, Variables and Constants
Proportional Reasoning	Pattern	**Functions and Relationships**	**Position and Movement**	**Shapes and Solids**	Types of Data	Data Collection
Data Organisation	**Data Representation**	**Data Interpretation**	Chance	Measures	**Expressions, Equations and Inequations**	**Proof**

Mathematics National 5	
Know: What do we want learners to know that (Conceptual Knowledge)	**Do**: What do we want learners to be able to do (Skills/ Procedures/ Strategies)
Number & Algebra: • Types of Number • Structure of Number • Operations of Number • Estimation, Error and Accuracy • Proportional Reasoning **Geometry & Trigonometry:** • Proportional Reasoning • Shapes and Solids • Position and Movement • Measures • Functions and Relationships • Expressions, equations and inequations • Proof **Statistics:** • Data Representation • Data Interpretation	**Reason and model**: • Explore, analyse and apply mathematical ideas using reason, technology, and other tools • Estimate reasonably and demonstrate fluent, flexible, and strategic thinking about number • Model with mathematics in situational contexts • Think creatively and with curiosity and wonder when exploring problems. **Understand and solve**: • Develop, demonstrate, and apply mathematical understanding through inquiry, and problem solving • Apply flexible and strategic approaches to solve problems • Solve problems with persistence and a positive disposition. **Communicate processes and solutions:** • Explain, justify and prove mathematical ideas and decisions in many ways • Represent mathematical ideas in concrete, pictorial, and symbolic forms • Use mathematical vocabulary and language to contribute to discussions in the classroom.

SCQF Level 5 Mathematics - Exemplification of Know and Do

Statistics	
Data Representation • Quartiles are three values which split sorted (ordered) numerical data into four equal parts • Interquartile range and standard deviation are statistical measures of spread • The interquartile range is the difference between the upper and lower quartiles • Standard deviation is a measure of the dispersion of a dataset relative to its mean **Data Interpretation** • A linear model can be created to describe a correlated data set. These models can be used to make predictions • A best fitting straight line on a scatter graph can be used to create the linear model	**Data Representation** • Select and use appropriate mathematical approaches and notation to: • Identify the upper and lower quartile of a given data • Calculate interquartile range of a given data set • Calculate the standard deviation of a given sample **Data Interpretation** • Analyse and compare data sets using measures of spread and central tendency • Determine the equation of a best-fitting straight line on a scatter graph and use it to model a linear relationship between y and x.
Number and Algebra	
Types of Number • Rational numbers can be expressed as a ratio of two integers • Irrational numbers cannot be expressed as a ratio of two integers • A surd is a root of a whole number that has an irrational value **Structure of Number** • Surds can be simplified using various rules or by rationalising the denominator • Expressions involving indices can be simplified using the following rules: **Multiplication**: $a^m \times a^n = a^{(m+n)}$ **Division**: $a^m \div a^n = a^{(m-n)}$ **Power of a power**: $(a^m)^n = a^{mn}$ **Zero power**: $a^0 = 1$ (where *a* is not zero) **Negative indices**: $a^{-n} = \frac{1}{a^n}$ **Fractional indices**: $a^{\frac{m}{n}} = \sqrt[n]{a^m}$	**Structure of Number** • Select and use appropriate mathematical approaches and notation to: • Express surds in their simplest form • Rationalise denominators of fractions that contain surds • Apply rules of indices to simplify expressions **Operations on Number** • Select and use appropriate mathematical approaches and notation to multiply and divide expressions containing positive, negative and fractional indices • Solve problems where numbers are expressed in scientific notation • Solve problems by performing operations (addition, subtraction, multiplication, division) and combinations of operations on fractions including mixed numbers
Estimation, Error and Accuracy • Numbers can be rounded to a specified number of significant figures **Proportional Reasoning** • The terms appreciation and depreciation describe percentage increase and decrease respectively. This may be a repeated or compounded **Functions and Relationships** • Linear relationships can be described algebraically and graphically	**Estimation, Error and Accuracy** • Round to a given number of significant figures to communicate the solution to a problem in context **Proportional Reasoning** • Apply reverse percentages to calculate an original quantity • Apply flexible and strategic approaches to perform appreciation and depreciation calculations including compound interest **Functions and Relationships**

• Quadratic functions are symmetrical, and their graphs are in the shape of a parabola. • The roots of a quadratic function are the values of x that satisfy the quadratic equation • $ax^2 + bx + c = 0$ • By writing the equation of a quadratic function in different ways, a variety of features of its graph can be noted including its points of intersection with the *x* and *y* axes, its axis of symmetry and the nature and coordinates of its turning point • The four arithmetic operations on rational numbers can be applied to algebraic fractions • By factorising the numerator and denominator, algebraic fractions can be given in their simplest form **Expressions, Equations and Inequations** • A linear relationship in *y* and *x* can be plotted on Cartesian axes to form a straight line. The gradient and any point on the line can be gleaned from this equation • When two such linear relationships are plotted, the lines will intersect in a single point, as long as the gradients of the two lines are not equal. This point of intersection gives the pair values of x & y that satisfy both equations • Given appropriate information, two linear equations in two unknowns can be solved simultaneously, either graphically or algebraically, to solve problems in context • The distributive law can be used to expand expressions that include more than one set of brackets. • Some, but not all quadratic expressions can be written in a factorised form • All quadratic expressions can be written in a form which includes a perfect square • Quadratic equations have either two real, distinct roots, one repeated real root or no real roots. The discriminant can be used to determine the nature of these roots • Quadratic equations can be solved graphically or algebraically	• Find the equation of a straight line given the gradient and any point on that line. • Construct linear equations to model given situational contexts • Use functional notation to calculate outputs from and inputs to a given function **Expressions, Equations and Inequations** • Select and use appropriate mathematical approaches and notation to: • solve linear equations and inequations where numerical coefficients are rational numbers • solve linear equations and inequations where numerical solutions are rational numbers • solve pairs of linear equations using appropriate algebraic strategies • Through applying a sequence of algebraic steps, change the subject of a given linear formula, or a formula involving a simple square or square root • solve quadratic equations: • from factorised form • having factorised first • graphically • using the quadratic formula • use the discriminant to determine the nature of the roots of a quadratic equation **Position and Movement** • Identify the gradient and y-intercept from various forms of the equation of a straight line • By using graphical representation, solve pairs of linear equations simultaneously by finding the point of intersection of their graphs • Apply knowledge of a quadratic function to: • identify, from its graph, its equation in the form $y=kx^2$ and $y=k(x+p)^2 + q$ • sketch its graph given its formula in either the form • $y = (ax - m)(bx - n)$ or $y = k(x + p)^2 + q$ where *k, p, q* are rational numbers • identify the nature and coordinates of its turning point • determine the equation of its axis of symmetry
Geometry and Trigonometry	
Shapes and Solids • An arc is a portion of the circumference of a circle (other than the full circumference) • A sector is an area enclosed by two radii and an arc • A chord of a circle is a straight line segment between any two points on the circumference of the circle • The perpendicular bisector of a chord always goes through the centre of the circle • The converse of Pythagoras' Theorem	**Shapes and Solids** • Apply Pythagoras' Theorem in complex situations including in 3 dimensions • Apply the converse of the Theorem of Pythagoras to solve problems in context • Use strategically the properties of shapes to determine the size of an angle involving at least two steps **Measures** • Apply formulae to calculate the volume of standard and compound 3D object • Apply the sine rule and cosine rule to find the length of a side or the size of an angle in any triangle

- There exists a relationship between the size of each angle in any triangle and the length of its opposite side

Measures

- The formulae required to calculate the volume of a sphere, cone and pyramid
- The sine rule and the cosine rule describe the relationships between the sizes of angles and lengths of sides in any triangle
- Trigonometry can be used to calculate the area of any triangle

Proportional Reasoning

- For any given sector there is a proportional relationship between its arc length, area and the angle (subtended) at the centre of the circle
- In similar 2D shapes and 3D objects the relationship between corresponding dimensions is proportional and the corresponding angles are equal

Position and Movement

- The co-ordinates of any two points on a straight line can be used to determine its gradient
- A point in space can be represented using co-ordinates in 3 dimensions
- A vector quantity has both magnitude and direction
- A scalar quantity has magnitude only
- A vector can be represented by a directed line segment
- Vectors can be described using components which are parallel to the x, y and z axes
- Pythagoras' Theorem can be applied to calculate the magnitude of a 2 or 3 dimensional vector (the distance between any two points in 2 or 3 dimensional space)
- Trigonometric functions describe the position of a point as it moves around a circle

Functions and Relationships

- The amplitude of a sine or cosine graph is the distance from the centre line to the top of a crest or bottom of a trough
- The period of a trigonometric graph is the distance in the *x* direction taken for the pattern to repeat
- Trigonometric functions have symmetries which can be used to identify related points on their graphs

- Apply trigonometry to calculate the area of a triangle
- Apply trigonometry and bearings to find a distance or direction

Proportional Reasoning

- Calculate the length of an arc, area of a sector or angle at the centre of the circle and solve related problems
- Calculate linear, area and volume scale factors and solve related problems

Position and Movement

- Select and use appropriate mathematical approaches and notation to:
- Determine the gradient of a straight line, given the coordinates of two points
- Determine the coordinates of a point from a diagram representing a three-dimensional object
- Add or subtract two-dimensional vectors using directed line segments
- Add or subtract two- or three-dimensional vectors using components
- Apply Pythagoras' Theorem to calculate the magnitude of a two- or three-dimensional vector
- Apply the symmetries of trigonometric functions to find the sine, cosine and tangent of angles from 0^o to 360^o

Functions and Relationships

- Explore, identify and sketch graphs of basic trigonometric functions
- Using technology and a knowledge of basic trigonometric functions, explore, analyse, identify and sketch the graphs of related trigonometric functions using vertical translation, multiple angle and phase angle

Proof

- Use the trig identities $cos^2x^\circ + sin^2x^\circ = 1$ and $\tan x^\circ = \frac{\sin x^\circ}{\cos x^\circ}$ to prove more complex identities

Expressions, equations and inequations

- Apply the symmetries of trigonometric functions to solve basic trigonometric equations