CAMAU

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Learning about Progression –

Informing thinking about a Curriculum for Wales

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Explanatory Foreword

Learning about Progression – A Research Resource Tailored to Meet your Needs

'Learning about Progression' is a suite of research-based resources designed to provide evidence to support the building of learning progression frameworks in Wales. 'Learning about Progression' seeks to deepen our understanding of current thinking about progression and to explore different purposes that progression frameworks can serve to improve children and young people's learning. These resources include consideration of how this evidence relates to current developments in Wales and derives a series of principles to serve as touchstones to make sure that, as practices begin to develop, they stay true to the original aspirations of *A Curriculum for Wales – A Curriculum for Life.* It also derives, from the review of evidence, a number of fundamental questions for all those involved in the development of progression frameworks to engage.

Within this suite of resources you will find

- **Reviews of research into progression in children and young people's learning**
  - research related to progression in learning generally and research on progression in learning specifically related to each of the six AoLEs
- **Reviews of policies on progression from other countries**
  - who have similar educational aspiration to Wales in each of the six AoLEs
- **A review and analysis of progression as it is emerging in Wales in *Successful Futures* and in *A Curriculum for Wales – A Curriculum for Life*.**

We hope that you will find 'Learning about Progression' a useful resource. We recognise that a range of audiences will want to make use of its contents for a range of purposes and thus present information from 'Learning about Progression' in different ways, leaving you to choose which form is most useful for your purpose.

1. **Learning about Progression: a comprehensive review of research and policy to support the development of Learning Progression Frameworks in Wales**

   The whole report, 'Learning about Progression' offers a **comprehensive overview of research and policy related to progression in learning in general and to progression in learning in all six AoLEs**.

2. **Diving into Research and Policy in an Area of Learning and Experience**

   For individuals or groups who are interested in finding our more about the **evidence as it relates to an individual Area of Learning and Experience (AoLE)**, a detailed report is provided for each AoLE derived from Section 2 of 'Learning about Progression'. These six reports offer an overview of research on progression, an in-depth analysis of evidence exploring how different countries have tackled progression in an individual AoLE and evidence from research on progression within the discipline. These reports are entitled *Learning about Progression: Expressive Arts, Learning about Progression: Science and Technology* etc. You are currently using this mode.

3. Learning about Progression: From Ideas to Action

If you want to identify key messages from 'Learning about Progression' and your major concern is how to **use** the ideas as you develop progression in your AoLE, then read '**Learning about Progression: From Ideas to Action'** as your first point of engagement. This provides

- **key messages** on progression relevant to all of the AoLEs
- **an analysis of how the evidence from international policy and research relates to policy advice on progression in Successful Futures and A Curriculum for Wales**
- principles that might act as a touchstone to promote a close alignment between ideas and action and
- information on the strategy used to **inform decision making** about the framework to be used to develop statements of progression.

'Learning about Progression: From Ideas to Action' is supported by

- **a series of PowerPoint slides to introduce key ideas to others**
- **Decision Tree Workshops**

The evidence emerging from 'Learning about Progression' indicated strongly that there were a number of decisions that AoLE groups had to take before embarking on the development of statements of progression. These related to the major questions derived from the research. Decision tree workshops were designed to support AoLE groups and others in that process.

Decision trees were used as the basis of workshop activities at AoLE meetings to support AoLE discussions. Each decision tree

- identified the decision to be taken
- offered evidence from the 'Learning about Progression' report (from research, policy and practice) to help inform discussions within each AoLE
- was consistent with the principle of subsidiarity and encouraged AoLE members to add to the evidence available
- provided a framework where each individual AoLE, having reflected on the evidence, agreed a decision proposal to be shared with the Coherence Group.

All proposals were reviewed to ensure that they were consistent with the vision *A Curriculum for Wales – A Curriculum for Life* and reflected what AoLE members believed would best serve young people in Wales.

Proposals from the six AoLEs were then submitted to the Coherence Group whose task was to reach agreement about which decisions had to be consistent across AoLEs to promote coherence across the system and where there could be flexibility for individual AoLEs. This would then inform the next stage of work of the AoLE groups.

Terminology within both the Welsh and English versions of this report reflects the range of current thinking about concepts of progression; this may lead to one term being employed with different but related senses and/or to one concept being referred to by different terms.

Introduction

The education system in Wales is in the process of transformation. Since the publication of *Successful Futures* (Donaldson, 2015) and the subsequent adoption of its recommendations in *A curriculum for Wales – a curriculum for life* (Welsh Government, 2015), a national strategy has been underway to build new curriculum, pedagogy and assessment arrangements to offer young people in Wales educational experiences that are fit for the 21st century. The creation of these new arrangements is the responsibility of all involved in education in Wales – communities, policy makers, practitioners and researchers – and is led by a network of Pioneer schools whose task it is to identify what matters in the curriculum and how progress might best be described and discerned. The Curriculum Pioneer schools are working in national groups related to each of the six Areas of Learning and Experience (AoLEs) – Expressive arts; Health and well-being; Humanities; Languages, literacy and communication; Mathematics and numeracy; and Science and technology. The CAMAU project, a collaboration between the University of Glasgow (UofG) and the University of Wales Trinity Saint David (UWTSD), funded by the Welsh Government and the UWTSD, seeks to support the Welsh education system in its task by providing evidence to address three main questions:

- How might curriculum, progression and assessment be described and developed in Wales to focus on learning and to promote better alignment between research, policy and practice?
- In what ways do models of curriculum progression relate to progression in learning emerging from evidence of learning and progression within schools and classrooms?
- To what extent is it possible to think of assessment as the use of evidence to enable future learning, as 'progression steps', rather than as a summary of past achievement? (And how might we avoid this focus leading to a narrowing of the curriculum?)

The focus of the CAMAU project is **progression**. It takes its starting point from *Successful Futures* (Donaldson, 2015) and *A Curriculum for Wales* (Welsh Government, 2015), builds on the work of the Progression and Assessment Group (Welsh Government, 2017) and on what the AoLE groups have identified as what matters. The project works with teachers, schools, researchers and policy makers (local, national and international) to bring different knowledge, skills and understandings together to explore how progression might best be described and developed in relation to the AoLEs and to investigate how progression steps might be most helpfully identified, described and used to support learning.

Progression matters. Since the seminal Black & Wiliam (1998) review highlighted the potential for formative assessment (or Assessment for Learning as it is sometimes called) to enhance learning, particularly amongst learners who found learning most challenging, countries internationally have sought to realise that potential in schools and classrooms. The way in which Assessment for Learning has spread has been compared to a 'research epidemic' that has 'feverishly spread into every discipline and professional field' (Steiner-Khamsi, 2004: 2). However, at best, the enactment of Assessment for Learning has been patchy (Hayward *et al*, 2006, Marshall & Drummond, 2006) and problems around the articulation of progression have been part of the problem. Wiliam & Thompson (2007) offer a framework to articulate the roles that key actors (teacher, peer and learner) play in the assessment process based on three key ideas: where the learning is going, where the learner is right now and how to get there. Implicit in this model is the centrality of progression. For example, for teachers to provide feedback that moves learners forward, they must have a conceptualisation of what matters next both for learning in the domain and for the learner. But self-evident as that might

seem, progression and its relationship to assessment and learning has proven to be a complex business. Indeed, in a recent article Baird *et al* (2017) argue that learning and assessment have been 'fields apart'. Recognising the inexorable relationship between learning and progression, Heritage (2008) argues that

> *'By its very nature, learning involves progression. To assist in its emergence, teachers need to understand the pathways along which students are expected to progress. These pathways or progressions ground both instruction and assessment. Yet, despite a plethora of standards and curricula, many teachers are unclear about how learning progresses in specific domains. This is an undesirable situation for teaching and learning, and one that particularly affects teachers' ability to engage in formative assessment.'* (p.2)

Internationally, there are areas of the curriculum where work has been done to build understandings of progression. Pellegrino (2017) argues that research undertaken on cognition and learning has led to the emergence of highly developed descriptions of progression in particular curricular areas (science, reading and mathematics) and that these can form a sound basis for assessment design (e.g. Bransford, Brown, Cocking, Donovan, & Pellegrino, 2000; Duschl *et al*, 2007; Kilpatrick, Swafford, & Findell 2001; Snow, Burns & Griffin, 1998). There are, however, other areas where work related to progression is far less well developed.

Progression as a concept is built in to *Successful Futures* through the identification of reference points (Progression Steps). The term 'reference point' is important. It establishes learning as an expedition, with stops, detours and spurts, rather than as a linear process. The progression frameworks will be central to the work of teachers and learners as they seek to enhance the learning of every young person in Wales and thus it is crucial that these frameworks are dependable. To address this challenge, the CAMAU project seeks to work with policy makers and practitioners to build progression frameworks that are, as far as is possible, evidence informed and supportive of assessment practices that are consistent with the 'spirit' rather than the 'letter' of assessment for learning (Earl, Volante & Katz, 2011; Marshall & Drummond, 2006).

Theoretically, the design of the CAMAU project builds on the work of Senge & Scharmer (2001) and on the empirically derived Integrity model of change (Hayward & Spencer, 2010). This model argues that for change to be meaningful and sustainable, project design must pay attention to three main areas:

- Educational integrity (a clear focus on improving learning)
- Personal and professional integrity (participants have a significant role in the construction of the programme, rather than being passive recipients of policy directives)
- Systemic integrity (coherence in development at all levels of the education system)

The CAMAU Project is designed in three phases. This first phase is concerned with the co-construction of an evidence-based Progression Framework. The second phase is designed to develop, review and learn from feedback on the draft Progression Framework and the third phase will trial, evaluate and review the Progression Framework in action. In all phases of this project teachers, pupils, policy makers and researchers are co-investigators with the shared aspiration of developing high quality, well-informed curriculum, pedagogy and assessment arrangements for Wales.

This report provides evidence on three specific aspects of the first phase of the CAMAU project:

- the review of how progression is described and structured within frameworks in other countries
- the review of progression in learning (in policy and research) and of evidence related to progression contextualised in each area of learning experience and
- initial work undertaken to explore teacher perceptions of progression in learning. (Evidence on teachers' and pupils' perceptions of progress will be collected throughout the CAMAU project and will be published in the final research report.)

Following this introduction that includes a description of methodology, Section 1 of the report identifies ideas about progression as they emerge in *Successful Futures* and then analyses these ideas using evidence from research on progression.

Section 2 is divided into six sub-sections, each devoted to one of the six Areas of Learning and Experience (AoLEs) identified in *Successful Futures* (Donaldson, 2015): Expressive arts; Health and well-being; Humanities; Languages, literacy and communication; Mathematics and numeracy; Science and technology. The evidence offered to each AoLE is in two parts. The first part is a review of how different countries have conceptualised and interpreted progression in that area of learning. The second part provides insights into evidence available from research on progression relevant to the specific AoLE.

Section 3 provides evidence of teachers' understandings of progression.

Section 4 draws together themes emerging from the different sources of evidence analysed and identifies decisions which require to be taken to allow the development of statements of learning progression within the AoLE.

This research report is intended to provide a dependable evidence base to inform thinking in the AoLE groups as ideas of progression are developed. The CAMAU project team throughout the project will work with AoLEs to use evidence from international curriculum and assessment documentation of how progression has been conceptualised in the research literature and in policy contexts similar to Wales. When AoLEs have identified what matters in the curriculum and have built initial models of progression, the CAMAU team will obtain and analyse empirical evidence from wider teachers' and learners' experiences of progression in schools and classrooms: evidence from teachers' perceptions of what is central to enable effective progression in their pupils' learning; and pupils' reflections of their own progression in learning. This sense checking of existing and expert models of progression is intended to promote curriculum, pedagogy and assessment arrangements in Wales that are grounded in teachers' and young people's actual experiences in learning. This work will be reported in the final CAMAU project report.

Methodology

The central purpose of the reviews of international policy and of research on progression is to provide dependable information to AoLE groups to support their thinking. Thus both the policy review and the review of research are focused and purposeful. Discussion with AoLE groups made it clear that to be useful, the reviews must be clearly focused, succinct and directly related to the task which the groups are being asked to undertake. In addition, the CAMAU project sits within the demands of a development programme operating to tight policy deadlines: all activities must be undertaken within a limited time-frame and with limited resources. This is not a situation peculiar to this project.

Dependable Evidence Summaries

The methodology for the creation of dependable evidence summaries emerges from the recently developed EPPI (Evidence for Policy and Practice Information) protocol for a rapid review of existing evidence (O'Mara-Eves *et al.*, 2016). Rapid reviews have been commonly used in Health policy contexts to inform evidence-based practice. The Welsh Government has itself used the process in an educational context, e.g. in a review of the impact of poverty on attainment (Wilson, 2011). Rapid Reviews are contentious. They are seen by some as conforming to policy timelines at the cost of rigour in the literature or policy review. More recently, rapid evidence assessments have become more common in policy contexts and the method is referred to on a number of Government websites across the UK. The Department for International Development identifies three main uses for rapid evidence assessments:

> *'[They] provide a more structured and rigorous search and quality assessment of the evidence than a literature review but are not as exhaustive as a systematic review. They can be used to:*
>
> - *gain an overview of the density and quality of evidence on a particular issue*
> - *support programming decisions by providing evidence on key topics*
> - *support the commissioning of further research by identifying evidence gaps'*

(https://www.gov.uk/government/collections/rapid-evidence-assessments -- accessed 10/07/17)

These aims are consistent with the aspirations of the CAMAU project. The challenge is to provide evidence that is dependable within the constraints identified.

Grant *et al.* (2009) suggest that if Rapid Research Reviews (RRR) are to be dependable, they need to be rigorous and explicit about their methodology and acknowledge the concessions that have had to be made to breadth and depth. The need to synthesise evidence within a limited time frame with the specific intention of informing decision making processes lies at the heart of the increased use of RRRs. Khangura *et al* (2012) argue that, despite the rise in the popularity of this approach, very little has been published on appropriate methodologies. They rename RRRs as evidence summaries and propose a methodology to increase the means by which the validity, appropriateness and utility of the review might be discerned. The authors identify eight steps developed from their Knowledge to Action programme. These steps have been adapted in the CAMAU project as the framework for the

development of the Dependable Evidence Summaries, designed to inform the thinking of AoLE groups as they tackle the complex challenge of describing progression.

Table 1: Outline of eight steps informing Knowledge to Action evidence summary approach (Khangura et al, 2012)

Knowledge to Action step	Task
Step 1	Needs assessment
Step 2	Question development and refinement
Step 3	Proposal development and approval
Step 4	Systematic literature search
Step 5	Screening and selection of studies
Step 6	Narrative synthesis of included studies (including assignment of evidence level)
Step 7	Report production
Step 8	Ongoing follow-up and dialogue with knowledge users

The Evidence Summaries in the CAMAU project have been developed as part of a process of on-going discussion with the knowledge users – each of the AoLE groups.

Progression in International Policy and Practice

The countries involved in the international policy and practice review were identified in two ways. The first priority was to identify countries of particular interest to the individual AoLE group. Second, CAMAU team members sought to select countries with aspirations similar to those identified in *Successful Futures* where different approaches to descriptions of progression were illustrated. The analysis of policy in each country followed a three-stage process:

- eliciting information on curriculum design, 'what matters' in the curriculum and how progression is described
- making summary statements of the above
- analysing information from across countries

Table 2 on the next page provides the framework for responding to questions on progression. The complete protocol can be found as Appendix 1.

Recognising the difference between policy intention and policy enactment, the final stage of this policy review went beyond the analysis of policy documentation. As part of the work of the CAMAU project's National and International Advisory Group, leading researchers in selected review countries were invited to discuss the enactment of policy in their respective countries in order to provide insights into how ideas have played out in practice. These reflections on the implementation of policy and on lessons learned add depth and texture to the information available in policy

documentation and enhance the knowledge of policy-in-action afforded to CAMAU researchers by research publications.

Table 2

Country Information
Name of Country: Year the curriculum was written/published/updated: Website(s) where materials were found:
How is the curriculum structured? e.g. Is there a curriculum document as well as achievement outcomes or are these combined? Are there supporting materials for teachers? Is there one curriculum across all ages or is it split into primary and secondary? How many stages/levels/benchmarks are included? Are they aligned with specific years?
What components/subjects/themes related to the AoLE are covered in this country's curriculum? What seems to be missing?
How does the documentation define 'what matters' in this AoLE? Does this include content knowledge, competencies, skills, etc? What is the balance between knowledge and understanding, skills, attributes, and capabilities?
How is progression defined? Is it defined explicitly or implicitly? You may need to look beyond the statements themselves at the supporting documentation and introductions to the curriculum. Give some specific quotes or examples.
Are key progression points identified as expected standards for specified ages? Or as descriptions of knowledge, skills, capabilities needed for further progression in learning? Or is it some combination?
What form do statements of progression take? Are they detailed or broad? Are they in pupil-first person language or written for the teacher? Provide some examples.
To what extent does the curriculum for this AoLE seem to align with what is written in Successful Futures? Does it seem to align with Donaldson's vision for progression? Give some examples.
Is there anything else worth noting? E.g., Is there anything particularly unique, innovative, or useful about this curriculum? Are there any aspects of the AoLE that are included in cross-curricular aims? Was there anything within this portion of the curriculum that seems to have connections with any other AoLE?

Progression in Research Literature in the Context of Policy in Wales

The review of research literature in the context of policy in Wales was undertaken in three strands

- a review of *Successful Futures* to identify what had been written about progression
- a review of seminal papers on the concept of learning progression
- six separate reviews, one undertaken for each of individual AoLE.

Whilst much has been written on curriculum progression, far less is available on learning progression. Papers for the review were identified using three approaches:

- expert knowledge (including recommendations from CAMAU Professorial Consultants - internationally recognised experts in individual Areas of Learning Experience)
- search strategies
- reference snowballing.

As reviews for individual AoLEs were undertaken by several members within each AoLE team, detailed guidance was provided. Reviewers conducted independent searches using keywords, employing Ebscohost or a similar academic database. Key terms were contextualised in each AoLE, e.g. 'progression in mathematics'; keywords specific to particular domains were identified, e.g. in Health and well-being keywords included 'child development' and 'developing'. Texts published before 2000 were excluded unless identified by Professorial Advisors as seminal texts. Wales is a bilingual country. Where possible, eg, in LLC, the review included evidence from bilingual countries. However, we recognise that most of the evidence used to inform this report has been drawn from material published only in English, that the research has to a large extent considered practice in English speaking countries and that, with few exceptions, progression frameworks examined have been drawn from countries and states in which English is the sole or a major language of schooling. This limitation has to be recognised.

When lists of possible texts had been generated, titles and abstracts were reviewed to identify potentially relevant sources. Expanded or snowball searches were also carried out where authors cited within the original sources were investigated, either by following up on articles cited or by undertaking author searches within Ebscohost. In addition to recommendations made by Professorial Advisors, CAMAU researchers sought advice from colleagues in the University of Glasgow and in the University of Wales Trinity Saint David with specific expertise in a particular area. From this range of sources, a list of all papers considered was generated by each group and the screening processes that led to the final selection of papers to be reviewed were documented.

The analysis of literature review is intended to address critical questions related to progression within a particular Area of Learning Experience. To illustrate this process *Table 3* on the next page offers an example from the review for the Health and well-being AoLE. The full protocol can be found in Appendix 2.

Table 3

Literature Review- Critical Questions
• What evidence exists that informs our understanding of progression in this domain?
• In what ways have researchers described how children develop their knowledge/ skills/ capacities in this area? In other words, how do they model progression? For example: – According to the literature, are the changes that children make qualitative jumps (with big steps at key moments) or more gradual sophistication (children seen to gradually add more of the same skills over time)? – Is progression linear or could children move backwards and forwards? – Do the researchers see children's progression as something that can be impacted on by the environment and open to change, or is it fixed? – Is there one path that children seem to take in this area, or are there multiple paths? Do the researchers acknowledge that children may have different paths based on the context in which they grow up/learn? – Are there different models of progression for the same topic and to what extent do they overlap, complement, or conflict?
• To what extent does the literature focus on how children develop in terms of their knowledge/understandings vs. behaviours/skills?
• To what extent is the progression that is described at a micro-level (for one lesson/unit) or at a macro-level (across multiple years)?
• What ages are covered when describing how pupils learn in this area? Which ages seem to be missing or receive less adequate attention?
• What is the theoretical background of the relevant literature (e.g., education, public health, psychology, etc.)? We may get some insight by looking at the journal it is published in.
• Importantly, what seems to be missing in this area? What do we still not know? Is there little research on this topic?

Building Dependable Evidence: Synthesising Sources

The evidence emerging from across the six AoLEs was then compared with the review of *Successful Futures* and the more general research evidence on progression. From this synthesis key themes were identified. These themes were then used as the evidence base to inform for the final section of this report, Learning about Progression: from ideas to action.

This central purpose of this research report, *Learning about Progression – Informing thinking about a Curriculum for Wales*, is to provide a dependable evidence base to inform the work of each AoLE. To

maximise the use of the evidence to inform action in AoLEs, the research report is available in a number of forms.

The full research report is available to all interested parties. In addition, a domain specific report has been developed for each individual AoLE. Each individualised report contains key points from:

- the introduction
- the review of *Successful Futures* and research evidence on progression as a concept
- the policy review and research review specific to the area of learning experience
- 'Decision Trees' as an enabling artefact to stimulate use of an extensive evidence base in practice: 'Decision Trees' structure evidence from the research report succinctly around key questions for use within AoLE workshops. Their purpose to promote better informed decision making.

The decision trees identify crucial questions to be addressed by each AoLE as they design a progression framework for the Welsh curriculum. Using evidence from the research report, they offer insights into how issues have been tackled in different countries and suggest some initial possible advantages and disadvantages related to each decision. They also identify relevant insights from research. Examples of decision trees can be found in Appendix 3.

Using the decision tree approach as a stimulus for discussion and negotiation, each AoLE group was invited to respond to each question, to consider evidence available from research and policy and to add insights from their own professional experience. Once the group had considered the evidence, they were invited to develop proposal to be considered by the cross-AoLE Coherence Group. The role of the Coherence Group was to consider proposals from each AoLE and to take decisions to promote consistency and coherence across the six AoLEs.

Evidence from Teachers and Learners

A central feature of the CAMAU methodology is to promote approaches to progression that are empirically informed by evidence from practice.

In line with the principles of partnership, subsidiarity and collaboration which underpin the CAMAU research project, teachers are co-researchers. While teacher participation in the curriculum development process was an expectation arising from their employment in pioneer schools, participation in related research was voluntary. Consequently, all teachers in the AoLE groups were asked and agreed to participate in this research in accordance with the ethics procedures of the two universities.

Between April and July 2017, collaborative research focused on the articulation of teachers' conceptualisation of learning progression. Evidence was generated through approaches which acted as prompts to support this articulation. The aim was to draw on teachers' practical experience to contribute to developing learning progression frameworks.

Four research questions were developed by the CAMAU team. These were designed firstly to explore evidence of teachers' understanding of progression in learning emerging from the data and secondly to consider the efficacy of different approaches to the collection of evidence of teachers' understandings of progression:

- What evidence on progression emerges from teachers' articulations of progression in learning in their classrooms?
- What are the characteristics of learning identified?
- What types of activities led to teachers articulating their understanding of progression most effectively?
- What sorts of group structures and size supported such activities?

Evidence related to the first two questions would directly inform the drafting of progression statements; evidence related to the latter two would inform later research into teacher views to further develop these statements and to offer insights into processes of sustainable change.

The CAMAU team developed three principal approaches to gathering evidence relevant to the first two questions. It was agreed that the approach(es) used in each AoLE would recognise the views of teacher participants and would be reviewed in the light of evidence related to the latter two questions. The CAMAU team adapted tasks to take account of the broad direction of developing thinking within each AoLE about what matters.

Approach One – Time1-Time(n) (see Newby, 2010)

Teachers were supported to articulate typical learner progress across a period of time; the number of stages (i.e. T1-T2, T1-T3) used was determined by the perceived requirements of each AoLE. The fundamental questions posed took the form of:

- T1 - Can you describe what, in general terms, you expect a learner to know, understand and be able to do at a start time (e.g. the beginning of the year)?
- T2 - Can you describe what, in general terms, you expect a learner to know, understand, and be able to do at an end time (e.g. the end of the year)?

A variant of this approach explored progression made by three individual young people in a class as they moved through a phase: one who finds little challenge in relation to expectations; one who generally achieves expectations; one who finds expectations challenging.

Approach Two – Evaluation of progression in other countries' frameworks

Teachers were asked to examine critically aspects of frameworks from other countries. This afforded opportunities for teachers to review, from a relatively disinterested stand-point, policy and practice and to articulate views on models of progression, broad progression steps and appropriate language.

Approach Three – CoRe (Content Representation) (see Eames et al. 2011; Loughran et al. 2004)

This approach involves identifying areas of knowledge or skill that seem central to learning in an AoLE and for each of these areas responding to questions such as:

- What do you intend young people to learn about this idea or skill?
- Why is it important for them to know this?
- What prior or related knowledge do learners have of this idea or skill?

- What difficulties / limitations may be associated with progression in developing this idea or skill?
- How do you ascertain learners' progression or difficulties in developing this idea or skill?

Findings from this early stage of teacher research are reported in Section 3.

Section 1: Progression – Welsh Policy and Research Insights

Progression in learning is crucial to the realisation of the aspirations of *Successful Futures* and it is essential that progression as developed across the AoLEs is well informed. As indicated in the Introduction, the evidence to promote well informed ideas of progression in learning comes from different sources. This section of the report reflects on two sources of evidence: evidence from policy – what *Successful Futures* says about progression – and evidence from research – an analysis of research on progression.

Evidence from the Policy Context in Wales - Donaldson, Progression and Learning

The concept of progression is at the centre of the new curriculum in Wales. It structures, describes, and enables learning. Donaldson's use of the term represents a shift in discourse that aims to restructure the learning experience for pupils, from discrete and generalised stages of attainment, to a **learning continuum** of individual achievement. Within this new structure, each learner moves forward fluidly through statutory education from age 3 to age 16, guided as appropriate by reference points, supported and challenged according to his/her needs, and assessed in relation to the four purposes of the curriculum.

The four purposes describe what all children and young people should become and achieve through statutory education as well as how they are perceived and positioned as they experience the curriculum.

Recommendation 2 (p.23) states:

> *'The school curriculum should be designed to help all children and young people to develop in relation to clear and agreed purposes. The purposes should be constructed so that they can directly influence decisions about curriculum, pedagogy and assessment'.*

This follows the argument that:

> *'statements of curriculum purpose need to be formulated carefully so that they have integrity, are clear and direct and become central to subsequent engagement and development; in that way they can shape the curriculum and suffuse practice. Common understanding of **why** we are doing what we are doing is a powerful starting point from which to determine **what** it is we need to do and **how** we are going to do it.* (p.22, author's emphases)

The purposes tell us about how children should experience their curriculum day to day. Learners progress to become more ambitious, capable, enterprising, creative, ethical, informed, healthy, confident individuals. Progression is characterised in terms of depth, complexity, level of abstraction, accomplishment and skill, for disciplinary knowledge and wider competencies, and each child's learning continuum functions as a journey through the curriculum. This journey will include diversion, repetition, and reflection, as appropriate for each individual to make progress in learning. There is greater responsibility for teachers to ensure child-centred learning to ensure effective learning takes place, since the pace of each journey is set according to the requirements of the learner.

Discerning the progress being made by each child is fundamental to establishing learning. While the concept of progression shifts control of the curriculum into the hands of the schools, it also shifts assessment from generalised phases and stages, to a greater focus on the evaluation of learning from the perspective of the child: a shift from 's/he should' to 'I can'. This means all children and young people can travel on the same continuum, regardless of any Additional Learning Needs. In the new curriculum, assessment is purposeful and designed to support the progression of each child's learning: what does each child need in order to move forward, what difficulties might s/he have, what are the next steps and how might these next steps best be supported?

Assessment is the means by which teachers seek to discern progress and to identify what is most important for future learning. Progression, and therefore achievement, in Donaldson's terms is positive, beginning from the child or young person's point of departure. Progression describes a forward movement for each learner which is not necessarily linear and which does not end at a given age or stage. Throughout the Donaldson Review, learning is conceptualised as growth. Learners build on previous knowledge/skills/competencies/dispositions in a continuous journey across and within the Areas of Learning and Experience.

Learning is defined through the concept of progression, which is represented as a coherent continuum without separation or interruption. The continuity that the new curriculum places at the centre of learning describes a holistic approach to the development of the individual, including experiential learning that is valuable in and of itself. Learning is the end goal of the education system. The learner is at the heart of the process and a fundamental element of the curriculum is choice. Learners are encouraged to take responsibility for their own learning, to become pro-active, and teachers are encouraged to ensure learning is meaningful and 'authentic', so that it has real world relevance.

What Successful Futures says about Progression

The term progression occurs 116 times in Successful Futures. Additional Document 1 provides a list of each occasion when the word progression is used and an analysis of the different contexts for the idea of progression. In *Successful Futures* (2015) the four purposes provide 'coherence, progression and flow' to learning intentions (p.21). Significant emphasis is placed on manageability:

> *'Having common Areas of Learning and Experience from 3 to 16 should promote and underpin continuity and progression and help to make the structure easier to understand'* (p.39).

Successful Futures presents a clear vision for progression

1. Phases and key stages should be removed in order that progression can be continuous, increasing the potential for higher attainment by minimising transitions.
2. Progression in each Area of Learning and Experience should be based on a well-grounded, nationally described continuum of learning that flows from when a child enters education through to the end of statutory schooling at 16 and beyond.

3. Learning should be an expedition, with stops, detours and spurts rather than a straight line. Progression is a 'road map' for each and every child/young person's progress in learning though some children and young people will progress further than others.
4. Progression Steps will be described at five points in the learning continuum, relating broadly to expectations at ages 5, 8, 11, 14 and 16 (staging points for reference rather than universal expectations – but expectations should be high for all learners).
5. Progression Steps are made up of a number of achievement outcomes linked to what matters in the curriculum and linked to the four purposes ('I can' statements). Literacy, numeracy, digital competence and wider skills should be embedded as well as elements of the Cwricwlwm Cymreig.
6. Achievement Outcomes should not be a checklist of knowledge or skills and should incorporate effective pedagogy.
7. Achievement outcomes should inform next steps and be framed as broad expectations achievable over a period of time (approximately 3 years).
8. Achievement Outcomes should use 'I can', 'I have' (and 'I am ready to') statements to describe progression (not over specified or overly vague – this may vary across AoLEs).
9. Assessment (relevant and proportionate) should be focused on learning intentions and progression in relation to the four curriculum purposes and based upon the intentions set out in the Achievement Outcomes at each Progression Step within each Area of Learning and Experience. In each AoLE the Achievement Outcomes at each Progression Step will need to encapsulate the most important aspects of learning, take account of the ways in which children progress in different kinds of learning and recognise what they need to be able to know and do to move securely to the next stage.
10. Professional judgement is central to assessment (formative assessment with relevant summative information collected and used formatively within classrooms and schools).
11. Schools should use teacher assessment of progression systematically, together with other sources of evidence, to inform their self-evaluation for school improvement purposes.

The ideas presented in *Successful Futures* form the principles from which curriculum, progression and assessment in Wales should be developed and offer a touchstone against which emerging proposals can be evaluated.

Evidence from Research – an Analysis of Research on Progression

The inter-relationship of curriculum, assessment and pedagogy is recognised as being at the heart of learning. Yet, Wyse, Hayward & Pandya (2015), analysing the state of the field internationally, suggested that all too often research has focused on these as different fields leading to a lack of alignment in how curriculum, assessment and pedagogy are experienced in learning. This theme was developed by Wiliam (2017:1) who argued that theories of learning and theories of assessment lack connection because assessment and learning are trying to do different things and each field has been inward looking in identifying and addressing challenges. *Successful Futures* (2015) recognises the importance of promoting a strong relationship between curriculum, assessment and pedagogy. The policy states clearly that everything in education in Wales should be driven from the curriculum: the identification of what matters for a person to be considered educated. What matters in the curriculum in Wales is being identified by the Pioneer Schools in each AoLE. This research review

begins from that premise and explores how progression and assessment might emerge in relation to what matters.

Curriculum, Progression, Pedagogy and Assessment – a Coherent Whole

Built into every curriculum internationally is a notion of learning development but there are different ways in which this can be done. Some countries seek to describe outcomes in different areas of the curriculum through the specification of standards commonly related to ages and stages on development in schools. The aspiration is that by specifying standards, these will become teachers' expectations and student performance will improve. Yet concerns have been raised that many of the statements of standards do not provide the information necessary to achieve that aspiration and are not helpful in developing an understanding of where students are in relation to what might be regarded as desired goals (Heritage, 2008). This lack of clarity can lead to problems emerging between curriculum and learning, for example, teachers may find these statements of standards difficult to use for formative assessment purposes – where the learning is going, where the learner is right now and how to get there (Wiliam & Thompson, 2007). Learning progressions offer the potential to support learning more effectively as they offer teachers the opportunity to relate learning in their class to learning undertaken in previous and learning to be undertaken in future classes. They can make connections between prior and future learning and use information from formative assessment to discern where students' learning lies, allowing them to relate teaching more specifically to what matters and, crucially, to what matters next. Heritage (2008) suggests that '*Explicit learning progressions can provide the clarity that teachers need'.*

Heritage (2008:2) also suggests that greater attention should be paid to the different levels of specificity used to articulate the curriculum. Some curricula specify detailed objectives to be mastered at each grade in sequence. When the curriculum is described in this level of detail, its 'grain size', it may be difficult to see how these discrete objectives connect to bigger, organising concepts and learning can become little more than a checklist of things to be learned. Curricula organised around core concepts or 'big ideas' and sub-concepts offer better opportunities for a stronger relationship between assessment and learning goals: assessment for formative purposes. However, Heritage (ibid) argues that care also needs to be taken with this approach for too often 'big ideas' are not brought together as a coherent vision for the progressive acquisition of concepts and skills. Without a coherent vision the potential for teachers to have a broad overview of learning in a specific domain is restricted. Broadly speaking, learning progressions differ in the span of the progressions and the degree of granularity in their description. Some models present a learning progression as almost a unit of work, whilst others, such as spelling, span several years. Often, the shorter the span, the greater the detail and specificity.

The work of Black *et al.* (2011:74) develops the idea that having a coherent model of progression that is closely linked to assessment and pedagogy will effectively support learning. They conclude that progressions are essential to high quality learning and teaching.

> *'One essential ingredient for a teacher is to have in mind an underlying scheme of progression in the topic; such a scheme will guide the ways in which students' contributions are summarized and highlighted in the teacher's interventions and the orientation the teacher may provide by further suggestions, summaries, questions, and other activities.'*

Pellegrino *et al.* (2012) offer further insights into what is important in the assessment process, a process he describes as reasoning from evidence, and how assessment might relate to curriculum and pedagogy. He identifies three interconnected elements that should underpin any assessment and conceptualises these as an assessment triangle whose three sides are:

- a model of student cognition and learning in the assessment domain
- a set of assumptions and principles about the kinds of observations that will provide evidence of competences
- an interpretation for making sense of the evidence

Whilst all three elements are essential, in a later article (2017:361), Pellegrino argues that often the critical cognition component is missing. The focus of learning should be determined as far as possible by models that describe *'how people represent knowledge and develop competence in the domain of interest*'. This, he suggests, is a distinguishing feature of an evidence-based approach to assessment design, where the most important aspects of student achievement are identified, aspects which then become the focus for '*inferences'* and which should '*provides clues about the types of assessment tasks or situations that will elicit evidence to support those inferences'.*

Although most work on learning progressions has been carried out within domains, deeper understanding of what is important to improve learning may require work to be undertaken across domains. Some more recent studies have begun to explore learning progression across domains. An example of this is to be found in Wylie *et al* (2017 in press) where the researchers sought to build companion learning progressions in mathematics and language. They argue that analysing mathematics and language learning progressions together offers a more detailed and nuanced picture of progression to inform teaching and formative assessment. By focusing on both mathematical knowledge and the discursive skills required to share that understanding, the researchers moved thinking from right versus wrong to a deeper understanding of the ways in which pupils were developing competences in mathematics and language. The application of content and language progressions, they suggested, provided teachers with a deeper understanding of the interaction of mathematical knowledge and language proficiency.

What are Key Characteristics of Learning Progressions?

Mosher & Heritage (2017:1) define Learning Progressions as

> *'inferences or hypotheses describing the order of definable steps, stages, or levels that students' understanding and skill in a subject or discipline are likely to go through over time in response to instruction and experience as they reach the levels of understanding and skill that are the goals of instruction.... The inferences should be based on empirical evidence from student work, assessment performance, responses to clinical interviews, or other observations by teachers or researchers. They may describe likely steps or growth paths in the context of typical instruction, or they could describe what becomes possible with more effective instruction.'*

Learning progressions are pathways along which students are expected to progress. These pathways or progressions are the basis of teaching and assessment. Learning progressions can be conceptualised in different ways but as part of a review of a range of different approaches to learning progressions, Heritage (2008) identified certain common features.

- All models conceptualise progression as a continuum of increasing sophistication of understanding and skills as young people move from 'novice to expert'. (p.4)
- No definition contains references to grade or age level expectations, in contrast to many standards and curriculum models. Instead, learning is conceived as a sequence or continuum of increasing expertise.
- Learning progressions adopt a developmental view, inviting teachers to conceptualise learning as a process of increasing sophistication rather than as a body of content to be covered within specific grade levels.
- Progression also implies a sequence along which students move incrementally from novice to more expert performance. Implicit in *progression* is the notion of continuity and coherence. Learning is not seen as a series of discrete events, but rather as a trajectory of development that connects knowledge, concepts and skills within a domain.
- Learning progressions are accommodating. They recognise that students do not move forward at the same rate or with the same degree of depth and progression and see this as an expected part of learning.
- Learning progressions enable teachers to focus on important learning goals paying attention to what a student would learn rather than what a student would do (the learning activity). The learning goal is identified first and teaching, pedagogy and assessment are directed towards that goal. 'Consequently, the all too common practice of learning being activity driven rather than driven by the learning goal is avoided.' (p.5)
- Learning progressions are an important part of assessment to support learning. Clear connections between what comes before and after a point in the progression offers teachers a better opportunity to calibrate their teaching, to address misunderstandings or to develop skills as revealed by assessment, and to determine what important next steps would be to move the student forward from that point.

Further key features of learning progressions are identified in the work of Duschl *et al* (2007) and Pellegrino (2017). Duschl *et al.* (2007) suggest that a distinctive feature of learning progressions is the evidence base from which they are developed. They define learning progressions as evidence based hypotheses about how students' understanding and ability to use core concepts and explanations become more sophisticated over time. These hypotheses represent the pathways that young people are likely to follow as they make progress. These pathways should be empirically tested to ensure that they relate closely to how most students experience progression and should be empirically evaluated to determine their efficacy to discern whether or not lead to better learning.

Pellegrino (2017) suggests that although learning progressions are not developmentally inevitable, they may be developmentally constrained. He suggests that numerous progression paths are possible and that progress rather than being linear may be more like 'ecological succession' (p.362). A learning progression offers one or more possible paths but 'does not represent a complete list of all possible paths'. In addition, at any point in the process, an individual may demonstrate thinking and/or practices that could be considered to be at different points on the path. Mosher & Heritage (2017) support this view, adding an optimistic view of learning progressions which suggests that there is a small number of likely paths, that the steps along the way are clearly distinguishable and that they represent understanding and related skills which are stable for reasonable periods of time. They also re-emphasise the complex nature of the progression concept, its non-linear pathways, its confusions and regressions as learner thinking develops over time to new levels of sophistication.

The inter-relationship between the learner and progression is further complicated by regressions that can occur in particular circumstances, e.g. stress or challenges that feel to them to be too great. This approach may align more closely with Bruner's spiral curriculum than any model of linear learning, building on the hypothesis that '*any subject can be taught effectively in some intellectually honest form to any child at any stage of development*' (Bruner, 1960*:* 33). Pellegrino (2017) argues that there is a clear connection between progress in learning and the quality of teaching to which the young person is exposed. High quality curriculum and pedagogy are essential for optimal progression as is the teacher's confidence in dealing with the complexities of differentiated instruction.

Learning Progressions and Audience

There is a further characteristic of Learning Progressions worthy of consideration: the audience. Many learning progressions are written primarily for teachers and tensions can arise if a single learning progression attempts to serve too many purposes. For example, Heritage (2008) draws attention to the problems that can arise if it is assumed that the same degree of granularity will serve both planning and assessment. The degree of granularity in a learning progression designed to ensure that teachers have an overview of progress from novice to expert is very different from the degree of granularity necessary to enable teachers to support learning formatively: the latter would require a far more detailed analysis of progress in learning. She proposes that a possible way to deal with this issue would be to have different learning progressions serving different purposes. An overview learning progression to offer a multi-year picture of the journey from novice to expert. These could then be linked to learning progressions related to each of the key building blocks of what matters in the curriculum. These more detailed learning progressions would support teachers in formative assessment whilst their relationship to the multi-year learning progression would allow them to locate their own work in the bigger learning picture. This could also be helpful in offering support to teachers who are working with young people whose learning is outside the range of normal expectations for the group or year with whom they are working.

Learning progressions can also be written in ways which provide a framework for learners to understand the learning journey they are on. Heritage (2008) argues for the importance of learners being aware of longer term goals and the relationship between those and their day to day progress. It is unquestionably desirable for students to know what the longer-term goal is or what the final product of the learning will be. Increased involvement in learning occurs when teachers share with the students what their longer-term goals are and enable them to participate in evaluating the degree to which they have met the goals. The changing role of the learner within social constructivist and sociocultural theories of learning is highlighted by Baird *et al.* (2014, 2017). Within these overlapping theories, there are common learner characteristics. Learners are active in the learning process, involved in self and peer assessment, in social processes and interactions where there is a changed 'contract' around learning. If the aspirations for this new relationship, this new contract between the learner and society, as articulated in Baird *et al.* (ibid) are to be fulfilled, there are implications for the level of transparency in curriculum, progression, pedagogy and assessment. Learners need deeper and more meaningful understandings of what matters in learning and a voice in what matters. They would have the right to understand the longer-term journey in the domain being studied and the responsibility to work with teachers and others to engage in learning

processes and, crucially, in assessment as part of learning. Learning progressions are a crucial part of this process.

Progression and Assessment

There is strong research evidence that approaches to formative assessment can and do improve learners' attainments (Black & Wiliam, 1998; Wiliam *et al.*, 2004). Black *et al.* (2011) suggest that these approaches are based on principles of learning well informed by cognitive research. They define the principles as

- *'Start from a learner's existing understanding.*
- *Involve the learner actively in the learning process.*
- *Develop the learner's overview, i.e. metacognition – this requires that students have a view of purpose, have an understanding of the criteria of quality of achievement, and self-assess.*
- *Emphasise the social aspects of learning (i.e. learning through discussion) as these make a unique contribution.'*

There are strong areas of overlap between this definition and Heritage's (2008) conceptualisation of formative assessment:

- eliciting evidence about learning to close the gap between current and desired performance (Pellegrino (2001) would describe this as drawing inferences);
- providing feedback to students; and
- involving students in the assessment and learning process.

Both definitions privilege the role of the learner in learning and assessment.

Black *et al*. (2011) make a strong case for the centrality of teacher assessment. They suggest that teachers' in-classroom assessments offer opportunities to achieve far better standards of validity than national or state tests. The evidence they generate is richer and more meaningful. However, they caution that significant professional development (2001:106) is necessary, for teachers' professional judgements to be both valid and reliable. The authors present five steps essential to the design and implementation of any learning exercise. The exercise must have strategic aims that involve understanding concepts and methods of a subject or developing reasoning skills. Teaching has to be planned, involving what the authors describe as choosing the tactics for realising the strategy in order to '*help build a picture of learners' existing understanding, especially with respect to the learner's location on the learning progression, so that the next challenge can be framed to take that understanding further'* (2001:77). The plan then has to be implemented, reviewed and summed up. The researchers argue for the importance of a curriculum as an evidence-based model of the paths through which learning typically proceeds used to inform both pedagogy and assessment. These 'road maps' they describe as central for all five steps outlined above. And they offer an example of a road map for the scientific concept 'atomic-molecular theory of macro properties'. Through this example, the authors suggest that we can create roadmaps by synthesising several sources of evidence (2011: 85)

- research results about common pupil misconceptions
- internal logic of the concepts involved
- indications from learning theory about difficulty of the types of thinking involved

- results from assessment items that indicate problems/possibilities with the topic sequence

They argue that, although previous qualitative studies on this topic provide rich understandings of progression of learning, they are limited by the specific contexts in which they were developed. They propose larger scale and longitudinal studies to deepen understanding of trajectories of change of individuals.

Black *et al*. (2011) argue that progression is needed for formative assessment:

> *'(a) to formulate a task or test so that the responses can provide evidence of learning progression, (b) to formulate helpful comments, tailored to the individual needs of each student, and (c) to give clear guidance on how to improve, all require a clear road map, that is, a view of the learning aim and of the steps along the route, or routes, that the student needs to take to get closer to the aim in light of his or her position en route.*' (p. 75)

Pellegrino (2014, 2017) supports this view. He suggests that learning progressions are helpful ways to think about the assessment of student learning. Like Black *et al* (2011), he argues that learning progressions should contain multiple elements, including *Learning Performances.* These he describes as

> '*the kinds of tasks students at a particular level of achievement would be capable of performing. They provide specifications for the development of assessments by which students would demonstrate their knowledge and understanding. Such assessments allow one to observe and infer students' levels of competence for major constructs that are the target of instruction and assessment within and across grade levels. Thus, an adequately specified learning progression should include an approach to assessment, as assessments are integral to learning progression development, validation, and use'* (2017:362).

He also concludes (Pellegrino, 2017:363) that when detailed maps of learning progression exist at grain sizes to support teaching and assessment, these will form a conceptual base that can be used as evidence of longer term growth and change, evidence currently collected through large-scale assessments. This will improve the validity of the assessment because there is a clearer idea of the construct being measured and the level at which student learning and performance is understood.

In conclusion

There is recognition in both policy in Wales and research of the importance of learning being articulated progressively. Although in Successful Futures (2015) this is described as a *learning continuum* and in research as a learning progression, these terms share many common characteristics. For example,

- Curriculum, assessment and pedagogy should be seen as an integrated whole
- Progression should be continuous
- Progression is not linear
- The journey from the point a young person transitions into the curriculum until the point where the young person transitions into life beyond school education should be sufficiently clear to allow both teachers and learners to make sense of how day to day activities relate to the learning journey over time.

- Assessment for learning has the potential to enhance young people's learning but there are a number of areas to be considered as part of curriculum and assessment innovation if this potential is to be realised

The key messages emerging from the review of all the evidence sources examined in this research report and possible implications for how evidence from policy and research might influence emerging practice are considered in the next section of this report.

Mathematics and numeracy: Review of Frameworks

Introduction

As far as documentation permits, the following reviews examine the place of progression within curricula from a range of countries. The first sections provide an overview country by country of how progression is conceptualised, how progression points are described and how they relate to broader curricular principles. Doing so also provides insight into what matters. The final section draws out similarities and differences of interest across those countries examined.

Australia

https://www.australiancurriculum.edu.au/f-10-curriculum/mathematics/

The Australian mathematics curriculum spans two broad stages: Foundation to Year 10, and then a Senior Phase in which students study more discrete courses (e.g. Mathematical Methods, Specialist Mathematics). A new national curriculum (rather than state curricula) emphasises consistency and is structured around three content strands:

- number and algebra
- measurement and geometry
- statistics and probability

and four proficiency strands:

- understanding
- fluency
- problem solving
- reasoning.

Progression is understood as the application of skills and understanding to increasingly more complex situations. It is expected that mathematical skills become increasingly sophisticated through the years of schooling.

Within the curriculum, there is year on year scope and sequence within identified standards. Comparison of level descriptions and achievement statements between years illustrates shifts in performance expectation. For example, mathematical fluency between Years 2 and 5 describes shifts from readily counting in sequence and using informal units to compare measurements to choosing appropriate units and instruments in measurement. Such shifts do capture aspects of procedural fluency but, with the exception of 'readily', do not regularly foreground adverbs in relation to notions of flow, highly developed practice and accuracy. Similar shifts are articulated in aspects including reasoning and problem solving. Within the content description, performance statements are used, e.g. 'Investigate the conditions required for a number to be odd or even and identify odd and even numbers.' These are initiated with a range of words that relate to a range of skills, attributes and capabilities (e.g. recognise, connect, investigate, apply, develop, solve, select, find, compare).

Additional documents articulate progression in other forms that support the main curriculum. The 'Sequence of Achievement' document provides successive grade-level vignettes of expected performance across standards at the end of each year. These take the form of 'Students are able

to...' statements that relate mathematical skills to aspects of curricular content. The detail included is helpful and conveys a sense of progression; however, the form that they are in does not make this readily apparent and hence may not be effective for formative discussions. The accompanying 'Sequence of Content' document is more stratified and helpful, providing overviews for high level planning.

Interesting work, however, has been undertaken by individual states, such as Victoria, which have created developmental learning continua from Foundation to Level 10 (http://www.education.vic.gov.au/school/teachers/teachingresources/discipline/maths/continuum/Pages/mathcontin.aspx). As with New Zealand, indicators of progress are identified with associated exemplification of student work (images and video) and linked teaching strategies. The 'illustrations' within these provide teachers with valuable insights in changes and challenges in learning, again, useful for formative assessment.

British Columbia

https://curriculum.gov.bc.ca/curriculum

This interesting concept-based and competency-driven curricular model is structured around the interaction between

- big ideas (understanding, e.g. numbers, fluency, patterns, attributes, familiar events)
- curricular competencies (doing, e.g. reasoning, analysing, understanding, solving, communicating, representing, connecting, reflecting)
- curricular content (that which students should know: e.g. number concepts to 20).

These three dimensions are differentiated by year group and collectively articulate lines of progression as students move from one year to the next. There is a strong link evident between these three dimensions within the documentation.

Notably, 'Big Ideas' are consistently centred upon core entities but evolve in emphasis from one grade to the next. The documentation cites no evidence base for why these particular shifts are conceptualised as they are; however, they appear to promote successively deeper understanding.

These are detailed further in elaborations which are also included for content and curricular competencies. Within these, sample questions are included at different stages to support students' inquiry. For example, from Kindergarten through Grade 5, 'pattern' shifts from identification, through regularity, change, representation and expression and then to linear relationships in Grade 6. One support question at this stage asks: 'How do linear expressions and line graphs represent linear relations?' (p. 43) whilst, at Grade 9, the parallel question asks 'How do [continuous] linear relationships help us to make predictions?' (p. 62). These are valuable in supporting the teaching of mathematics at a given stages and in pitching the level of expectation. Though content, competence and big ideas are detailed, there is not the hierarchical sense evident in the Singapore documentation and there is an explicit acknowledgement that these things will take place at different times.

British Columbia has also compiled performance standards for numeracy, one of three core dimensions of the curriculum, which are exemplified with student work (http://www2.gov.bc.ca/gov/content/education-training/k-12/teach/bc-performance-standards/numeracy). These relate to more formal aspects of mathematics defined within the

curricular document and are designed to apply across all curricular areas. Progression is illustrated for four aspects of numeracy

- Concepts & Applications
- Strategies & Approaches
- Accuracy
- Representation & Communication

Performance is described in terms of 'is not yet within', 'minimally meets', 'fully meets' and 'exceeds' expectations. These descriptions illustrate development in features of performance such as confidence, connection to prior knowledge, flexibility, level of support, perseverance, analysing and planning.

Table 11 illustrates a snap-shot entry for Grade 4 Strategies & Procedures.

Table 11

Not Yet Within Expectations	Meets Expectations (Minimal Level)	Fully Meets Expectations	Exceeds Expectations
• cannot break the task into stages, steps, or sections • unable to verify results or solutions	• tries to follow instructions; does not check or adjust procedures • needs help to verify results or solutions	• structures the task logically; may be inefficient • if asked, verifies results or solutions	• structures the task efficiently • may independently verify results or solutions

These are likely to be effective in making summative judgements and, in most instances, the full (rather than snapshot) illustrations, in conjunction with the examples of work, are sufficiently detailed to guide formative assessment and future learning.

Finland

http://www.oph.fi/english/curricula_and_qualifications/basic_education/curricula_2004

(Note that a newer curriculum was released in 2016; this was not accessible in English.)

The curriculum spans Primary and Secondary (Grades 1-9); progression stages are defined at the end of Grades 2 (approximately 9 years old) and 5 (approximately 12 years old); terminal expectations are listed for Grade 8. Though there are not explicit pathways of progression articulated outside of the core curricular content, the documentation does stress that there should be systematic progression facilitating the assimilation of mathematical concepts and structures (though this is framed in terms of instruction rather than learning).

There are hence three stages defined across the curriculum (Grades 1-2, Grades 3-5 and Grades 6-9). For each of these stages, there is a brief statement describing the core purpose of instruction (e.g. *'…the development of mathematical thinking; practice concentrating, listening, communicating; and acquisition of experience as a basis for the formulation of mathematical concepts and structures'*). Objectives are then listed which also give insights that would support teaching approaches (e.g. learning to justify conclusions; using pictures; concrete models; tools in writing or orally). These are followed by statements of core content for

- Numbers & Calculations

- Algebra
- Geometry
- Measurement
- Data Processing
- Statistics.

In relation to these, descriptions of good performance by learners (using the future tense) are included at for the end of Grades 2, 5 and 8, but no description of the nature of learning progression between these is given. The descriptions themselves often give quite specific indications of performance expectations and capabilities. For example: '*pupils will know simple fractions such as one half, one third and one quarter and how to present them by concrete means*.'

A section is included describing thinking and working skills in which reference is made to problem solving contexts and students' ability to remember and focus their attention in, for example, making observations. It is notable that many of the performance indicators use the word 'know' even in instances where it refers to more procedural aspects of learning (e.g. 'know how to..' rather than refer direction to the process itself).

In the absence of explicit descriptions of learning progression, it is necessary to infer this between stages. In most cases, alignment is sufficiently congruent to allow for this, but it is not necessary intuitive for use by teachers in supporting finer-grained formative assessment with cognisance of learning trajectories. Notwithstanding this, shifts can be inferred. Between Grades 2 and 5, for example, more developed learning in thinking and working skills involves more expansive and/or diverse ways of communicating understanding; in geometry learning shifts from knowing basic forms, to recognising similarity, formation of figures and judgements of sensibility. These include some references to independence and confidence.

New Zealand

http://nzcurriculum.tki.org.nz/The-New-Zealand-Curriculum/Mathematics-and-statistics/Achievement-objectives

https://lpf.education.govt.nz/

Mathematics & Statistics are structured around three strands:

- Number and Algebra (including, e.g. number strategies, number knowledge, equations and expressions, pattern and relationships)
- Geometry and Measurement (including, e.g. shape, position and orientation, transformation)
- Statistics (including, e.g. statistical investigation, literacy and probability).

The core curricular documentation is staged through levels 1 to 8 with achievement objectives articulated with progressive complexity but in quite a general sense (e.g. use a range of counting, grouping and equal sharing strategies with whole numbers and fractions). Areas of learning within each of the three strands are fairly constant from levels 1 to 6, but the final two levels are described in two strands (Mathematics and Statistics) in which calculus is discretely included. It is noteworthy that the achievement objectives appear to constitute the curriculum itself and in the primary documentation the percentage of time to be spent on number contexts is specified.

Though lines of progression can be inferred from the achievement objectives by learning area, progression is also supported through the Mathematics Framework (part of the Progression and Consistency Tool). The can be accessed freely after creating a user account. This framework purposefully breaks down and exemplifies successive stages in learning in eight 'big ideas'

- additive thinking
- multiplicative thinking
- patterns and relationships
- using symbols and expressions to think mathematically
- geometric thinking
- measurement sense
- statistical investigation
- interpreting statistical and chance situations.

Though not structured in the same way as the achievement objectives, they complement these and mathematical learning generally. No indication is given of how or why these particular 'bigger ideas' were identified, but it is noteworthy that they are all principally procedural (rather than conceptual) in nature and are exemplified through task-based problem solving.

For each big idea, progression steps are exemplified as a series of 'sets' from one to eight. More detailed introductory descriptions articulate the ways in which performance and learning is expected to change and these are associated with exemplar activities and extracts from student work. One example for additive thinking at level 4:

- states that the student can count back across a decade
- provides a description of the problem
- provides a transcript of verbal interaction between the teacher and the student
- provides an image from the student's written work that evidences success in this.

For measurement sense at the same level, there is exemplification of a similar nature around the creation of measurement scales. Again, photographs of student work illustrate success for two scales created using matchsticks. Though the achievement objectives themselves are relatively broad, this form of exemplification around big ideas could be useful in supporting formative discussions and in cultivating a less abstract sense of learning trajectories. They give important insights to contexts that allow learners to acquire the necessary skills and strategies.

Quebec

http://www1.education.gouv.qc.ca/progressionPrimaire/mathematique/index_en.asp

http://www1.education.gouv.qc.ca/progressionSecondaire/domaine_mathematique/mathematique/index_en.asp

Approaches to conceptualising and using progression are addressed explicitly within the Elementary and Secondary curriculum. Knowledge, competence and the role of the teacher are viewed as critical in cultivating progression with articulations of progression harmonised between both stages of schooling.

For the express purpose of supporting teachers planning, progression tables (http://www1.education.gouv.qc.ca/progressionPrimaire/mathematique/index_en.asp) which accompany the main curricular document illustrate several phases of progression in each of the five

areas of mathematics (arithmetic, geometry, measurement, statistics and probability). Phases are either: (→) construction of knowledge with teacher guidance, (★) application of knowledge by the end of the school year, or (■) reinvestment of knowledge by student. When considered across several years of schooling, these form a comprehensive planning matrix.

Table 12 illustrates selected performance statements, in no particular order, from planning matrices where 1-6 represent the years of elementary schooling.

Table 12 – Selected entries from Progression Planning Matrices

	Cycle 1		**Cycle 2**		**Cycle 3**	
	1	**2**	**3**	**4**	**5**	**6**
An addition or subtraction involving natural numbers	→	★	■	■	■	■
Any of the four operations involving natural numbers			→	→	→	★
Develops various strategies that promote mastery of number facts and relates them to the properties of addition.	→	→	★	■	■	■
Builds a memory of multiplication facts (0 × 0 to 10 × 10) and the corresponding division facts, using objects, drawings, charts or tables			→	★		

Progression steps are depicted annually in alignment with school years through three cycles at elementary level and two cycles at secondary level. The points at which different performance statements are developed appear to account for the dependencies between mastering certain foundational skills and competencies within topic areas. More detailed analysis would be required to verify such dependencies between topic areas but these are assumed to hold true also.

A range of words or phrases are used at the beginning of performance statements (e.g. uses, determines, establishes, builds a repertoire, develops processes) and, interestingly, there are examples that appear to suggest ways in which these should be taught (e.g. uses his/her own processes as well as objects and drawing to determine the sum or difference of two natural numbers less than 1000). These are further supported by exemplar cognitive and meta-cognitive strategies, in the form of reflective prompts/questions, intended to support the development of mathematical competencies. There appears to be clarity between performance statements and the associated principles, although no specific evidence base is cited in relation to models of progression.

Though powerful as a means of structuring learning for progression at the level of planning, additional detail and exemplification may be necessary to support formative assessment. The main curricular documentation at both Pre-School/Elementary and Secondary levels (secondary 1 and 2), provides additional detail on content, presented in terms of concepts and associated processes. As expected, progression in complexity is evidenced between successive cycles and, in conjunction with the progression tables, provides quite a detailed curricular framework. Notably, there is significant discussion in the main curricular documents of matters such as conceptual learning, development of competencies, increasing complexity, and application and re-application of learning across cycles. Though not frameworks of progression, this description supports and significantly deepens understanding around the associated tables and description of progression elsewhere.

Singapore

https://www.moe.gov.sg/education/syllabuses/sciences/

The mathematics curriculum in Singapore spans three phases: primary, secondary and pre-university. All three stages are underpinned by a framework that groups what matters under:

- attitudes (e.g. interest, appreciation, confidence)
- skills (e.g. numerical, algebraic, spatial, data)
- concepts (e.g. numerical, algebraic, statistical)
- processes (e.g. reasoning, communication, application, modelling)
- meta-cognition (monitoring and self-regulation).

In the broadest sense, progression in mathematics is set within this framework for all stages of schooling and problem solving is explicitly stated as central to this. The curriculum acknowledges the hierarchical nature of mathematics and recognises that progression depends on developing certain foundational understandings. The documentation structures pedagogy to support learning move through three phases from 'Readiness' through 'Engagement' to 'Mastery'. Readiness takes cognisance of prior knowledge and the importance of the learning context and environment. Engagement is the phase in which a range of strategies support the learning of learning new concepts and skills with attention given to instructional approaches such as Polya's Problem Solving Heuristic. In the Mastery stage, consolidation of learning is supported through reflective review and purposeful extension. The interdependency among instructional approaches, content and assessment is emphasised in how progression is described.

Progression points in key curricular areas (e.g. Numbers & Operations, Ratio & Proportion, Algebraic Expression and Formulae) are described using both clearly specified content and associated descriptions of intended learning experiences. The specified content – which is set out in a high level of detail – implies a pathway of progression both within different content areas at given levels (e.g. for Secondary One, for Secondary Two) as well as across year groups (from Secondary One to Secondary Two). Implied progression appears to reflect increasing complexity, task demand and the hierarchical nature of the domain.

The layout and numbering system suggest quite linear and successive stages, but it is unclear whether this reflects the way teachers approach and structure content in classrooms. Progression is, in this sense, the curriculum itself. The accompanying statements of expected learning opportunities provide some insight into shaping learning experiences and could be used to support formative interactions with students.

There does not appear to be any exemplification of student performance in work at different stages in learning but assessment rubrics are referred to in the 'integrating assessment with instruction' section. The layout and level of detail give a greater sense of prescription regarding content and teaching, though it is unclear how teachers utilise this in practice.

Observations & Considerations

- Relative high degree of consistency in what matters, though variation in emphasis, structure and degree of specificity.
- Curricula generally include content relating to number/arithmetic, geometry, measurement, algebra and representation/statistics/probability. Skills and competencies relate to reasoning, problem solving/application, fluency, justification, confidence, accuracy, reflection and metacognition.
- Curricular complexity in documentation varies. Finland is simpler in conception than, for example, British Columbia that is predicated upon interaction between three dimensions.
- Descriptions of progression range from the relatively implicit and integrated (e.g. Finland and Singapore) to the quite explicit and complementary (e.g. Quebec and Victoria), though all convey a sense of increasing complexity/demand.
- Progression steps span single years (British Columbia), two-year cycles (Quebec) or longer periods (Finland).
- The wording of performance statements varies, which has implications for supporting formative assessment. More detailed descriptions are likely to be more useful.
- Exemplification of standards through learner work significantly reduces the level of abstraction (e.g. Australia, British Columbia, New Zealand). It is not always clear what performance/behaviours at a given level would look like in a classroom and this is a powerful way of addressing this.
- Though Singapore recognises 'readiness' as a phase in progression, progression does not seem to be articulated as sufficiency to move onto further learning, but is largely summative of what has happened up to the progression step.
- In most instances (Australia is an exception), it is unclear on what evidence, if any, conceptions of progression are based. As such, it is difficult to know the extent to which these reflect the way learning progresses for learners in relevant classroom contexts.

Mathematics and numeracy: Research Review

Introduction

The learning of mathematics has arguably been a central part of research and debates related to general cognitive development (e.g. Piaget and Szeminska, 1952) and a large body of literature informed by research into the learning of mathematics has developed over time. Whilst this literature can inform understanding of how mathematics may be learned, the nature of what progression in mathematics involves can be more difficult to ascertain. The aim of this review is not to outline all research related to mathematics learning. Rather, it aims to highlight some key literature that may be useful in supporting understanding of learners' progress in mathematics and numeracy and to raise considerations in relation to points that arise. The term *mathematics* is used here to encompass *mathematics and numeracy*. Numeracy is not seen as a sub-set of mathematics; rather, being numerate is considered an outcome of successful mathematics learning including, in particular, the application of mathematics learning within a range of contexts.

Any attempt to map mathematics and the progression of ideas within it necessarily invokes discussion of the very nature of mathematics itself. Many mathematicians would argue that the beauty and power of mathematics lie in its abstract nature; that a compact representation can be applied to describe and analyse a multitude of situations. This abstract nature means that learners need to learn to use and interpret a range of symbols and representations, many of which subsequently become further objects to be manipulated, and they need to learn how to model situations in a mathematical way. Being able to successfully understand and reason with a range of ideas, concepts and representations and being able to generalise, predict, justify and deduce are all key aspects of mathematics. Applying Piaget's concept of abstraction, Tall (2013) believes that there are 'three integrated worlds' of mathematics which learners may journey through:

- embodied mathematics (involving abstraction from perceptions on objects, for example shapes);
- symbolic mathematics (involving abstraction from actions and ideas into symbols);
- formal mathematics (building formal knowledge into axiomatic systems).

Tall (2013) argues that the first two worlds start with practical experience, moving into more theoretical mathematics and culminating in formal axiomatic mathematics. Whatever the belief in the nature of mathematics, a simple summary of progress through school mathematics necessarily recognises a hierarchy of increasingly complex abstraction, manipulation, interpretation and generalisation. This review explores progress in mathematics including general descriptions, conceptual frameworks and research informed learning trajectories.

General descriptions and conceptual frameworks for progress in mathematics

General descriptions

General descriptions of what it means to make progress in mathematics are very difficult to find. Watson *et al*. (2003) in their work analysing the progress of low attainers in mathematics used the term 'deep progress':

'Deep progress means that students:

- *learn more mathematics*
- *get better at learning mathematics*
- *feel better about themselves as mathematics learners'*

Watson *et al*. (2003, p. 4).

It is noteworthy that Watson *et al*.'s (2003) succinct idea of deep progress reflects aspects of metacognition and self-efficacy. Such notions seem to be present in the curricula of high performing countries (e.g. Singapore and China); they also relate to the four purposes of the Welsh curriculum. In addition, studies of international PISA assessments in mathematical literacy have suggested a link between practices that encourage metacognition and self-efficacy and high performance (e.g. OECD, 2016). However, although the work by Watson *et al*. (2003) outlines some effective approaches to supporting deep mathematics progress, it does not suggest how 'getting better at learning mathematics' and 'feeling better about themselves as mathematics learners' can be used as measures of progress and these are likely to be context dependent. If such notions are considered as part of progression in mathematics then careful consideration would need to be given to whether, and, if so, how such aspects could be interpreted.

In a United States National Research Council review synthesising research into mathematics learning from pre-school to sixteen, Kilpatrick *et al*. (2001, p.5) use the term 'mathematical proficiency' to describe the outcome of successful mathematics learning. They regard mathematical proficiency as having five strands:

- *'conceptual understanding – comprehension of mathematical concepts, operations and relations*
- *procedural fluency – skill in carrying out procedures flexibly, accurately, efficiently, and appropriately*
- *strategic competence – ability to formulate, represent, and solve mathematical problems*
- *adaptive reasoning – capacity for logical thought, reflection, explanation, and justification*
- *productive disposition – habitual inclination to see mathematics as sensible, useful, and worthwhile, coupled with a belief in diligence and one's own efficacy'*

Kilpatrick *et al*. (2001, p. 5)

Kilpatrick *at al*. see these strands being *'interwoven and interdependent*' (p. 5) and imply that progress in mathematics would include development of all these strands. They comment (p. 217) that *'the path to proficient performance requires progress along each strand interactively'*. It is interesting that the term 'multidimensional' is used in relation to mathematical proficiency; examples discussed imply that there can be progress by moving *between* strands as well as *along* strands. For example, *developing procedural fluency* with multidigit algorithms could lead to *improved conceptual understanding* of place value and could *support strategic competence* in being able to represent and solve problems. It would be a vital role for the teacher to ensure such connections are identified and exploited. Kilpatrick *et al*. note that strands may be linked effectively in the teaching of whole numbers but less effectively in the teaching of other areas, e.g. rational numbers. The implication is that teachers must support learners in identifying, understanding and applying connections between strands of proficiency in order for them to make progress.

Indeed, highlighting relationships between skills and knowledge being learnt in mathematics has long been promoted by mathematics education experts (e.g. Skemp's (1976) writing on relational

and instrumental understanding in mathematics). Denvir and Brown (1986) noted that for low attaining learners in particular the highlighting of relationships between accruing skills and knowledge may need to be particularly explicit. Hence, progress in mathematics involves building a network of connections between what is being learned and how it is being learned at whatever 'stage'.

Development stages

Piaget and Szmeniska's (1952) work on cognitive development in mathematics contributed significantly to research into mathematics learning. However, the idea of discrete and inflexible 'stages of development' has frequently been criticised. For example, in relation to mathematics, McGarrigle and Donaldson (1974) showed that very young children could show understanding of conservation if the context was relatable. At a simple level, such research confirmed that a child's understanding may depend on how a problem is situated within a particular context and contributed to a growing body of research which suggests that global developmental stages, through which children progress in a linear way, cannot be assumed in the learning of mathematics.

Networks, hierarchies and layers

The 2011 report of England's Advisory Committee on Mathematics Education (ACME) looked at what learners need in order to become successful in mathematics. The report described mathematics as being made up of components *'which link together in networks, hierarchies and layers'* (ACME, 2011, p. 5). Furthermore, the report suggests that mathematics *'is learned not just in successive layers, but through revisiting and extending ideas'* (ACME, 2011, p. 1). This view reinforces that progress in mathematics involves building on previously learned ideas, being able to make connections between ideas and proficiencies (as discussed above) whilst also acknowledging that, within layers (or 'stages') there will be depths or levels of understanding.

The idea of depth of understanding is not new and the use of taxonomies (such as Bloom's and SOLO) to describe learning of a particular proposition and how it might develop is common in schools. Meel (2003) gives a useful overview of some theories of mathematical understanding and how they have developed. These include Skemp's (1976) seminal theory on instrumental and relational understanding and theories such as: understanding as overcoming obstacles; understanding as generating images, definitions or generalisations; and understanding as being able to operate multiple representations. These theories appear to build on and incorporate aspects of more general cognitive development theories proposed by researchers such as Piaget, Bruner and Vygotsky.

Meel (2003) also discusses the model of understanding proposed by Pirie and Kieren, developed through observation of middle and high school learners, and presented as an 'onion-layer' description of understanding. Of particular note in this model is that, as Pirie and Kieren (1994) point out, it is not a linear sequence (i.e. a learner can operate at a level without necessarily having to have operated at earlier levels) and it is not unidirectional (e.g. when faced with a difficult problem which is not immediately solvable a learner may need to 'fold back' (Pirie and Kieren, 1994, p. 173). Furthermore, Pirie and Kieren (1994) discuss how they attempted to map learners' growth of understanding in topics such as fractions and graphing of functions and found, not unsurprisingly, that learners' maps were different. They acknowledge that the reasons for the difference could be learner dependent or topic dependent or perhaps both. A key point is that the differences were not

related to age. Pirie and Kieren's model has been used in informing a model of growth of understanding used in the New Zealand mathematics framework.

A similar view of this 'layered' aspect of developing competence in mathematics is proposed by Sarama and Clements (2009) in a theoretical framework which they call 'Hierarchical Interactionalism'. This framework, developed through observation of young children's mathematics learning, attempts to synthesise contemporary views of cognitive development and mathematics specific educational research. It attempts, like Pirie and Kieren (1994), to account for the view that progress in mathematics over time and within a specific domain involves building on layers of thinking (several of which may develop at once) and that students may access these layers in varying ways over time. Students may move between these layers in particular contexts. Such views are very similar to those discussed by Pirie and Kieren (1994). An illustration and summary of this framework is provided in Daro *et al*. (2011).

Content and reasoning

The theoretical models for growth of understanding in mathematics discussed above relate primarily to particular topics or domains within mathematics, i.e. growth in understanding of mathematical content. One aspect that has not been discussed so far is progression in problem solving and/or mathematical reasoning. The notion of being able to reason with ideas and solve problems related to those ideas seems implicit in models such as those of Pirie and Kieren (1994) and Sarama and Clements (2009) discussed above; indeed, the solving of problems related to ideas is mentioned frequently when the different levels or layers are discussed and explained. This would therefore imply that a teacher would be posing problems (e.g. open-ended questions and those that invoke cognitive conflict) in order to ensure growth of understanding. Indeed, such an approach has been linked to improved problem-solving skills (Tanner and Jones, 2000). There are also numerous heuristics that have been developed to describe phases of problem solving (e.g. Polya's, which is mentioned in the curriculum for Singapore). However, although these heuristics detail necessary phases for problem solving, they do not describe how learners might progress in their competence in problem solving. Some (e.g. Carlson and Bloom, 2005) argue that problem solving is cyclical in nature (i.e. it is skill that is applied in the same way at whatever level or stage it may be met). Wismath *et al*. (2015) studied students' problem-solving skills in an attempt to identify 'threshold concepts' (i.e. fundamental concepts which may be initially difficult but once understood will not be lost and will transform future learning). Their research suggested three thresholds in relation to problem solving:

- persistence (e.g. being prepared to try something);
- process over answer (valuing processes and a variety of processes over just finding an answer);
- careful modelling (being prepared to spend more time at the start determining possible models/ approaches/ representations).

These are behaviours which arguably could be trained, relate closely to self-efficacy and attitudes and may vary depending on context.

Section summary

To summarise this section, mathematics progress over time, although there is undoubtedly hierarchy, is not a simple linear progression and involves building and using connections between

learning with layers of understanding and application which will be context and learner (rather than age) dependent. Aspects such as problem solving may be cyclical and may also relate to self-efficacy and metacognition. Reflecting such a complex view of progression in mathematics in a simple, usable format is undoubtedly a significant challenge. ACME (2011) provide examples of models of mapping for some areas which attempt to show how ideas connect and progress and suggest that an electronic map could be developed to present an idea in a number of layers and to address depths.

Progression in particular areas of mathematics

Exploring children's mathematical thinking

Much of the literature that could support an understanding of learners' progress in specific areas of mathematics has been developed from research and analysis of learners' responses to mathematics questions or tasks. This research has contributed to a body of literature considering how specific areas within mathematics may be learned and identifying typical misconceptions that may arise along the way. In some cases, such work has been used to inform the development of frameworks (or trajectories) of learning for specific areas of mathematics. Such literature is discussed within this section.

Ryan and Williams (2007) report the results of a UK cross-sectional survey of 15,000 learners aged between 4 and 15 years old which involved standardised assessments. They use the results to contribute to a body of literature highlighting typical errors and misconceptions that learners may demonstrate. They argue that awareness of such errors and misconceptions can contribute to teachers' pedagogical content knowledge; coupled with effective pedagogical strategies, understanding these errors and misconceptions should support teachers in using formative assessment effectively for mathematics. Hence such literature can be used to inform understanding of progression by highlighting typical misconceptions that, if not addressed, may inhibit progress and by signalling useful ways of eliciting and developing understanding to support progress.

Nunes *et al*. (2009) published a comprehensive and thorough synthesis of research literature on how children learn mathematics. Their aim was to identify issues that are fundamental to understanding children's mathematics learning. Their three main questions were:

- What insights must students have in order to understand basic mathematical concepts?
- What are the sources of these insights and how does informal mathematics knowledge relate to school learning of mathematics?
- What understandings must students have in order to build new mathematical ideas using basic concepts?

Nunes *et al*. (2009:3).

The resulting work is a very useful synthesis of research grouped in the following six areas:

- understanding extensive quantities and whole numbers
- understanding rational numbers and intensive quantities
- understanding relations and their graphical representation
- understanding space and its representation in mathematics
- algebraic reasoning
- modelling, problem-solving and integrating concepts.

The first four areas focus on mainly primary mathematics whilst the latter two relate more to secondary mathematics.

Each paper highlights key issues which could be useful for consideration in curriculum design and related progression. Of note, is that many of the recommendations relate to points discussed in the ACME (2011) report, particularly the need for explicit connections to be made between certain concepts and skills. Furthermore, the work signals some concepts which could be considered essential to ensure future progress. The findings also highlight specific themes which relate to longitudinal progress:

- number
- logical reasoning
- implicit models that children may use (which also relates to misconceptions)
- understanding of systems and symbols
- the learning of mathematical modes of enquiry.

These themes, which relate to all the areas considered and link to some of the aspects of progress discussed previously, are therefore key considerations for understanding progression in mathematics.

Denvir and Brown (1986) attempted to develop a framework for describing low attaining students' acquisition of number concepts (from one-to-one correspondence to being able to add or subtract pairs of two-digit numbers). They used the results of diagnostic interviews to inform the framework they developed. They found that some skills formed part of a hierarchy (e.g. a strand relating to 'place value' showed strong hierarchy); in contrast, the acquisition of other skills appeared quite independent and although some skills might appear easier than others they did not appear necessary stages for later understanding. They also found that when they used the framework as a tool to inform diagnostic teaching, the amount of progress (measured through assessment) varied for different learners and was not predictable (i.e. it did not neatly follow pathways outlined and children might 'jump' skills). Whilst this again reinforces the complexity and non-linearity of progress in mathematics, Denvir and Brown emphasised the value of developing and using such research-informed learning frameworks as support for formative and diagnostic teaching sequences. Such work could be considered the start of the development of 'learning trajectories'.

Learning trajectories

Simon (1995) introduced the term 'hypothetical learning trajectory' to describe a predicted pathway along which learning might proceed. The term also reflects such findings as Denvir and Brown's (1986): i.e. that learning can follow 'idiosyncratic, although often similar, paths' (Simon, 1995, p. 135). Over the past two decades, there has been significant research informing the development of learning trajectories within specific mathematical domains, most notably in the United States, the Netherlands, Australia and New Zealand. Stephens and Armanto (2010) suggest that learning trajectories are represented in some countries' textbooks; they analyse Japanese textbooks, concluding that these textbooks show 'carefully chosen examples and a well-developed learning and teaching trajectory' (Stephens and Armanto, 2010, p. 529). As Clements (2011) points out, the word 'curriculum' stems from the Latin word for 'racecourse' and is used to describe a path or course. Thus any curriculum framework or scheme of work could be considered a learning trajectory of

some form. However, in mathematics, learning trajectories are considered research-informed trajectories for specific domains.

Learning trajectories attempt to use research to map 'typical' progression in understanding in a specific domain and their supporters argue that they contribute to teachers' pedagogical content knowledge and can therefore be used for formative assessment and for determining instructional sequences (e.g. Kobrin and Panorkou, 2016). There can be a perceived tension between 'learning trajectories' and 'instructional sequences'. However, most learning trajectories have been designed to inform both learning and teaching; in the Netherlands, the term 'learning-teaching trajectories' is used to ensure that the two are intertwined. The perceived tension should, however, be noted when evaluating a specific trajectory as its value as a framework indicating typical progression in a specific domain and/or its value as a formative teaching tool might need to be considered.

Clements (2011) points out that most trajectories begin with a goal (a 'big' or 'central') idea within mathematics (e.g. multiplicative reasoning) and are considered in relation to research to determine whether there is a 'natural developmental progression' (Clements, 2011, p.366) informed by theoretical and empirical models of children's thinking, learning and development. In summary:

> *'researchers build a cognitive model of students' learning that is sufficiently explicit to describe the processes involved in students' progressive construction of the mathematics described by the goal across several qualitatively distinct structural levels of increasing sophistication, complexity, abstraction, power and generality'* Clements (2011, p. 366)

Hence a learning trajectory matching the description above should not just list everything that learners may need to achieve a particular goal; it should also outline levels of thinking or depth of understanding within the domain (theories related these have been indicated above). As Clements (2011) emphasises, a level of thinking applies *within* a domain and may not apply *across* domains. Clements (2011) argues that such learning trajectories are therefore different to previous attempts to develop sequences of learning which have been based on a top-down approach, reducing adult perceived standards into sub-skills.

A very comprehensive review of learning trajectories and how they could be used in the US has been produced by Daro *et al*. (2011). The review explores the notion of learning trajectories and considers means of using them within curriculum development and for assessment and instruction. It was informed by the work of US researchers, including Douglas Clements (mentioned above) and Julie Sarama, who has worked extensively with Clements to develop learning trajectories for early mathematics learning in domains such as Number Recognition, Counting, Comparing, Ordering and Estimating Numbers and Geometric Measurement. The review provides a useful overview of learning trajectories that have been developed.

Most of the learning trajectories reviewed in Daro *et al*. have been developed for the early years or for domains covered mainly within the primary years. Key gaps identified in the review include topics such as: Algebra, Geometry, Measurement, Ratio and Mathematical Reasoning. However, since the publication of the review, there appears to have been significant work on the mapping of the US Common Core Standards in Mathematics (mathematics standards applicable in all US states) to specific domain learning trajectories.

The GISMO research team in North Carolina State University (headed by Jere Confrey, who contributed to the Daro *et al*. (2011) review) has developed 18 learning trajectories and mapped the

standards up to grade 8 (equivalent to UK year 9). This work appears as an interactive hexagonal map available online and it outlines progress through the standards in specific domains in addition to attempting to show the link between those domains. Of significance is that this work spans the typical age range from 5 to 14. However, this work is also based on the US Common Core Standards in Mathematics (i.e. expected standards for grades) and it could therefore be argued that learning trajectories may have been designed to reflect the standards rather than standards being informed by available learning trajectories. Nevertheless, this is a significant body of work which illustrates how learning trajectories could be used to map progress and connection of ideas in mathematics over a longitudinal period.

As noted previously, learning-teaching trajectories have also been developed in the Netherlands, Australia and New Zealand. The available literature in English on learning-teaching trajectories in the Netherlands seems sparse although it seems these trajectories are a significant part of Dutch mathematics teaching and learning. Van den Heuvel-Panhuizen (2003) links the use of learning-teaching trajectories to the theoretical teaching approach called Realistic Mathematics Education, developed initially by Freudenthal and later in the Freudenthal Institute. This approach to teaching mathematics is underpinned by a belief that mathematics is generated and created from human activity. Of significance is the notion of 'levels of understanding'; learners can initially devise informal solutions to contextual problems, then can use specific schemes and can finally show insight into general principles behind a problem. These levels link to levels of understanding discussed earlier and also suggest that problem solving is integral and implicit within the trajectories. As Van den Heuvel-Panhuizen (2008) reinforces, Dutch learning-teaching trajectories incorporate the notion that a level of understanding is domain specific, which relates to points discussed earlier. The learning-teaching trajectory texts available in English seem to be mainly for the primary years.

In Australia, much of the development of learning trajectories seems to have evolved from analysis of numeracy teaching and learning in the middle years of education (10-13 years). Of note is that learning trajectories in Australia seem to have been developed as tools to support assessment alongside the use of rich assessment tasks. A key researcher in this work, notable because of her prominence in any writing on learning trajectories related to Australia, is Dianne Siemon. Through the development of materials to develop and scaffold numeracy in the middle years of schooling in the state of Victoria, Siemon and colleagues developed a 'learning assessment framework' for multiplicative thinking (Siemon *et al*., 2006) which is, essentially, a learning trajectory for the big idea 'multiplicative thinking'. Siemon has subsequently been involved with other colleagues in the development of trajectories in 'big ideas' in number (Siemon *et al*., 2012). Significant and unusual in this work, is the small number (six) of progressive 'big ideas' in number; this contrasts with other discussions on mathematical 'big ideas' (e.g. Charles, 2005) in which numerous big ideas might be seen as ideas that connect across mathematics in a longitudinal manner.

In Victoria, 'big ideas' for which assessment frameworks (considered as learning trajectories) have been developed are, in progressive order:

- Trusting the Count
- Place Value
- Multiplicative Thinking
- (Multiplicative) Partitioning
- Proportional Reasoning

- Generalising.

Siemon *et al*. (2012, p.24) comment that these ideas are '*very big ideas in Number without which students' progress in mathematics will be severely restricted'*. As Hurst and Hurrell (2014) point out, the work on 'big ideas' by Siemon *et al.* (2012) has a particular strength as it highlights the hierarchical and connected nature of these ideas. Hurst (2015) further argues that a model for a curriculum which uses 'big idea' thinking as a way of organising content could support teachers in planning for connecting content and ensuring development of those ideas over time, thus supporting progress and depth of learning.

Significant work on learning trajectories has also been undertaken in New Zealand. This arguably began with the development of 'The Number Framework'; a construct for promoting part-whole thinking in the early years of schooling (Higgins and Parsons, 2009). The framework reflects the belief that there are increasingly sophisticated ways of thinking mathematically in relation to early number concepts. Of note is the idea that knowledge and strategy are two interdependent components necessary for progress which echoes (although with fewer components) the competence notion of Kilpatrick *et al*. (2001). Higgins and Parsons (2009) argue that application of this number progression framework, alongside the use of a theoretical model of growth of understanding and participation in diagnostic interviews related to the framework, contributed significantly to teachers' professional development.

Since the development of this framework there has been significant work developing learning trajectories called 'Learning Progression Frameworks' from school years 1 to 10 (ages 5-14). For mathematics, the progression framework incorporates eight 'big' aspects:

- additive thinking
- multiplicative thinking
- patterns and relationships
- using symbols and expressions to think mathematically
- geometric thinking
- measurement sense
- statistical investigations
- interpreting statistical and chance situations.

Learning trajectories for each aspect provide stage (not age) illustrations of genuine learners' work and analysis of their response to tasks. These trajectories can be used to identify where a learner may be within each aspect of mathematics and what will be needed to ensure further progress. One point to note is that it is not clear from this current analysis whether any links *between* trajectories is made within the framework.

To conclude, this section has discussed the concept of learning trajectories in mathematics, how they have been developed and what they involve, and has indicated some of the learning trajectory work undertaken internationally. A common feature is the belief that learning trajectories should helpfully outline progress within a specific domain, not simply through accumulation of facts and concepts but through reflecting levels (or depths) of understanding. Developing a learning trajectory needs identification of 'big' areas whether these are related to content/process areas (as in the case of US, Netherlands and New Zealand) or whether these are related to progressive and interdependent areas (as developed in Australia). Both approaches arguably have their advantages

and disadvantages but what seems clear is that the development of learning trajectories can support teachers' understanding of progression within specific domains.

Summary and overall conclusion

- The notion of 'connectedness' and 'depth' or 'level' of understanding is strongly emphasised in literature related to progression in mathematics.
- Progression in mathematics is not a simple linear development.
- The ability to solve problems and reason with ideas and concepts related to specific content is also a key indicator of progress.
- Progress also relates to metacognition and self-efficacy. Such notions have already been identified in the Mathematics and Numeracy Strand 2 report.
- The research work that has been undertaken in relation to children's learning of mathematics could be used to inform understanding of progression and misconceptions in specific domains of mathematics.
- The work undertaken internationally to try to describe and map progression in specific domains through the development of learning trajectories could be useful, particularly as these seem to be underpinned by theoretical frameworks related to children's learning of mathematics and, perhaps more significantly, are also informed by evidence of children's learning.
- However the curriculum is ultimately organised and whatever the 'big ideas', it should be possible to map progression in a way that recognises the complex and multidimensional nature of learning mathematics.
- There is no single correct way of doing this; there is no universal 'truth' in this respect. However, it seems the countries that have developed seemingly coherent and potentially useful progression frameworks for progression have done so in a way that has been informed by research and is underpinned by theory about the way in which children learn mathematics.

Section 4: Conclusions and Framework for Decision Making

Introduction

This section of the report is in four parts.

- Part 1 draws together major themes emerging from evidence analysed in Sections 1 and 2 of the report.
- Part 2 relates key messages to *Successful Futures*.
- Part 3 states fundamental principles which will underpin decisions within each AoLE Group.
- Part 4 provides evidence derived from the review relevant to key questions each AoLE will consider as they take decisions about the development of progression frameworks.

This **research** report is intended to support thinking across and within the AoLE groups as ideas of progression are developed and shared across Wales.

Part 1: Major themes

Progression matters for learning

The crucial function of the curriculum is to identify for each AoLE what matters in order to achieve the overall purposes of the Welsh curriculum, viz., to enable each young person to be

- an ambitious, capable learner, ready to learn throughout life;
- an enterprising, creative contributor, ready to play a full part in life and work;
- an ethical, informed citizen of Wales and the world;
- a healthy, confident individual, ready to lead a fulfilling life as a valued member of society.

Within the curriculum for each AoLE description of progression is important:

- for teachers to have an overview of the curriculum
- for learners to see a bigger picture and relate what they do on a day to day basis to a broader understanding of what matters
- as the basis of decisions about next steps in learning and pedagogy.

The research review suggests that, to achieve these three purposes effectively, descriptions of progression should be structured in terms of learning development such as beginning learner to expert in a domain, rather than in terms of predetermined statements of standards related to age or stage of education.

Descriptions of progression serve two main purposes

The research and national framework reviews suggest that descriptions of progression can usefully be of two broad kinds, interrelated but with the following separate purposes:

- **Broad statements providing an overview of the journey from beginning learner to expert in a domain**.
  - These descriptions summarise succinctly what matters over time within the domain.
  - They can guide teachers' large-scale planning over an extended period of students' education.

  - They can show students and teachers how current work relates to longer term aims and so avoid students seeing their learning as fragmented and with little sense of clear purpose.

- **Detailed description of progression in learning within topics in a given domain**
  - Specifying the knowledge, skills and capacities which students acquire and practise in the process of working towards the learning described in the broad statements.
  - These detailed descriptions should enable the teacher and the learners to identify in assessment for learning dialogue what has been achieved and the next immediate steps to ensure further successful learning.

Evidence emerging from the research and frameworks reviews suggests that different countries have taken different approaches to the presentation of national curricula and assessment arrangements. In Wales, it will be important to consider how best to address both the above purposes in a way that would promote clarity, eg, allowing teachers and learners to have a sense of the overall learning journey using broad descriptors whilst more detailed information on learning related to the overall descriptors is contextualised within professional learning. Such an approach should create clear links between the national framework and local practice, providing an effective basis for

- developing teachers' discussion and deep understanding of learning
- exploring means of responding to the voices of learners and promoting their ownership of learning
- exploring the potential of assessment for learning and pedagogical action to ensure success
- demonstrating ways in which day to day work builds towards achievement of what matters in the AoLE, as defined in succinct broad curriculum descriptors.

Successful curriculum and assessment development is only possible if contextualised in professional learning.

Successful development and enactment of learning progression frameworks developed for Wales will depend on an inextricable relationship between development of curriculum and assessment and professional learning.

Part 2: Relating AoLE Review Findings to *Successful Futures*

The ideas presented in *Successful Futures* form the principles from which curriculum, pedagogy, models of progression and assessment in Wales are to be developed and offer a touchstone against which emerging proposals can continue to be evaluated. These principles serve as touchstones for the CAMAU project processes.

Progression is characterised in *Successful Futures* in terms of increasing achievement in a range of aspects of learning such as: breadth, depth, complexity, level of abstraction, mastery of techniques, sophistication, accomplishment and skill, application, challenge and independence and confidence: this increasing achievement will be evident for both disciplinary knowledge and wider competencies. *Successful Futures* recognises the diverse needs of learners and is clear that the curriculum purposes can be met in a wide variety of ways and allow for wide variations in the experiences of individual children and young people. Each child's learning continuum functions as a journey

through the curriculum; while the road map will be common to all learners, this journey should allow for variety of pace, diversion, repetition, and reflection, as appropriate for each individual to make progress in learning. These aspects of progression are all identified in the six reviews in section 2 as being visible to some extent and at some points in both the findings of research and national policy statements, but the review found no existing national system where all these issues had been fully addressed.

Similarly, learning is defined in *Successful Futures* through the concept of progression, represented as a coherent continuum without separation or interruption. The continuity that the new curriculum places at the centre of learning describes a holistic approach to the development of the individual, including experiential learning that is valuable in and of itself. The characterisation of progression embedded within Successful Futures as the vision for education in Wales is not fully evident in any one country's policy or one theoretical model.

The Curriculum for Wales, therefore, is breaking new ground and will need to bring together multiple forms of evidence, for example, research where it exists as documented in the research reviews, teacher and pupil understandings of progression, samples of pupil work that show progression, and insights from other national frameworks, in order to create bespoke progression frameworks for each AoLE tailored to the needs of young people in Wales.

By revisiting the elements of the *Successful Futures* vision for progression outlined in section 1 of this report we can summarise relevant findings of the six reports in section 2 (see *Table 15*). Each of the 12 points summarised in this table may help inform decision-making within each AoLE group as well as across the system.

Table 15

	Element of the vision for progression embedded within *Successful Futures*	Summary comment from section 2 reviews
1.	Phases and key stages should be removed in order that progression can be continuous, increasing the potential for higher attainment by minimising transitions.	Evidence from research considered in some reviews supports this principle: if progression steps represent significant aspects of learning, then reference to specific ages/stages/phases is at least difficult, and maybe inappropriate. There exist some frameworks which do not prescribe attainment by age or grade.

	Element of the vision for progression embedded within *Successful Futures*	Summary comment from section 2 reviews
2.	Progression in each Area of Learning and Experience should be based on a well-grounded, nationally described continuum of learning that flows from when a child enters education through to the end of statutory schooling at 16 and beyond.	Reviews report that some progression frameworks run through the whole of a child's learning while others are specific to particular stages (e.g. primary, early secondary). The latter may be marked by discontinuity. Some research reviewed considered the whole continuum; other research reviewed investigated progression in the shorter term. The latter may inform the former.
3.	Learning should be an expedition, with stops, detours and spurts rather than a straight line. Progression is a 'road map' for each and every child/young person's progress in learning though some children and young people will progress further and/or faster than others.	Although some countries do outline tightly prescribed linear progression, there is considerable evidence from research that non-linear progression (sometimes 'spiral') is either to be expected or is necessary. This is recognised in some policies. The question of moving forwards and backwards in learning is raised in some reviews, as is the notion that there may be multiple paths of progression that different children may take.
4.	Progression Steps will be described at five points in the learning continuum, relating broadly to expectations at ages 5, 8, 11, 14 and 16 (staging points for reference rather than universal expectations – but expectations should be high for all learners).	Research considered in some reviews questions the value of progression steps which represent significant aspects of learning referring to specific ages/stages/phases as at least difficult, and perhaps inappropriate.
5.	Progression Steps are made up of a number of achievement outcomes linked to what matters in the curriculum and linked to the four purposes ('I can' statements). Literacy, numeracy, digital competence and wider skills should be embedded as well as elements of the Cwricwlwm Cymreig.	The reviews provide evidence on the nature of 'achievement outcomes'. Some progression frameworks contain many statements of achievement, an approach which presents both practical and educational difficulties: difficult to manage and detailed prescription is unlikely to be consistent with flexibility in individuals' learning. Very broadly stated outcomes may be open to a breadth of interpretation and be perceived by teachers as unsupportive. First person learner statements are uncommon.

	Element of the vision for progression embedded within *Successful Futures*	Summary comment from section 2 reviews
6.	Achievement Outcomes should not be a checklist of knowledge or skills and should incorporate effective pedagogy.	The reviews provide accounts of research evidence which points up the potential disadvantages of this 'checklist' approach. While some countries do adopt this 'checklist' approach there exist in at least some curricular areas in some countries models of progression which avoid this approach.
7.	Achievement outcomes should inform next steps and be framed as broad expectations achievable over a period of time (approximately 3 years).	While a number of countries monitored progression across periods of time longer than a year, there was less clarity about how achievement outcomes might explicitly inform next stages in learning.
8.	Achievement Outcomes should use 'I can', 'I have' (and 'I am ready to') statements to describe progression (not over specified or overly vague – this may vary across AoLEs).	The reviews found that use of first person statements is rare in the countries examined. Typically, third person statements referred to the past 'The learner will have developed…' or present 'The learner is able to…'. There seem few statements that could be equated with 'I am ready to…'
9.	Assessment (relevant and proportionate) should be focused on learning intentions and progression in relation to the four curriculum purposes and based upon the intentions set out in the Achievement Outcomes at each Progression Step within each Area of Learning and Experience.	There was some evidence that tensions could arise from seeking to incorporate within achievement outcomes both learning directly related to the discipline and evidence related to broader statements of learning such as the four purposes.
10.	In each AoLE the Achievement Outcomes at each Progression Step will need to encapsulate the most important aspects of learning, take account of the ways in which children progress in different kinds of learning and recognise what they need to be able to know and do to move securely to the next stage.	This issue is noted in some of the reviews: some progression frameworks reviewed would seem to be inconsistent with aspects of this aim, those which have many statements of achievement for example. In many countries statements of standards (or similar) focused on attainment to date and made little reference to next stages of learning.

	Element of the vision for progression embedded within *Successful Futures*	Summary comment from section 2 reviews
11.	Professional judgement is central to assessment (formative assessment with relevant summative information collected and used formatively within classrooms and schools).	The research and policy reviews undertaken here found less evidence for the use of assessment to inform school evaluation than for its use to inform learning.
12.	Schools should use teacher assessment of progression systematically, together with other sources of evidence, to inform their self-evaluation for school improvement purposes.	The reviews found less evidence for the use of assessment to inform school evaluation than the use of assessment to inform learning. This applies both to research and policy reviews.

Part 3: Principles

Building from the evidence emerging from the review of national frameworks and the research literature, a number of principles emerged that might be used to take forward the progression aspirations of Successful Futures.

Principle 1

The four purposes should inform and be evident in learning progression frameworks and achievement outcomes.

The six reviews in Section Two recognise that each AoLE has specific characteristics, reflected in both research and existing national frameworks. It will be important that learning progression frameworks in Wales recognise these characteristics. In some of the frameworks reviewed, the 'main aims' of the curriculum are articulated at the start and then elaborated in detail in a description of the curriculum or in a description of learners' expected achievement (e.g. learning or achievement outcomes, standards, descriptions of progression) or in descriptions of both. A learning progression framework, the progression steps within it and associated achievement outcomes must reflect or encapsulate what the designers of the curriculum most value in the process of educating young people**.**

Principle 2

Progression frameworks must relate to what matters

Each progression framework should focus on the knowledge, skills and attributes which have been identified within each AoLE as the heart of successful learning in each domain and must encompass the four purposes of the curriculum.

Principle 3

Learning progression frameworks will place the development of learning at their heart rather than focusing on content or activities.

In the past insufficient attention has been paid to progression in learning with negative consequences for learners and teachers who perceive learning as fragmented and with little sense of

clear purpose. This leads to problems with practice in Assessment for Learning where understandings of where a learner is and where a learner might next progress to are commonly not linked into a bigger picture of what matters. Reviews emphasised the interdependency among pedagogic approaches, content and assessment in how progression is described.

Achievement outcomes at each progression step should encapsulate the most important aspects of learning, take account of the ways in which children progress in different kinds of learning and recognise what they need to be able to know and do to move securely to the next phase of learning in that framework.

Principle 4

Progression frameworks should serve two main purposes: broad statements and detailed descriptions

Each AoLE will develop broad statements to provide an overview of the learning journey over time and more detailed statements related to individual topics, themes or other aspects of learning. A little like Russian nesting dolls, the more detailed progression statements should be linked clearly to the broad progression statements and the broad statements should be derived from what AoLEs have identified as what matters.

Principle 5

National progression frameworks should enable and support schools to develop curriculum and assessment practices to suit local circumstances

It is important that broad progression statements are written in a way that allow schools to have the flexibility to ensure that they can relate the curriculum to local circumstances as they maintain high levels of challenge for all learners.

Principle 6

Successful curriculum and progression development requires professional learning

It is important that professional learning builds on available evidence: this involves bringing together research understandings with practice insights in the emerging policy context of Successful Futures. Professional learning will stimulate and support teachers to recognise, build on and develop their pedagogical insights and practice. There are opportunities for professional learning to be built around the development of the national programme rather than simply learning about the national programme. For example, the evidence base to build more detailed progression statements does not exist in all areas. One function of the professional learning programme should involve groups of teachers working together to help build a better evidence base whilst learning about the new curriculum and assessment arrangements.

Principle 7

Where possible progression frameworks should be informed by research evidence

Consistent with the policy aspiration of Successful Futures achievement outcomes should describe significant progression steps within a learning progression framework. Achievement outcomes should not be a checklist of knowledge or skills and should incorporate effective pedagogy; they should inform next steps and be framed as broad expectations achievable over a period of time (approximately 3 years).

Part 4: Evidence derived from the review which may help to inform decisions to be taken within each AoLE Group

Here, questions arising from the review related to the principles identified above were identified. These were offered as a stimulus for thinking within and across AoLEs as they made proposals to the Coherence Group on how progression frameworks might best be developed.

1. What are key features of research-informed progression?

Each of the AoLE reports refers to and supports Heritage's (2008) argument noted in section 1 that

> *'By its very nature, learning involves progression. To assist in its emergence, teachers need to understand the pathways along which students are expected to progress. These pathways or progressions ground both instruction and assessment. Yet, despite a plethora of standards and curricula, many teachers are unclear about how learning progresses in specific domains. This is an undesirable situation for teaching and learning, and one that particularly affects teachers' ability to engage in formative assessment.'* (p.2)

Common conceptual features of progression frameworks were summarised in Section 1. Heritage (2008) argues that all models of progression conceptualise progression as a continuum of increasing sophistication of understanding and skills as young people move from 'novice to expert'. This concept is explicit in some of the national frameworks and may underpin others; however, there is a range of understandings of the nature of development from novice to expert. Some learning progression frameworks adopt a developmental view, inviting teachers to conceptualise learning as a process of increasing sophistication rather than as new bodies of content to be covered within specific grade levels; others detail content or very specific skills to be developed at each stage. It seems that approaches may vary from AoLE to AoLE: whether this is the result of different epistemological models or of tradition is unclear. No definition of learning progression contains references to grade or age level expectations, in contrast to many standards and curriculum models as learning is conceived as a sequence or continuum of increasing expertise.

Implicit in progression is the notion of continuity and coherence. Learning is not seen as a series of discrete events, but rather as a trajectory of development that connects knowledge, concepts and skills within a domain. Issues related to interconnection of knowledge, concepts and skills across a domain – or domains – are considered in the individual AoLE reviews; these demonstrate differences between AoLEs, some associated with the range and fit of the domains within each AoLE, some associated with differing balances among knowledge, skills and dispositions. Learning progressions are accommodating. They recognise that, commonly, learners do not move forward at the same rate or with the same degree of depth and progression. This issue was consistently acknowledged in each of the AoLE reviews. A number of existing frameworks do not appear to allow learners to move forward at different rates.

Learning progressions enable teachers to focus on important learning goals, paying attention to what a learner would learn rather than what a learner would do (the learning activity). The learning goal is identified first and teaching, pedagogy and assessment are directed towards that goal. 'Consequently, the all too common practice of learning being activity driven rather than driven by the learning goal is avoided.' (Heritage 2008 p.5). Clear connections between what comes before and after a point in the progression offer teachers a better opportunity to use assessment to

calibrate their teaching, to address misunderstandings or to develop skills, and to determine what would be important next steps to move the student forward from that point.

2. Who might key audience(s) be for Learning Progressions?

Learning progression frameworks provide teachers with an overview of the curriculum and provide learners with a bigger picture which allows them to relate what they do on a day-to-day basis to a broader understanding of what matters. The AoLE reviews set out the intentions for the articulation of progression and achievement that can be summarised as follows:

> Achievement Outcomes and any associated description of learning progression should enable teachers to know what kinds of knowledge, skills and aptitudes they should aim to develop with learners at all stages of their learning journey. Achievement Outcomes should enable both teachers and learners to see the next steps to be taken.

The purpose, scope and structure of the progression frameworks within and across AoLEs will need to be clear to those who will use them prior to developing their content.

As noted in Section 1, Black *et al* (2011) make a strong case for the centrality of teacher assessment. This is well supported in the reviewed literature and international models where the potential for rich evidence of progression and better standards of validity and reliability than national or state tests are noted. However, each AoLE review highlights that, as Black *et al* (20011:106) suggest, attaining a position where teacher assessment fulfils this promise may require significant professional development. Lambert (2011) also raises the issue that the actual understanding (and perhaps even the actual relevance) of level descriptors is often questionable. Lambert cites the difficulties that teachers have in identifying work to exemplify certain levels, implying an uncertainty about what constitutes a level (and therefore arguably progression).

Heritage (2008) reminds us that many learning progressions are written primarily for teachers and tensions can arise if a single learning progression attempts to serve too many purposes. For example, problems can arise if it is assumed that the same degree of granularity (level of detail) will serve both long term planning and assessment to support immediate next steps. The degree of granularity in a learning progression designed to ensure that teachers have an overview of progress from novice to expert is very different from the degree of granularity necessary to enable teachers to support learning formatively: the latter would require a far more detailed analysis of progress in learning.

Learning progressions can also be written in ways which provide a framework for learners to understand their own learning journeys. Such models were not explicitly noted in the AoLE review reports. Heritage (2008) argues for the importance of learners being aware of longer term goals and the relationship between those and their day to day progress. Increased involvement in learning occurs when teachers share with the students what their longer-term goals are and enable them to participate in evaluating the degree to which they have met the goals.

3. How detailed should the descriptions be? (described in research literature as 'granularity')

There are different understandings about what is meant by progression in learning. It is important to make a clear distinction between learning progression as providing an overview of the long journey from emerging to expert in a domain and as detailed insight into the expectations of immediate progression in learning within a topic in a given domain. Both are necessary and inter-related but

different in their purpose, scope and level of detail. Both should help teachers and learners to see, and indeed to develop habitual awareness of, the appropriate next steps, as dialogue and assessment for learning take place during the learning process. Heritage (2008:2) suggests that greater attention should be paid to the different levels of specificity used to articulate the curriculum. Some curricula specify detailed objectives to be mastered at each grade in sequence. When the curriculum is described in this level of detail, 'grain size', it may be difficult to see how these many discrete objectives connect to bigger, organising concepts; learning can become little more than a checklist of things to be learned. Curricula organised around core concepts or 'big ideas' and sub-concepts offer better opportunities for a stronger relationship between formative assessment and learning goals. However, Heritage (ibid) argues that care also needs to be taken with this approach for too often 'big ideas' are not brought together as a coherent vision for the progressive acquisition of concepts and skills. Without a coherent vision the potential for teachers to have a broad overview of learning in a specific domain is restricted.

The AoLE reviews include some detail about specific models for progression which teachers may employ; these may be domain-specific or applicable more generally.

All of this implies the need for consideration not only of the determination of the central aspects of achievement in the AoLE but also of the appropriate (that is, helpful and manageable) levels of specification of description of achievement. If the central aspects are described in 'lean' statements, then it will be necessary to consider the most appropriate format: e.g. succinct broad statements, possibly with a small amount of expansion; or narrative descriptions. It will also be necessary consider where more detailed guidance and support for teachers about progression, next steps and pedagogy should be located and how this could be used? If descriptions of achievement are detailed, it will be necessary to consider how these can be used effectively to support assessment for learning and progression, given the issues about manageability which have been raised.

There is evidence from several countries reviewed that exemplification of standards through learner work significantly reduces the level of abstraction. Descriptive statements alone do not always make clear what performance/behaviours at a given level would look like in a classroom and this is a potentially powerful way of addressing this issue. The use of such material to inform professional learning requires consideration. Several of the reviews raise the issue of the most appropriate location of detailed guidance for teachers about progression, next steps and pedagogy: within the curricular/progression framework itself or in associated material available to teachers as part of their continuing professional development? Related to this is the question of how such material can be most effectively used to support professional learning.

4. Steps in a learning journey?

The issue of relating learning progression frameworks to ages, stages or even phases has already been referred to. Research argues that this should not be the case on both fundamental and instrumental grounds. As the groups develop an empirically well-founded learning progression framework where achievement outcomes describe learning necessary to make further progression, how will they address the issue of descriptions of achievement which are related to phases?

The reviews of international frameworks demonstrate how some frameworks seek to differentiate the performance of learners' who are at the same chronological or grade stage by using a grading system or mark. This may take the form of such phrases as *Not Yet Within Expectations*, *Meets*

Expectations (minimally), *Fully Meets Expectations* and *Exceeds Expectations* or a mark such as: *1 = limited effectiveness, 2 = some effectiveness, 3 = considerable effectiveness* and *4 = a high degree of effectiveness or thorough effectiveness*. This matter may be related to the level of specification or the number of stages of development employed in a framework. A possible justification for the kinds of grading or marks systems shown may be that very broadly defined frameworks do not give teachers and learners enough detail in deciding on next steps in learning. An obvious potential disadvantage is the danger of labelling learners and the associated motivational issues. Such grading approaches are usually linked to statements of standards which themselves may be linked to age and stage; there is powerful evidence that such approaches divert teacher and learner attention away from learning to simplistic models of attainment.

The reviews demonstrate that existing frameworks can provide ungraded descriptions of complex achievement and interacting skills. These may be supported by desirable guidance and support for pedagogy and assessment for learning through additional associated material and by encouraging continuing professional development activities.

5. How might the progression frameworks relate to previous frameworks?

During the process of review it was noted that the former National Curriculum in Wales and the Literacy and Numeracy Frameworks used progression frameworks which took some account of pupils' varying pace of progress. This raises the prospect that there may be some value in looking at earlier local models of curriculum and learning progression in the writing of new achievement outcomes. However, it was also noted that practice must align with the new intentions for the curriculum in Wales: in particular, the requirements to address the four purposes; the fundamental importance to learning of ensuring that curriculum, pedagogy and assessment are coherent and aligned; and the need to move from backward focused statements of standards to forward focused statements of achievement. This has implications for the development of learning progression frameworks which support effective learning.

While considering descriptions of performance it is worth noting the Review of the National Curriculum in England (2010-2014) was highly critical of the previous levels-based system. In this context, best-fit judgement failed to recognise major gaps in children's knowledge and contributed to superficial coverage of the curriculum because the levels-based system encouraged learners to move on to new content without secure grasp of key areas.

6. Relationship with literacy, numeracy and digital competence frameworks?

The Languages, Literacy and Communication review notes that *Successful Futures* explicitly states that the achievement outcomes and progression framework for Languages, Literacy and Communication should take appropriate account of the national Literacy Framework. There are therefore important decisions to take about how the development of the Languages, Literacy and Communication learning progression framework may relate to the Literacy Framework. Parallel issues will apply in the articulation of progression for numeracy with Mathematics and Numeracy and for digital competency and the computing aspect of Science and Technology. All AoLE groups will wish to consider how achievement in these three frameworks and in other cross-curricular aspects may be reflected in their learning progression frameworks.

7. What view do we have of the developing child and young person?

The place of child development within the domain and associated expectation for progression in learning is raised in several reviews. Pellegrino (2017) suggests that although learning progressions are not developmentally inevitable, they may be developmentally constrained. This issue was noted in some AoLE reviews and was of particular importance for the H&WB AoLE review. It may be that this issue is more broadly applicable, especially in the earliest years of learning. When considering progression (e.g. in H&WB), links have been made to research in child development. While child development differs from progression in learning within a domain, developmental stages are closely tied to achievement within H&WB: a young child typically cannot run, regulate emotions, navigate social situations or demonstrate self-control as well as an older child. Teachers may draw on knowledge of child development to understand what typical development looks like within the physical, mental, and social domains, identify when pupils seem to be developing atypically and provide support to maintain the progress of all learners. Progress in domain-related learning relates to developing metacognition and self-efficacy; this observation underlines that there is a complex relationship between children's progress in the H&WB and their progression in other AoLEs.

While it is argued that research undertaken on cognition and learning has led to the emergence of highly developed descriptions of progression in particular curricular areas, specifically science, reading and mathematics (Pellegrino 2017), the evidence from several of the AoLE reviews is that this is often at a micro or detailed level (e.g. one topic) rather than over a longer time scale. Learning progressions can be developed through tracking the actual development of thinking/learning during a sequence of learning or topic. The premise of these 'learning progressions' is that they allow the teacher to understand the ways in which learners progress in their thinking or skill development in order to track progress. This approach would seem to have the potential to produce evidence based learning progressions which would act as a usable version of level descriptors and would support a genuinely formative process of checking current attainment against a known progression and the setting of targets for improvement. However, it should be noted that such progressions are extremely complex (taking 2-3 years to produce) and that a large number of these may be needed in order to cover 'big ideas' within any curriculum area.

Children and young people are beings not becomings. The four purposes describe what all children and young people should become and achieve through statutory education as well as how they are perceived and positioned to experience the curriculum. *Successful Futures* (p.22) argues that:

> *'statements of curriculum purpose need to be formulated carefully so that they have integrity, are clear and direct and become central to subsequent engagement and development; in that way they can* ***shape the curriculum and suffuse practice*** [authors' emphasis]*. Common understanding of why we are doing what we are doing is a powerful starting point from which to determine what it is we need to do and how we are going to do it'.*

Recommendation 2 (p.23) states:

> *'The school curriculum should be designed to help all children and young people to develop in relation to clear and agreed purposes. The purposes should be constructed so that they can directly influence decisions about curriculum, pedagogy and assessment'.*

The purposes therefore tell us about how children should experience their curriculum day to day. Each child's learning continuum functions as a journey through the curriculum; while the road map will be common to all learners, this journey should allow for variety of pace, diversion, repetition, and reflection, as appropriate for each individual to make progress in learning. There is therefore a greater responsibility for schools and teachers to ensure that learning is child-centred, since the details and pace of each journey are set according to the requirements of the learner, always in order to ensure challenging, sustainable and effective learning takes place.

As children and young people move through the education system in Wales they must not be viewed as *aiming towards* the four purposes, but rather must be seen *as living the four purposes* during their time at school – the purposes, then, are not simply goals to be reached at the age of 16, but are also descriptions that inform how we 'position' children throughout their education in schools in Wales.

8. What view do we have of pedagogy?

The notion of 'child-centred' learning and children 'working at their own pace' can imply a pedagogic role that is facilitatory; that is, the role of the teacher is to facilitate the child or young person to lead their own learning or set the pace and/or direction of this learning; the teacher does not take a pro-active role in progressing this learning. It is suggested here that such a view of pedagogy in the new curriculum will be unhelpful. Wales has experience of significant curricular innovation in the shape of the Foundation Phase, introduced in 2008. Recent evaluations (Siraj 2014; Welsh Government 2015) have indicated that poorly understood models of appropriate pedagogy hampered the success of the innovation that, where effectively implemented, has had positive impact on learner outcomes.

Successful Futures provides clear guidance on what is meant by appropriate pedagogy:

> *Pedagogy is about more than 'teaching' in the narrow sense of methods used in the classroom. It represents the considered selection of those methods in light of the purposes of the curriculum and the needs and developmental stage of the children and young people.*

Teachers will draw on a wide repertoire of teaching and learning approaches in order to ensure that the four purposes are being fully addressed and that all learners are engaged and the needs of individual learners are recognised. Teachers will avoid labelling teaching approaches; rather they will consider their appropriateness in terms of purpose. Approaches will encourage collaboration, independence, responsibility, creativity and problem solving in authentic contexts which will draw on firm foundations of knowledge. Approaches will employ assessment for learning principles and make use of scaffolding, modelling and rehearsal.

In order to enact the vision set out in Successful Futures it may be helpful to signal *intentional pedagogic approaches* throughout. That is, the teacher, with the support of appropriately articulated progression frameworks, undertakes to work intentionally with each learner in the direction of progress and to maintain a focus on pace and ambition throughout this process. AoLE groups will wish to consider how this approach may be facilitated by the learning progression frameworks which they develop.

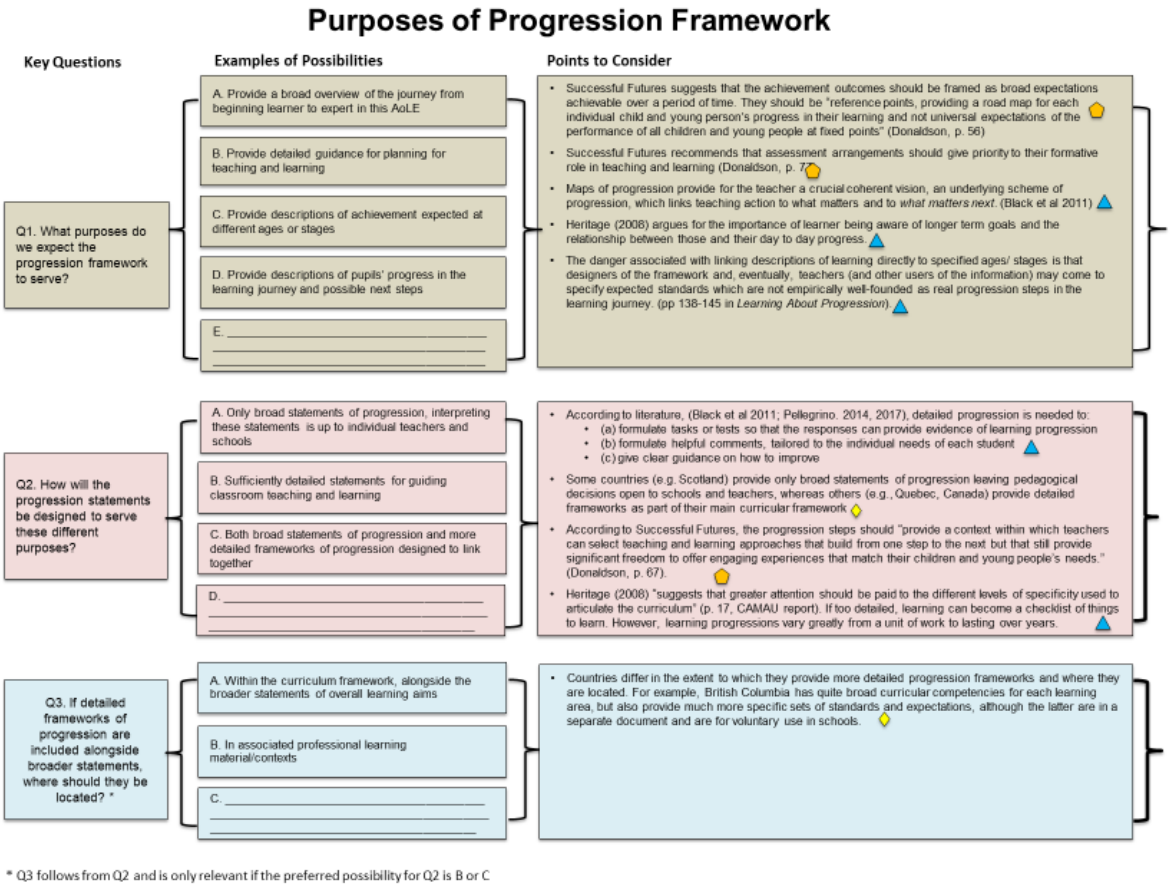
In conclusion

This research report, following the first seven months of work of the CAMAU project, is offered to the education community of Wales and, specifically, to the Pioneer Networks in the spirit of subsidiarity as set out in Successful Futures. The report reviewed evidence from a range of national curriculum and assessment frameworks and evidence from research on progression both as it relates to curriculum and assessment and in the context of the six Areas of Learning Experience. In this final section key ideas emerging from the various evidence sources were used to develop principles. These principles may be used in a number of ways, eg, as a touchstone to check that as ideas develop they remain consistent with original aspirations. Analysis of the evidence pointed to a number of possible alternatives approaches to the design and development of progression frameworks. To remain consistent with the concept of subsidiarity, these alternatives were offered as decisions to be taken. Each decision was structured around questions to be addressed, each supported by available evidence to promote better informed decision making. Each AoLE considered carefully the evidence available and made proposals to the Coherence Group. In the majority of cases it was possible for groups to agree a single proposal, however, in a small number of cases, two alternative proposals as to how a particular issue should be addressed were submitted from the same group. An example of a decision tree can be found in *Figure* 13 below. Further examples of decision trees from different AoLEs are provided in Appendix 3.

The decision tree approach was very well received by AoLE members and the proposals submitted to the Coherence Group provided them with a strong evidence base from across AoLEs to allow collective, well informed decisions to be taken.

The next and final CAMAU research report will begin by examining the agreed progression framework and will consider the development and enactment of its principles as they begin to emerge in practice.

Figure 13: Decision Tree



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Appendix 1

CAMAU Project

International Policy Review Guidelines

STEP 1: Notes on progression for the country

Name of Country:

Year the curriculum was written/published/updated:

Website(s) where materials were found:

How is the curriculum structured? E.g., Is there a curriculum document as well as achievement outcomes or are these combined? Are there supporting materials for teachers? Is there one curriculum across all ages or is it split into primary and secondary?

How many stages/levels/benchmarks are included? Are they aligned with specific years?

What components/subjects/themes related to the AoLE are covered in this country's curriculum? What seems to be missing?

How does the documentation define 'what matters' in this AoLE? Does this include content knowledge, competencies, skills, etc? What is the balance between knowledge and understanding, skills, attributes, and capabilities?

How is progression defined? Is it defined explicitly or implicitly? You may need to look outwith the statements themselves at the supporting documentation and introductions to the curriculum. Give some specific quotes or examples.

Are key progression points identified as expected standards for specified ages? Or as descriptions of knowledge, skills, capabilities needed for further progression in learning? Or is it some combination?

What form do statements of progression take? Are they detailed or broad? Are they in pupil-first language or written for the teacher? Provide some examples.

To what extent does the curriculum for this AoLE seem to align with what is written in Successful Futures? Does it seem to align with Donaldson's vision for progression? Give some examples.

Is there anything else worth noting? E.g., Is there anything particularly unique, innovative, or useful about this curriculum? Are there any aspects of the AoLE that are included in cross-curricular aims? Was there anything within this portion of the curriculum that seems to have connections with any other AoLE?

STEP 2: Summary Statement

Please write a summary of how this country has tried to describe or incorporate progression into their curriculum for the AoLE. Please include your own evaluation in terms of its potential advantages and disadvantages as an example of incorporating progression for this AoLE. This summary should be less than a page (less than 500 words) but can of course be shorter or longer as needed, and should complement the notes you have taken above.

STEP 3: Collating Across Countries

We will combine the information you have provided for each country into one document and write an overall summary statement comparing across the countries. We will then send this final document out for your feedback to make sure your country is represented appropriately and to seek your insight on

Appendix 2

Guidelines for H&WB Literature Review

Aim:

To describe what published evidence exists that might inform our understanding of how pupils progress within the domain of health & wellbeing

Scope:

Successful Futures defines the scope of this AoLE as: "This Area of Learning and Experience draws on subjects and themes from PE, mental, physical and emotional well-being, sex and relationships, parenting, healthy eating and cooking, substance misuse, work-related learning and experience, and learning for life. It is also concerned with how the school environment supports children and young people's social, emotional, spiritual and physical health and well-being through, for example, its climate and relationships, the food it provides, its joint working with other relevant services such as health and social work, and the access it provides to physical activity."(Successful Futures, p. 45). Our review, in line with Successful Futures, will aim to cover these core areas of the field. In accordance with the health and wellbeing report that the AoLE presented in June 2017, we will also include a brief overview of character education, which is somewhat aligned with the competencies that the teachers deem important: readiness, reflectiveness, resilience, respectfulness, resourcefulness and responsibility.

Thus our review will examine what evidence exists on progression in pupils' learning related to the following themes:

- physical education, physical literacy, physical wellbeing (Nanna)
- mental wellbeing and mental health (Sarah Stewart)
- healthy relationships, peer relations, sex, and parenting (George Wardle)
- nutrition, including healthy eating and cooking (Kara)
- substance misuse, abuse, and personal safety (Sue James)
- work-related learning and learning for life (Rachel Bendall)
- character education (Kara)

Stage 1: Finding Literature:

It is important to by systematic in the steps that we take so that we can communicate to others how we conducted our review so that it can be evaluated by others, be replicated if desired, and also to allow for consistency across the members of the group. In order to do this, we should follow the following guidelines:

1) Independent search with keywords: It is recommended that we use Ebscohost or a similar academic database and keep track of the keywords that we have used to search for literature. Certainly we should search for "progression" but be aware that it may not be a word that is commonly used so additionally we may look for similar keywords such as "child development" or "developing" + various keywords for the topic we are exploring. When looking through results, we can scan the title and abstracts to decide what may be relevant, and we should keep a running list of the sources that we plan to review. If a source sounds particularly relevant but one of our Universities do not have access we can use interlibrary loan to try to obtain the relevant source.
2) Expanded search: The next set of searches will involve exploring the work and authors that are cited within the original sources we have found. For example, one paper (such as the article by Margaret

Heritage) may cite very useful literature that we can then follow up with, or we may start to recognize some names of authors who are experts in our area and can do an author search within Ebscohost to explore their work. Again, we should keep track of the process we have used and keep a running list of the sources we plan to review.

3) Advice from Professors: We will ask our professorial consultants to also recommend papers or authors that would be relevant for our purposes.
4) Collegiate advice: If we come across something that may be relevant, share with one another. If we have a colleague who studies this topic, ask them. Keep track of which sources were recommended in this manner.

During this phase it is important to consider screening and excluding any papers that seem less useful. We may want to keep a list of all the papers we have considered and the ones we end up using for the review. Given our short time frame, the important thing is that we read enough core pieces in the area in order to begin describing with some confidence what is known in this area of progression.

Stage 2: Analysis for the Review:

Our literature review should be a synthesizing statement about the broader literature within a particular area that answers some critical questions related to progression (rather than just a summary of individual articles). It should be clear that this is an informed perspective and evaluation of the field, citing relevant sources for each point that we are making. When it is helpful we can use quotes and specific examples from the literature, or to create tables to help make points of comparisons or contrasts.

Next, using the papers that are relevant, we will want to report/describe substantial elements from the papers, consider the extent to which they inform our work of progression, note similarities/differences across the papers, and at the highest level, consider the sources themselves and their relevancy.

When reviewing the articles, we may wish to consider the following questions:

- What evidence exists that informs our understanding of progression in this domain?
- In what ways have researchers described how children develop their knowledge/skills/capacities in this area? In other words, how do they model progression? For example:
    - According to the literature, are the changes that children make qualitative jumps (with big steps at key moments) or more gradual sophistication (children seen to gradually add more of the same skills over time)?
    - Is progression linear or could children move backwards and forwards?
    - Do the researchers see children's progression as something that can be impacted on by the environment and open to change, or is it fixed?
    - Is there one path that children seem to take in this area, or are there multiple paths? Do the researchers acknowledge that children may have different paths based on the context in which they grow up/learn?
    - Are there different models of progression for the same topic and to what extent do they overlap, complement, or conflict?
- To what extent does the literature focus on how children develop in terms of their knowledge/understandings vs. behaviours/skills?
- To what extent is the progression that is described at a micro-level (for one lesson/unit) or at a macro-level (across multiple years)?
- What ages are covered when describing how pupils learn in this area? Which ages seem to be missing or receive less adequate attention?
- What is the theoretical background of the relevant literature (e.g., education, public health, psychology, etc.)? We may get some insight by looking at the journal it is published in as well.

- Importantly, what seems to be missing in this area? What do we still not know? Is there not a lot of research on this topic?
- To what extent could the research in this area help to inform models of progression that could be useful for teachers and for learners?
- What can we use from this literature for our purposes of writing a framework of how children progress in this area?

This literature review will serve two purposes. 1) to inform teachers about what is known in the literature that may inform their understanding of progression in this area, 2) to be a systematic review that would be appropriate for journal publication.

Stage 3: Writing the Review:

What will the overall review look like? Proposed outline for the literature review:

A. Introduction with description of H&WB for Wales based on Successful Futures
B. Literature reviews for each of the sub-areas we propose to examine
C. Overall summary comparing and contrasting literature across areas as well, as well as evaluation of the scope and depth of literature on progression in the H&WB area, and unanswered questions
D. Implications and issues, based on the literature, for creating assessment frameworks of progression in H&WB

How long should the review be? The overall review for our AoLE will likely be approximately 6-10 pages but could be up to twice as long if we happen to find a lot of relevant literature. That means approximately 1-2 full page per sub-area (about 500-1000 words if using Arial 12pt single spaced), with an understanding that some will be longer and others will be shorter depending upon what is or is not available.

Most of the work is done before writing, through coming up with a list of relevant sources, reading the literature, taking notes, and reflection and synthesis. Our point is not to be comprehensive but to read enough core pieces in each area in order to begin describing with some level of confidence what is known in this area. What we end up writing is a concise critique and summary of the literature in this area. Readers can refer to our cited sources if they want to learn more.

How many sources should I read? Again this depends strongly on each of our topics and what is available in the literature. We may be making several points that need to be justified by sources but the sources are only peripherally related to the main topic in which case we could have dozens that we are drawing upon for each part of the review. Or we may find just 3 or 4 highly relevant sources that cover the topic in great depth that we are focusing on and deem this to be sufficient for the sub-area.

Appendix 3

Mathematics & Numeracy: Points in the Journey

Points in the Journey

	Possibilities	*Points to Think About*
Q1. How do you identify beginning and end points in the journey?	A. Beginning point - The skills/ understandings/ dispositions/ experiences young pupils bring to the classroom B. End point - What a Welsh citizen should know/be able to do within the AoLE C. End point – Requirements for transition into different phases of the education system, e.g., higher education, vocational education D. Beginning point Pupils assessed for their starting point using formative assessment and taken forward from the point they are at.	Points to consider for identifying the journey starting point • According to Successful Future (p. 53), 'Initial Progression Steps should take full account of guidance on Routes for Learning' • Black et al. (2011) suggests that you "start from a learner's existing understanding' • Not all young pupils enter the classroom with the same experiences, meaning some flexibility may be required • _____ Points to consider for identifying the journey end point • Elective/non-core subjects in some countries mean pupils leave the system with different types of specialised knowledge • Identifying an end point as a minimal competency/skill/understanding may not allow all students to see the next step for reaching for their full potential, especially if they reach the highest progression at a young age • According to Successful Futures (p. 54), the curriculum should enable most children and young people to reach, or go beyond, each Progression Step • _____
Q2. Do different parts of the journey start at different points?	A. No, all skills, understandings, and/or competencies are represented at every step in the progression framework B. Yes, some skills, understandings, and/or competencies may begin at later points in the journey or end at earlier points in the journey C. _____	• Students can increase in knowledge/skills at any point in their learning experience and even young children can develop skills or have experiences that set the basis for future learning • Similar to Option B, some country's curricular frameworks (e.g., Quebec) that were reviewed do not introduce certain skills/understandings until later points in the journey and/or do not continue them through the full progression framework • Other countries that were reviewed repeat the same skill/understanding at multiple steps in order to represent that learning is happening over a longer period of time • _____ • _____
Q3. How do you break up the journey in ways that make the best sense for learning, e.g., number of progression points?	A. Five points in the learning continuum, relating broadly to expectations at ages 5, 8, 11, 14 and 16 (staging points for reference rather than universal expectations) B. The number of points may differ across learning depending upon the number of conceptual shifts that mark sophistication/development in the learning journey C. Descriptions of learning linked to each grade level, similar to standards D. Descriptions of learning needed to move into different phases of education, e.g., primary, secondary, subject choice E. _____	• Successful Future recommends Option A (see p. 53). There are also five progression points in the learning continuum in Scotland • Research on progression appears to align more closely with Option B, in the sense that many of the progression frameworks that were reviewed across AoLEs have no indication of age and range widely in the number of steps they have. On a continuum of learning you may need more, or fewer, points depending upon the skill/understanding. • Having the same number of points across each skill/understanding may be easier practically in terms of coherence across teachers and schools, but may require a compromise in terms of representing meaningful shifts in each skill/understanding, the latter of which is ideal for assessment for learning • Many countries tend to follow Option C (e.g., Australia, British Columbia), with some exceptions (e.g., New Zealand has 8 steps/points in the learning journey). However, Option C is critiqued in the literature as it links to grade level expectations (Heritage, 2008). • _____ • _____

Choice and Rationale

Rationale for Choice of Possibilities for Q1
Beginning Point - The teacher needs to use formative assessment to acknowledge what the learner has already achieved/ experienced / dispositions so they can assess the 'readiness' of the learner to continue their journey. (Singapore).
End point – Step achieved / reached towards the Four Core Purposes and the signal for where the next step will be.

Rationale for Choice of Possibilities for Q2
No, all skills, understanding, and/or competencies are represented at every step in the progression framework due to the way maths builds on the previous step. Each step is appropriate to the child's stage of development and introduced through play etc as appropriate. This is true for all "What Matters" within the Maths and Numeracy AoLE.

Rationale for Choice of Possibilities for Q3
Choose B – Discussion – evidence from practitioners during CAMAU research. We agree.
Point A – Discussion - Why are the ages chosen? 5 allows a child to settle into primary at the end of Reception. 8 acknowledges the infant / junior school situation and allows children to settle in a new school but then 11 when children move from primary to secondary is separating the two stages again. Dislike the clear distinction and not a journey more of a reaching different end points.

Point C – Discussion – Teachers needs guidance children do not need to be labelled and Welsh government label schools.

Point D – Discussion – Different phases of education seperating us too much still. 'Not our problem' idea.

AoLE proposal

Example: The aspect of the learning journey should be structured as… because…
Question 1 How do you identify beginning and end points in the journey?
The group proposes…
The teacher needs to use formative assessment to acknowledge where the learner is at , at the beginning of the journey. This will need to identify what the learner has already achieved/ experienced and the dispositions they have so they can assess the 'readiness' of the learner to continue their journey. (Singapore).
Step achieved / reached at the end of the journey should be measured against what steps the learner has taken towards the Four Core Purposes and the signal for where the next step will be.

Question 2 Do different parts of the journey start at different points?
The group proposes..
All skills, understanding, and/or competencies are represented at every step in the progression framework due to the way maths builds on the previous step. Each step is appropriate to the child's stage of development eg introduced through play etc as appropriate. This is true for all "What Matters" within the Maths and Numeracy AoLE.

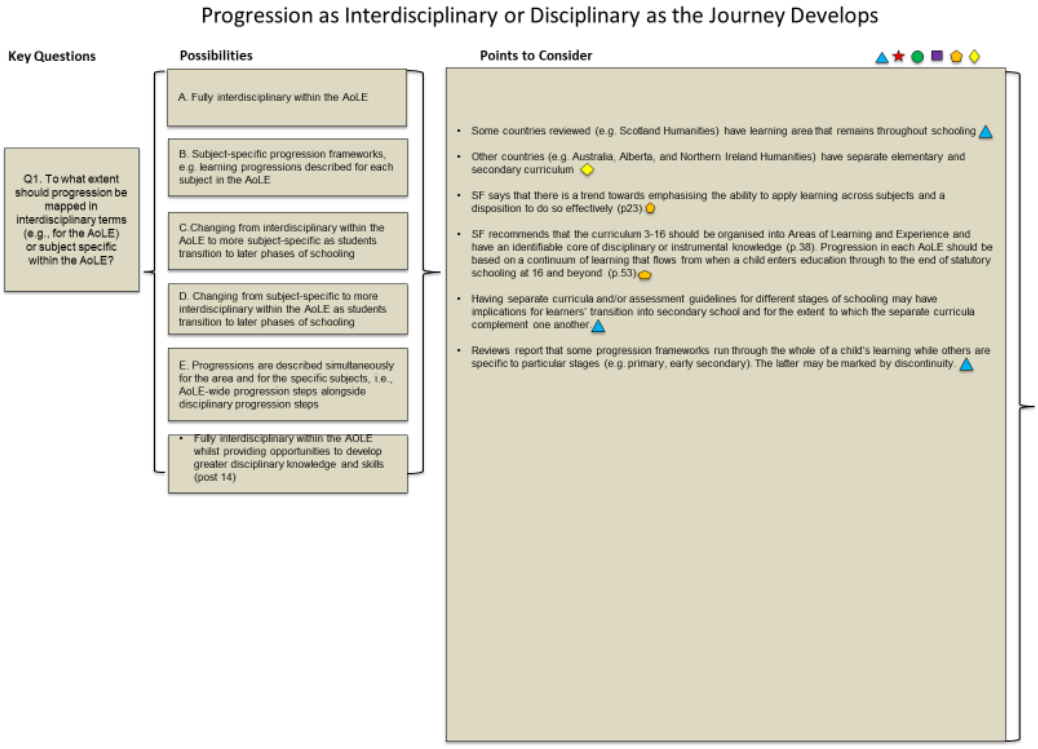
Question 3 How do you break up the journey in ways that make the best sense for learning eg number of progression points?
The group proposes….
The number of points may differ across learning depending upon the number of conceptual shifts that mark sophistication/development in the learning journey. This is evidenced from practitioners during CAMAU research. This is continous formative and summative assessment rather than just a point at a certain age for each child.

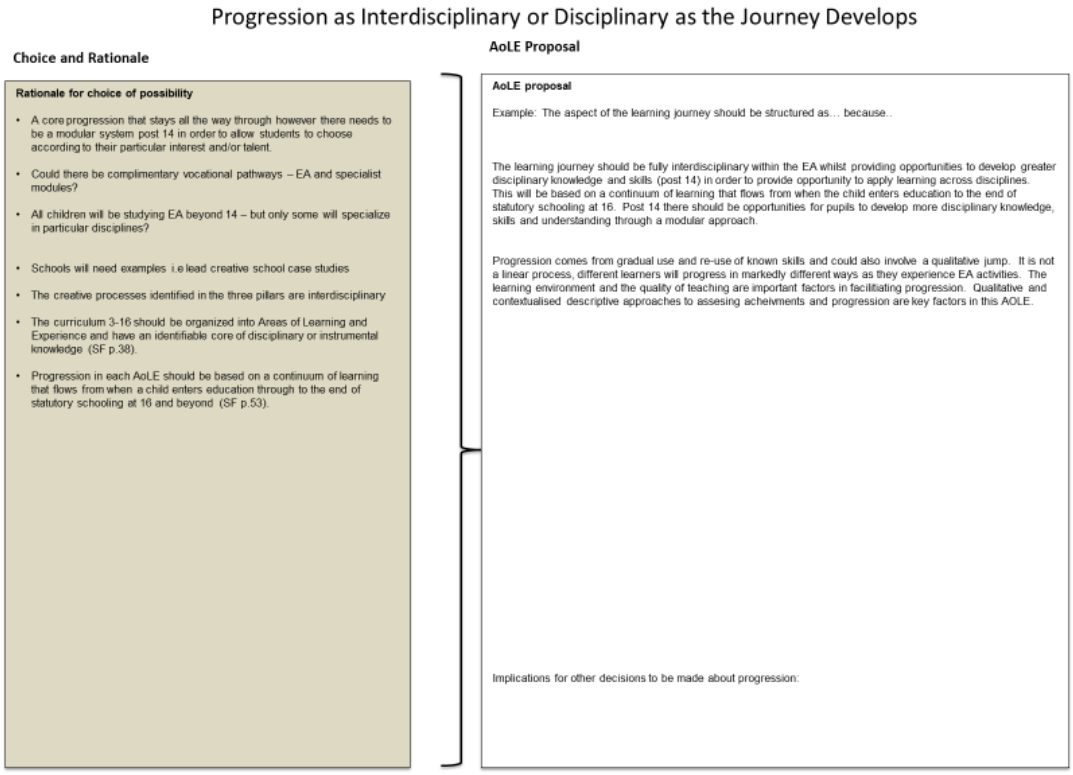
We dislike the clear distinction by age as not a journey more of a reaching different end points.
Teachers needs guidance for stages of development. Children do not need to be labelled and Welsh government then measure or label schools at artificial points of time. Support should be given to learners and schools without publicly shaming.

If we only assess different phases of education it is still separating primary and secondary schools too much and becomes the 'Not our problem' idea.

Implications for other decisions to be made about progression:

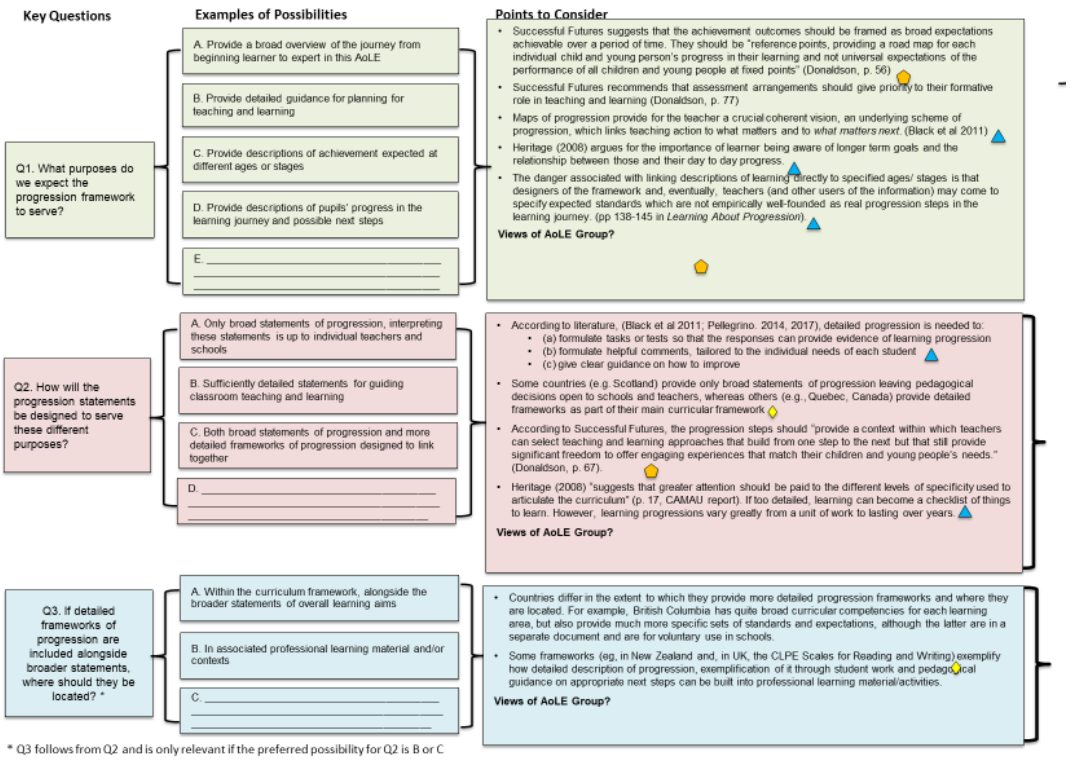
Expressive Arts: Progression as Interdisciplinary or Disciplinary



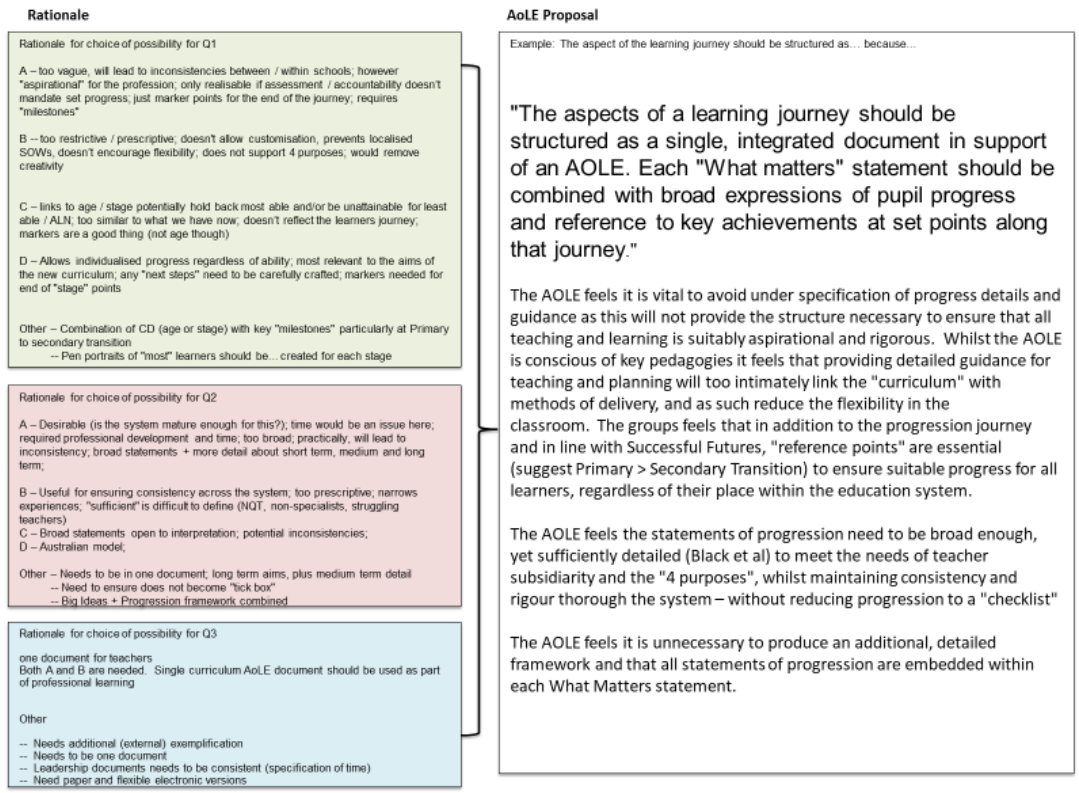


Science and Technology: Purposes of Progression Framework

Purposes of Progression Framework



Purposes of Progression Framework



List of additional documents available online

1. References to 'progression' in *Successful Futures*
2. Health and well-being: links to national curricula
3. Health and well-being: examples of progression statements
4. Humanities: links to national curricula
5. Examples of Religious Education Progression Statements in Scotland

These documents are available at
https://www.dropbox.com/sh/tgtjidlcuze9zt7/AABP34QNYEPcelJsjwlklBrGa?dl=0

Note also that analyses of individual country frameworks in the various curricular areas are available from the CAMAU project team.