

Professional learning paper: Significant Aspects of Learning

Assessing progress and achievement in Numeracy and Mathematics

The work in progress on Significant Aspects of Learning was reviewed in June and July 2015 in the light of feedback from practitioners, schools and education authorities and in the context of developments in national education policy. This has led to a number of changes both in the overarching paper and in each of the papers related to an area of the curriculum.

Within each of the curriculum area papers changes include:

- the addition of two sections which set the context for the work on significant aspects of learning
- the addition of references, wherever appropriate, to the relationship between significant aspects of learning and the development of skills for learning life and work, literacy and numeracy and digital competencies
- changes (usually minor) to the definition and illustration of the significant aspects of learning in that area
- the use of a common format in the presentation of the significant aspects of learning
- the insertion of hyperlinks to texts referenced in the paper.

The major single change within this paper, when compared to the original, is that the sections within this paper have been reordered to match the order in the other curricular papers in this series. This should support practitioners who need to refer to more than one of the papers. Again in order to match the other papers some headings have been removed and text allocated to other sections. There are no major changes to the content of the paper.

This preface has been added to each paper. Feedback from practitioners made it clear that the original papers lacked a clear initial statement of context and purpose.

Preface

This paper is one element of a suite of resources which support assessment of progress and achievement. You are recommended to read this paper in conjunction with the following:

- *Monitoring and tracking progress and achievement in the broad general education:* bit.ly/edscotapasal
- *Assessing progress and achievement overarching paper*
- *Numeracy and mathematics progression framework*
- *Annotated exemplification of work in numeracy and mathematics:* bit.ly/edscotsalmath

This resource supplements the [Numeracy across learning Principles and Practice paper](#), the [Mathematics Principles and Practice paper](#) and the [Experiences and Outcomes for numeracy and mathematics](#).

Introduction

The introduction to each paper has been revised as necessary to make clearer links to the Principles and Practice papers which identify the key aims of learning in the relevant curriculum area.

The Principles and Practice papers in [numeracy](#) and [mathematics](#) summarise the educational rationale underpinning the right of all young people to enjoy and succeed in developing their knowledge and understanding, skills, attributes and capabilities in numeracy and mathematics. The Numeracy across learning Principles and Practice paper describes what it means to be numerate:

Being numerate helps us to function responsibly in everyday life and contribute effectively to society. It increases our opportunities within the world of work and establishes foundations which can be built upon through lifelong learning.

Numeracy is not only a subset of mathematics; it is also a life skill which permeates and supports all areas of learning, allowing young people access to the wider curriculum.

We are numerate if we have developed: The confidence and competence in using number which will allow individuals to solve problems, analyse information and make informed decisions based on calculations.

The Mathematics Principles and Practice paper outlines the importance and value of mathematics in our everyday life:

Mathematics is important in our everyday life, allowing us to make sense of the world around us and to manage our lives. Using mathematics enables us to model real-life situations and make connections and informed predictions. It equips us with the skills we need to interpret and analyse information, simplify and solve problems, assess risk and make informed decisions.

Mathematics equips us with many skills required for life, learning and work. Understanding the part mathematics plays in almost all aspects of life is crucial. This reinforces the need for mathematics to play an integral part in lifelong learning and the richness it brings.

This paper builds on these statements by making use of *significant aspects of learning* to support practitioners in carrying out dependable valid, reliable and challenging assessment of progress and achievement in the sciences. This paper provides:

- a description of the significant aspects of learning within numeracy and mathematics
- an outline of what breadth, challenge and application look like within numeracy and mathematics
- information on planning for progression through curriculum levels, using breadth, challenge and application.

The overarching paper in this professional learning resource contains a section on 'What are the significant aspects of learning?' Feedback suggested strongly that it would be helpful to practitioners as they refer to and use the curriculum area papers to have a slightly abridged version of this section included in each curriculum area paper.

What are significant aspects of learning?

Significant aspects of learning have been identified for each curriculum area to support practitioners in assessing progress and achievement. Each significant aspect of learning brings together a coherent body of knowledge and understanding and related skills, as outlined in the Principles and Practice paper and detailed in the Experiences and Outcomes. Each significant aspect of learning

- is common to all levels from early to fourth
- can provide sound evidence of learning in accord with the principles of [Building the Curriculum 5: A Framework for Assessment](#)
- supports the practice of holistic ('best fit') assessment
- can be effectively used to inform assessment of progression within a level and achievement of a level
- can be used to plan further progression within a level and from one level to the next.

Using significant aspects of learning makes assessing progress and achievement more dependable and more manageable. This structure:

- supports practitioners in planning and integrating learning, teaching and assessment
- ensures that learners and practitioners can draw on a range of meaningful, robust, valid and reliable evidence from all four contexts of learning: classroom activities, interdisciplinary learning, the life and ethos of the school and personal achievements, including those outwith the school
- affords learners space to demonstrate the breadth of their learning, effective responses to challenging learning experiences and the ability to apply what they have learned in new and unfamiliar situations
- allows learners to progress by different routes and pathways through the experiences and outcomes
- helps practitioners avoid fragmented approaches to assessment which prevent learners from demonstrating the full range of their knowledge, understanding and skills
- removes the need to rely on evidence derived from single brief learning experiences or end of unit tests
- affords practitioners opportunities to plan and assess within a curricular area the development of the skills, attributes and capabilities required for learning, life and work, including the development of literacy, numeracy and digital competencies
- supports practitioners in making holistic ('best fit') judgements about the achievement of a level either in an individual significant aspect of learning or, drawing on evidence from across the relevant significant aspects of learning, in a curriculum area.

The use of significant aspects of learning will inform:

- moderation activities based on holistic judgements supported by dependable evidence
- monitoring and tracking progress in learning
- quality assurance approaches
- the use of assessment to inform improvement at all levels of the education system.

Significant Aspects of Learning in numeracy and mathematics

Minor changes have been made in this section: the significant aspects are presented as a bold bullet pointed list and the introductory paragraph has been redrafted. More significantly much of the text under this heading in the original paper has been moved into the section on 'Planning for progression through breadth, challenge and application in numeracy and mathematics'.

As staff plan learning, teaching and assessment using the experiences and outcomes, use of the significant aspects of learning in numeracy and mathematics will help them gather and organise a range of evidence of progress in mathematics and numeracy in a holistic way.

There are five significant aspects of learning in numeracy and mathematics:

- Using knowledge and understanding of the number system, patterns and relationships
- Using knowledge and understanding of measurement and its application
- Using knowledge and understanding of shape and space
- Researching and evaluating data to assess risks and make informed choices
- Applying numeracy and mathematical skills.

This section has been moved to this point to match the structure of other curricular papers. The final paragraph has been developed and extended to make clearer references to skills for learning, life and work, including references to digital competencies, and to the world of work.

What do breadth, challenge and application look like in numeracy and mathematics?

Well planned learning, teaching and assessment provide opportunities for children and young people to learn and demonstrate their learning across the significant aspects of learning in numeracy and mathematics through the experience of breadth, challenge and application.

Breadth

Learners demonstrate breadth in numeracy and mathematics when they:

- work confidently with an increasing number of connected experiences and outcomes
- identify the mathematical ideas and concepts required to interpret questions
- use an increasing range of mathematical language and notation, formulae and equations
- use an increasing range of mathematical tools.

Opportunities for breadth can be provided by planning a range of activities to bring together and use numeracy and mathematical knowledge and understanding developed in various contexts: for example, using money as a context for learning about number or using knowledge of decimal fractions within area and perimeter calculations.

Challenge

Learners are provided with challenge in numeracy and mathematics when they:

- work with increasingly complex questions involving more steps and operations
- work with open-ended questions and tasks
- use an extended range of mathematical knowledge in tasks
- interpret increasingly complex numerical information and use this to draw conclusions, assess risk, make reasoned evaluations and informed decisions
- communicate understanding by articulating ideas, approaches and processes with increasing clarity, both orally and in written form.

Challenge can be provided through planning an appropriate range of opportunities within tasks and activities. These tasks and activities should increase in complexity and require a greater number of processes to complete them: for example, learners may be asked to sort a range of shapes and

objects using their own criteria or to work out the cost and risks of various forms of loans and justify their choices. Using open ended tasks allows learners the opportunity to clearly explain their approach to the question.

Application

Learners demonstrate application of their numeracy and mathematics when they:

- make connections and apply knowledge, understanding and skills across the numeracy and mathematics experiences and outcomes
- use numeracy and mathematical skills in other curricular areas
- understand and explain how numeracy and mathematics impacts on the world of learning, life and work.

Learners should be provided with opportunities to use a wide range of numeracy and mathematical skills to address tasks in new and unfamiliar contexts. These will include planned opportunities for learners to use their mathematical skills in other curriculum areas: for example, designing and creating a new board game or working out the electrical consumption of a house and calculating the most effective way to save money. Practitioners should provide opportunities for children and young people to develop an awareness and increasing understanding of the importance of numeracy in society, the economy and the world of work. As a result, learners should better understand how learning in numeracy develops important transferable skills for learning, life and work. Practitioners can provide a wide range of opportunities for learners to use and develop digital competencies as they apply their learning in numeracy and mathematics.

Planning for progression through breadth, challenge and application in numeracy and mathematics

The introduction to this section is the text which, in the original paper, was placed under the heading 'Progression in numeracy and mathematics'; the remainder of this section has been slightly amended from text which formed the greater part of the section 'Significant aspects of learning in numeracy and mathematics' in the original paper.

Progression initially comes through learners developing their knowledge and understanding in the basic concepts such as the concept of number in numeracy and mathematics. Once mastered, learners can then use these building blocks to demonstrate breadth, challenge and application.

Mathematics is a sequential subject; the learning achieved at each stage of development of a skill provides the foundation for learning at the next stage. Each stage of development, however, benefits from being reinforced through challenging practice, including through contextualised problems and applications across learning, in real life and in the workplace. Therefore as well as making progress through the stages of mathematical concept or skill, a learner can also make progress in their capacity to apply that skill in an appropriate way.

(Excellence in Mathematics Report March 2011)

Well-planned learning, teaching and assessment in numeracy and mathematics which takes cognisance of breadth, challenge and application, will support staff in their professional judgement of learners' progress in achieving a level. This includes learners making connections across a range of experiences and outcomes, using higher order thinking skills and applying them in new and unfamiliar contexts. Learners should be encouraged to show, explain and justify the range of strategies they use.

- ***Using knowledge and understanding of the number system, patterns and relationships***

Learners' ability to use their knowledge and understanding of the number system will provide the basis for all other learning in numeracy and mathematics.

A sound understanding of place value, the concept of zero and its use as a place holder, underpins learners' ability to partition and to work confidently and flexibly with number, including fractions and decimal fractions.

Confidence in mental agility will be central to ensuring learners are accurate in calculations.

Learners' skills in, and application of, estimating and rounding should be a regular feature of learning. Progression in estimation should involve learners taking account of the impact of real life contexts and using this knowledge when communicating their understanding. For example, when solving word problems, such as those involving division, where the interpretation of the context is required to gain a reasonable answer.

From early level, learners will develop an understanding of relationships between operations, including inverse processes, commutative, associative and distributive laws.

The concept of wholes and parts, grouping and sharing will form the basis of understanding of number processes, fractions, decimal fractions and percentages including proportion.

The framework of organisers which structure the Experiences and Outcomes in numeracy and mathematics (such as money) provide a context for learners to develop their knowledge and understanding of the number system.

From early level, learners will be supported to think algebraically to provide a solid foundation for formal algebraic concepts. Learners' understanding of these algebraic concepts will be developed by investigating and exploring the relationships between operations. For example, inverse operations can be used to identify a missing number. Algebraic reasoning supports learners to identify, continue and extend a pattern: for example, when generalising a rule for sequences and using functions and creating pictorial representations.

- ***Using knowledge and understanding of measurement and its application***

Learners' understanding of measurement and its application is supported by their ability to draw on the knowledge and skills required to estimate, use number and number processes, fractions, decimal fractions and percentages.

Through practical activities, learners will initially develop their conceptual understanding of measurement, relevant to their own experiences: for example, when using time management to organise everyday tasks or plan a journey. Learners will progress to the use of standardised units and

knowledge of their interrelationships and will develop their ability to use measurement in unfamiliar contexts: for example, when calculating the surface area and volume of prisms and comparing their relative sizes.

Learners will use measuring instruments with increasing accuracy. Within a range of contexts, they will choose the level of accuracy required and understand the impact of tolerance: for example, when exploring the importance of tolerance in measurement when manufacturing components.

As learners progress, they will build an understanding of how formulae relate to measurement. They will establish algebraic formulae through investigative approaches and progress to the use and manipulation of formulae.

- ***Using knowledge and understanding of shape and space***

In developing an understanding of 2D shapes and 3D objects, learners will apply knowledge and skills in number, measurement, patterns and relationships. The development of visualisation and spatial awareness is also a feature of this significant aspect of learning: for example, creating a net from a representation of a 3D object then calculating the area of card required to build the net and using programmable toys or applications to explore properties of angles.

Through experience, learners will develop mathematical language to classify shapes and objects and describe position and direction. Learners' development of the understanding of properties and relationships of 2D shapes and 3D objects, alongside that of angle, will allow them to interpret complex mathematical diagrams and calculate within these: for example, using symmetry, rotation and transformation on a coordinate grid to create designs.

- ***Researching and evaluating data to assess risks and make informed choices***

Evaluating data to make informed choices involves extracting and interpreting information to draw valid, justified conclusions. When working with data in a variety of contexts, learners will apply the knowledge and skills from other aspects of numeracy and mathematics: for example, analysing statistical information relating to finances can readily provide opportunities to apply knowledge and understanding of fractions, decimal fractions and percentages.

It is important that learners have the opportunity at all levels to experience and use technology to create and display data. Learners will have an increasing range of knowledge of different types of tables, charts and diagrams, will be increasingly skilled in using these and will be able to choose the most appropriate form of display and justify their choice.

Learners will gather data in a range of contexts, including other curricular areas, such as social studies, the sciences and technologies, and interdisciplinary learning and create appropriate representations to communicate information. They will also assess the validity of data, consider its source and sample taken.

As they interpret and analyse increasingly complex information in a range of contexts, learners will use probability to assess risk and consider consequences in order to make informed decisions: for example, considering trends in weather records to predict the likelihood of rainfall.

- ***Applying numeracy and mathematical skills***

It is important that learners develop numeracy and mathematical skills as they build their knowledge and understanding. As learners progress, they should demonstrate an increasing sophistication in their ability to:

- interpret questions
- select and communicate processes and solutions
- justify choice of strategy used
- link mathematical concepts
- use mathematical vocabulary and notation
- use mental agility
- reason algebraically
- determine the reasonableness of a solution

These skills should be evident across the other significant aspects of learning in numeracy and mathematics. Staff should actively promote the development of these skills and ensure they are embedded in planning for learning, teaching and assessment.

At all levels, learners should be encouraged to identify relevant strategies for carrying out a range of tasks, communicate their thinking in different ways and explain and justify their answers. Developing mathematical language and notation is vital to ensure learners are supported to become confident in sharing their ideas and are mathematically articulate.

As learners progress in their understanding, they should be able to identify and use the links between mathematical concepts which will enable the development of a range of flexible strategies for calculating mentally and their skills in manipulating numbers with fluency, accuracy and confidence.

At all stages, it is important to build on learners' algebraic thinking and reasoning skills. As learners progress, they should begin to use algebra in problems of increasing complexity and abstraction. Proficiency in interpreting questions will be evidenced by learners' ability to choose, apply, communicate and justify their strategies using appropriate notation and mathematical vocabulary.

Estimation and rounding should feature regularly in learning, teaching and assessment, extending beyond the knowledge of a set of procedural rules. Learners should routinely use estimation and rounding to determine the reasonableness of their solutions or calculations.

Additional specific advice related to assessment in numeracy and mathematics

This section brings together material that was placed under various headings in the original paper. This ensures that practitioners referring to more than one curricular paper will experience the same structure.

Assessment evidence which demonstrates achievement of a level in numeracy and mathematics will show that learners have understood a significant body of knowledge, have used a range of skills, have responded consistently well to challenging learning experiences and have been able to apply what they have learned in new and unfamiliar situations. Due to the interconnected nature of learning within numeracy and mathematics, evidence collected through assessment can provide information on progress and achievement for one or more of the significant aspects.

To make a holistic judgement of learners' achievements, a collection of evidence on more than one occasion is required. No single task or test can validly reflect learners' achievements in numeracy and mathematics.

Staff should plan, design and carry out a range of assessments as part of learning and teaching. Learning, teaching and assessment should be planned using numeracy and mathematics experiences and outcomes which have naturally occurring links. Assessment should be ongoing, periodic and used at points of transition, as appropriate. Assessment evidence can be gathered through everyday activities or from planned assessment tasks. Assessment for numeracy and mathematics can also be planned for in other curricular areas or through interdisciplinary learning where the context and level of challenge is appropriate to learners' needs.

This section has been reworded to stress the value of using all elements of the professional resource: overarching paper, relevant curriculum area paper(s), progression framework(s) and annotated exemplification.

Next steps

Practitioners are encouraged to use this paper with the other elements of the professional learning resource to inform reflection on practice and plan for improvement as they support learners' progress and achievement in learning. The professional resource, including this paper, can be used to stimulate, inform and support professional dialogue during quality assurance and moderation activities.