In partnership with

AQA Questions matter

UCL

STRIDE Maths

AQA Stride Maths

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Information for maths teachers

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Associate Professor Cosette Crisan is involved in a wide range of activities supporting mathematics education in schools, colleges and universities, with particular interests in researching the nature of subject-specific knowledge within the school curriculum and teacher education, and in promoting and researching the use of digital technology in mathematics education.

David McEwan

AQA

David McEwan is the Subject Lead for mathematics at AQA. He has a background in Operational Research and has a wide range of experience in industry and teaching maths. He has spent the last 3 years developing onscreen diagnostic assessments, leading up to the release of AQA Stride in June, 2024.

About Stride

AQA has developed a new diagnostic assessment for maths called Stride. This assessment can be used to target students at the end of KS3 who are about to commence GCSE Maths studies as well as being suitable for students retaking the GCSE maths exams, post-16.

Each test evaluates students in a specific mathematical area crucial for success in learning GCSE Maths, with success defined as achieving a grade 4 pass in the GCSE maths examination. Each test will involve each student being asked 45 to 50 questions, covering various aspects of the KS3 mathematics syllabus, sourced from a question bank of around 200 questions designed by AQA, and intended to assess knowledge and skills. The test will analyse a student's response and offer the next question suited to their learning needs.

Why will teachers use Stride?

The suite of digital tests support diagnostic assessment, a type of assessment that provides opportunities to evaluate a student's strengths, weaknesses, and skills. Teachers use diagnostic assessment because "They can give useful insights into pupil learning, although interpreting the information they produce requires some level of professional judgment from teachers, as there are many reasons why pupils might answer a question in a certain way" (EEF, p.1).

The strength of the Stride tests is that they assess students' knowledge and skills, while also supporting the teacher to interpret and identify knowledge gaps and misconceptions.

Key Features of Stride tests

Formative – the strength of these tests lies in their formative functionality, providing instant feedback to students, and providing teachers with an immediate insight into a student's understanding at the time of taking the test; and

Adaptive – following each test, the individualised reporting generated offers teachers insights into the potential breakdown in student's learning path leading up to an understanding of the concept tested. This reporting helps teachers target support and intervention, and identifies the most opportune points for intervention. Understanding the position of students on their learning path allows teachers to support the unique needs of individual learners.

What is valuable about these on-screen maths tests?

In general, diagnostic tests gauge students' knowledge and skills by assessing whether or not they are able to 'do' some piece of mathematics at a given point in time. While these type of tests can be useful for monitoring progress and selecting likely topics for review or additional practice, they are not sufficiently targeted to reveal the underlying reasons for individual performance.

In line with best practice EEF recommendations, "It is important that misconceptions are uncovered and addressed rather than side-stepped or ignored." (EEF, 2021 p.11), AQA's assessments are hence designed to uncover underlying such issues that may persist for years unnoticed, offering thus a more thorough approach to support a solid foundation for mathematical understanding.

"Assessment should be used not only to track pupils' learning but also to provide teachers with information about what pupils do and do not know." (EEF, 2021, p. 8). AQA's suite of digital assessment tests stands apart by identifying knowledge gaps and misconceptions, often stemming from prior weaknesses in mathematical understanding.

Students have reported that they found these new tests engaging, since they offer rapid feedback on each question they attempt. In line with best practice in improving maths in key stages 2 and 3, the reports can be used by students and teachers alike to direct further study through "Selection [should be] guided by pupil assessment" (EEF, 2021, p. 9).

After the tests, students are offered an individualised learning experience, directing them to revisit and practise the knowledge and skills needed to close the gaps in their understanding.

Research-informed design of Stride assessment

At the heart of these assessment tests are the ***concept maps*** (see appendix) crafted by David McEwan, former maths teacher and subject lead for Maths at AQA, with support from Dr Cosette Crisan, a mathematics educator from UCL with extensive experience and expertise in teaching mathematics at secondary and tertiary levels of education. Informed by research in mathematics education, these maps illustrate the complex web of relationships between concepts, knowledge and skills, represented graphically in the form of networks, consisting of 'nodes' and 'arrows' (see Figure 1). They have undergone testing and refinement through trials involving 18 mathematics teachers and 93 students, across 18 secondary schools.

About the Concept Maps

The creation of these maps involved understanding the knowledge, skills, and insights required by students to develop a conceptual understanding in mathematics. They have been based on a subset of the non-statutory guidance for the National Curriculum in England document (DfE, 2021). This subset contains the mathematics that has the biggest influence on success at GCSE, as determined by the authors, AQA's subject experts and informed by discussions with teachers. It is categorized into five distinct concept maps titled: **Numbers**, **Algebra**, **Proportions**, **Graphs**, **Shapes**. Each map aims to show the structure of the acquisition of knowledge and skills in one concept. The intention is to ensure that students have grasped the mathematics needed to now go on and successfully acquire the higher-order skills needed for success at GCSE Maths.

- **Numbers** – the understanding of place value and powers of ten, number theory, sequences, and extension to fractions, decimals and percentages;
- **Algebra** – the understanding of the field axioms and their application to order of operations, expressions and equations;
- **Proportions** – ratios, scaling and proportional reasoning and its applications;
- **Graphs** – linear algebra and the mathematical interpretation of graphs, charts and diagrams.
- **Shapes** – mensuration in 2D and 3D space, properties of 2D and 3D shapes and transformations.

These maps encompass the various statements regarding 'knowledge, skills, and understanding' found in the guidance document, which have been reorganized and presented as maps, a choice driven by the specific objectives of the assessment tests. It is crucial to note that the design of these maps does not adhere to the hierarchical order typically followed in the teaching of maths topics. The nodes and arrows in these maps are dictated by the hierarchical learning path leading students to an understanding of each concept.

Successful study of GCSE Maths requires the learning of new concepts. These must be built on a robust foundation consisting of various previous knowledge while guiding the learner to increased conceptual complexity as learning progresses. Any gaps or misconceptions in this learning path can result in weak acquisition of subsequent knowledge and skills, leading to misunderstandings, errors, and misconceptions. These principles informed the design of the maps. To exemplify, the ***Numbers*** conceptual map excerpt below (Figure 1) was crafted with the understanding that students may struggle with operations involving fractions (addition and multiplication) if they have difficulty mastering pre-requisites.

For example, an end of year progress test may include questions about operations with fractions. If students are unsuccessful with these questions, then teachers may note this as an area of weakness and reteach operations with fractions. However, this may not get to the underlying problem. In order to be successful in operations with fractions, students need to understand equivalent fractions. This in turn relies on an understanding of factors and multiples, which relies on knowledge of multiplication tables. This suite of assessments is designed to reveal these underlying requirements and identify gaps and misconceptions.

Many students are retaught higher-order concepts many times over their school career without successfully learning them because their underlying understanding is weak or flawed. Opportunities to solidify the foundational prior knowledge are needed if this cycle is to be broken.

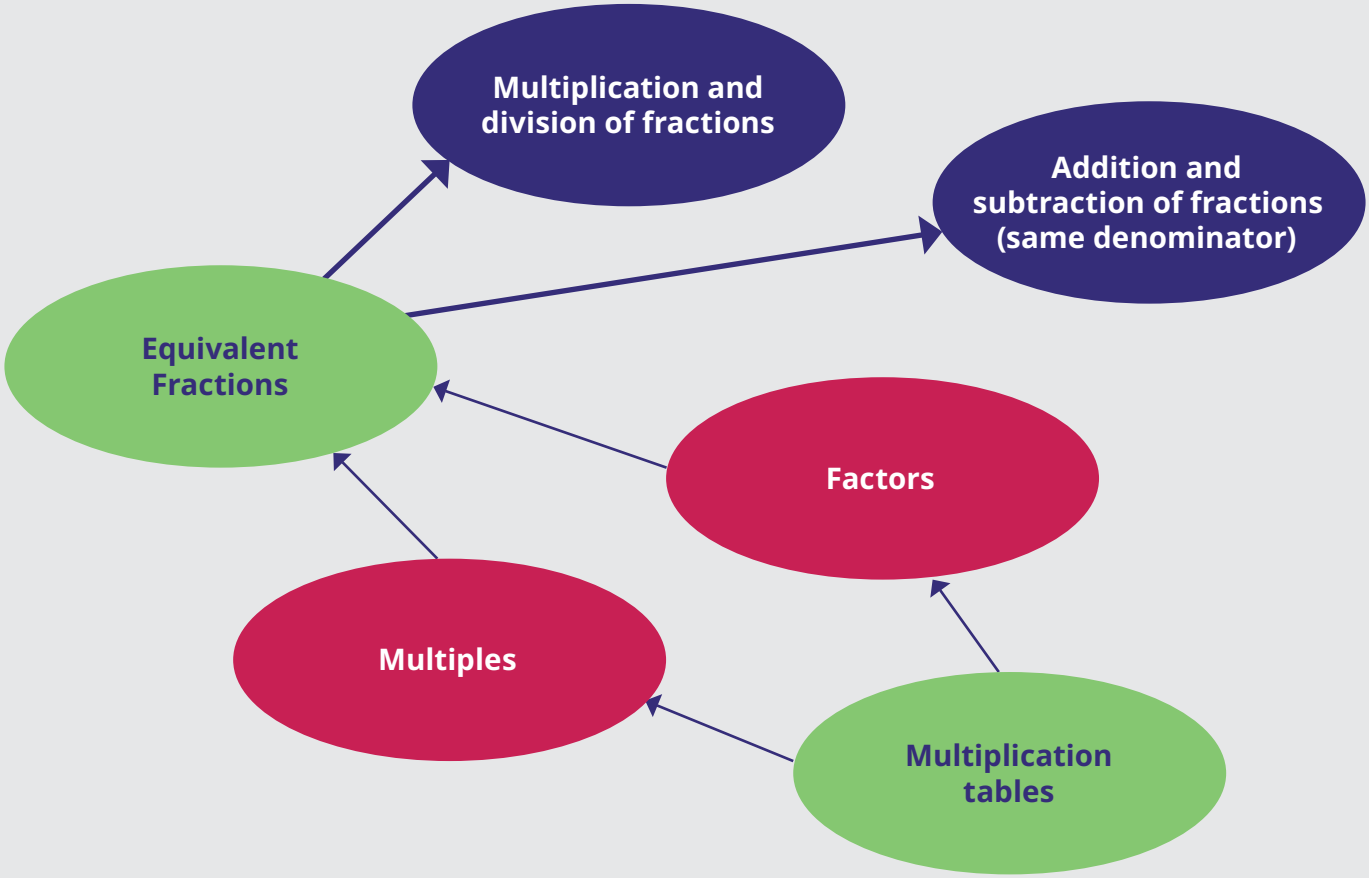

Figure 1: Excerpt from the *Number* concept map

How are these Concept Maps used?

At the beginning of a period of study (e.g., at the start of year 10 or the start of a resit course in year 12), students can take an initial test. Once the test is automatically marked, an individualised report is generated, with a score (e.g., 5 out of 10). Subsequently, students are prompted to complete a learning task with the objective of enhancing their performance. Later other tasks are generated that give spaced retrieval practice. Once a learner or their teacher feels that sufficient progress has been made, the test can be re-taken and progress can be measured (e.g. a student may now score 6.3 out of 10). These follow-on tests are automatically generated by the Stride system, and their **distinctiveness** lies in their formative and adaptive functionalities, as elaborated below.

Although there is an element of randomness in the selection of questions for the follow-on tests from the question bank, the system 'intelligently' samples questions. Each question is selected to answer the problem statement "What can I ask now that will give me the greatest understanding about this student's mathematics?"

Once this question is answered by the student, the system interacts with the appropriate Concept Map, and selects a question aimed at better the understanding the students' knowledge, in alignment with the structure of the Concept Map. Every time a student responds to a question, the system uses a combination of this response along with the problem statement, the structure of the concept map, and all of the student's previous responses to select a new question that is aimed at better understanding the student's knowledge.

How are Stride tests useful to maths teachers?

These tests provide teachers with a distinct advantage over traditional summative tests by serving as proxies for gauging student understanding. Unlike other summative tests which indicate what students can or cannot do, these maps enable teachers to pinpoint specific weaknesses in understanding, such as areas of missing knowledge or misconceptions. The strength of the reporting lies in the ability to compare a student's knowledge and comprehension against the structure proposed in the concept maps.

References

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Further references that informed the design of the conceptual maps

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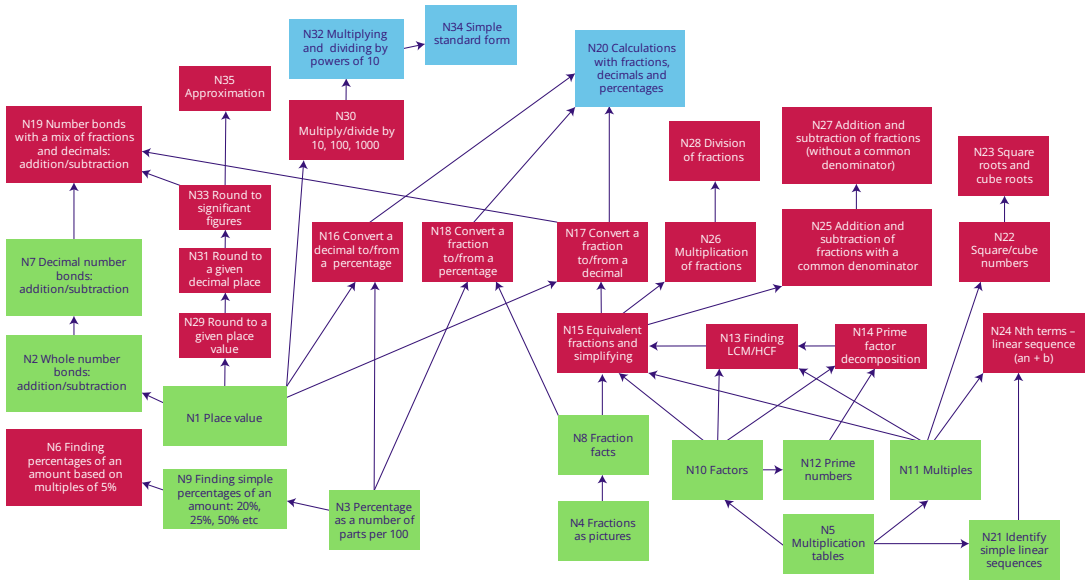
Appendix

Concept maps

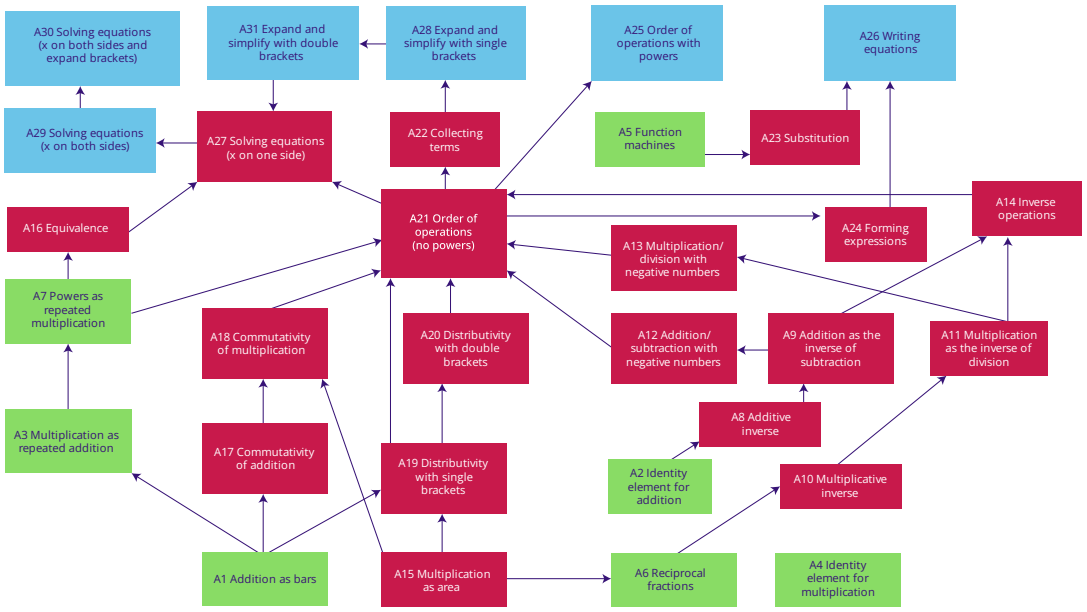
Numbers

The **fundamental knowledge** that underpins mathematics is shown as green nodes.



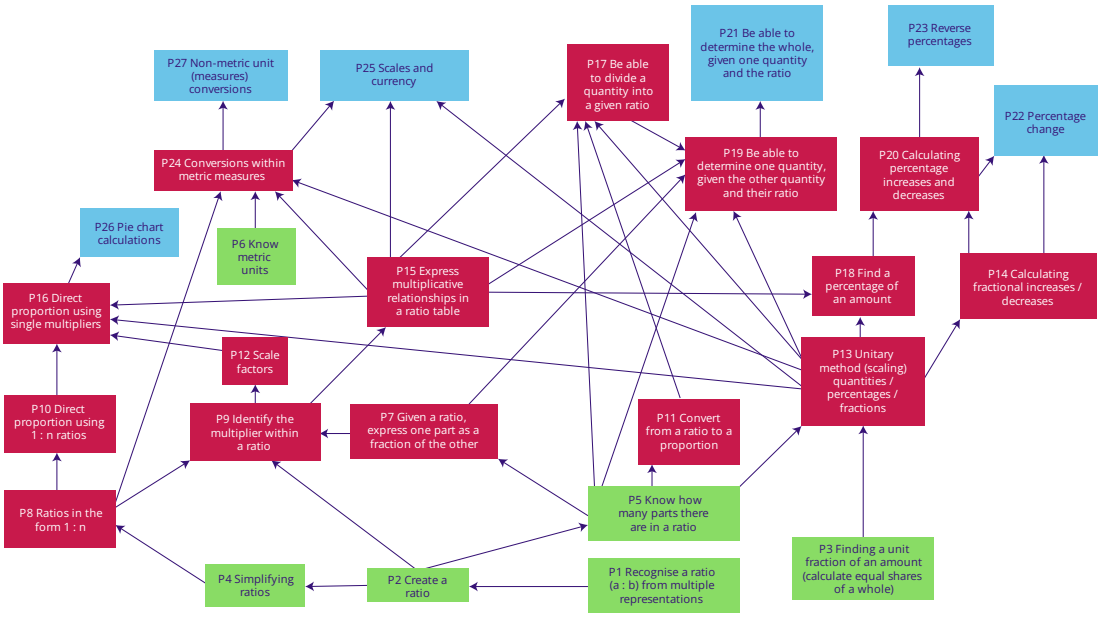
Algebra

The **main content of Key Stage 3** is shown as red nodes.



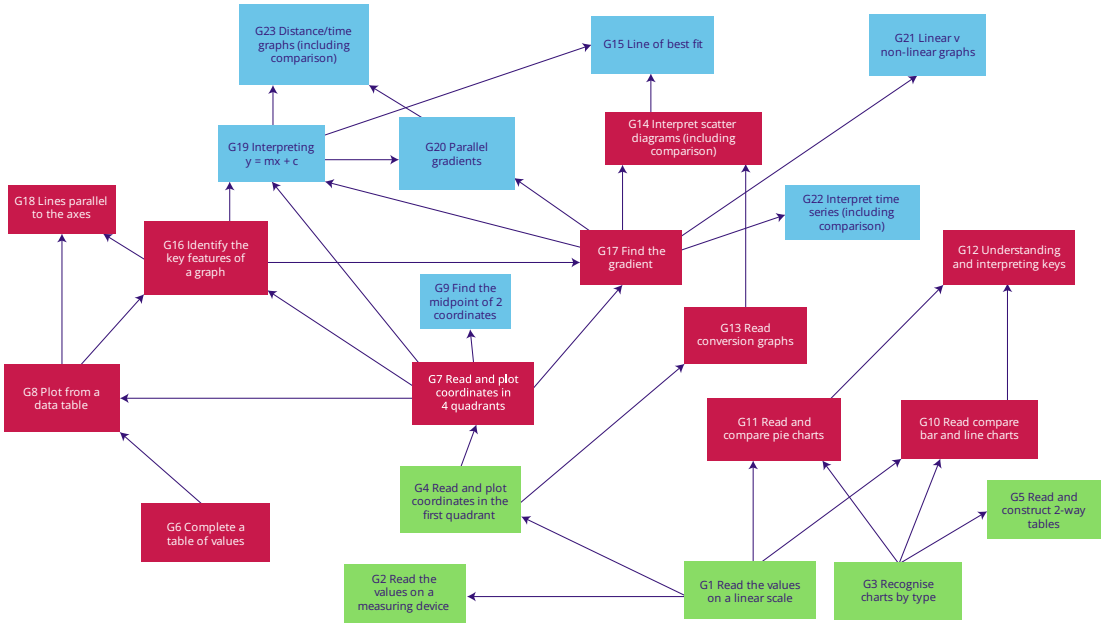
Proportions

Desirable knowledge for GCSE mathematics is shown as blue nodes.



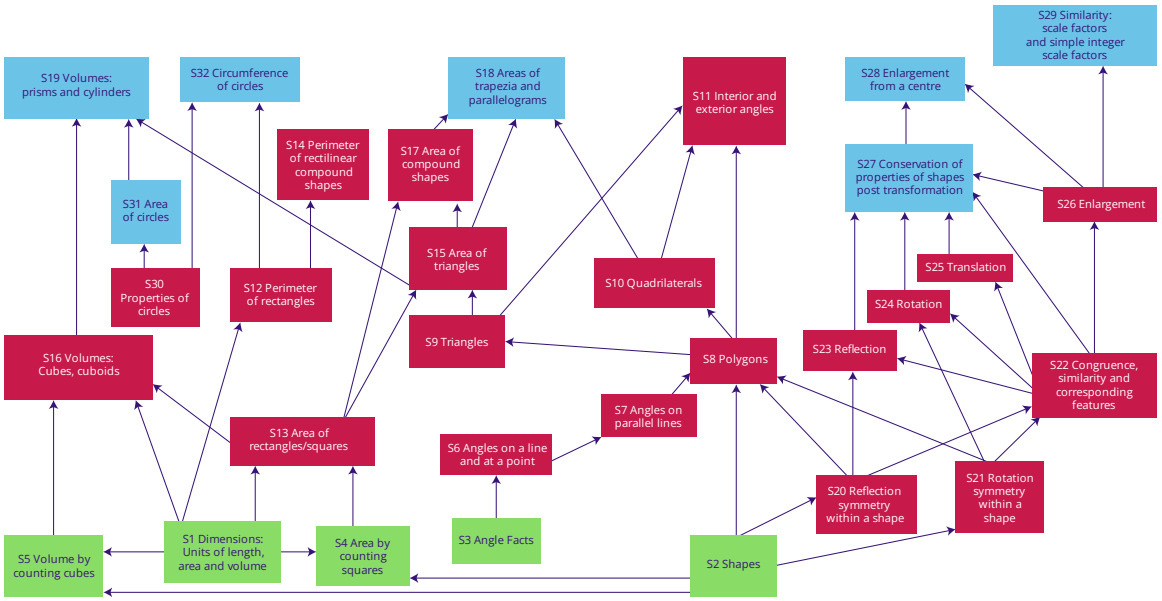
Graphs

Each assessment bounces around the **knowledge space**, understanding the strengths and areas for development of your learners.



Shapes

The **teacher analytics** provide important information about where your learners' gaps exist, so that you can develop the knowledge essential for GCSE study.



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