**Primary Initial Teacher Education: Curriculum Plan**

**Subject / Strand: Mathematics: Undergraduate Programme**

**(Links to Fluency/ Reasoning/ Problem Solving/ Mastery)**

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| **Curriculum Intent:** *Through our Initial Teacher Education Curriculum, it is our intention that all Edge Hill Primary teacher trainees will:* * *understand that mathematics is the route to developing both accurate and fluent numeracy skills and the importance of this in relation to everyday life skills and financial literacy*
* *understand that this approach is supported by robust evidence*
* *understand the purpose of the three mathematics curriculum aims and how these can be addressed for all areas of the mathematics curriculum.*
* *develop their confidence and promote an enthusiasm and passion for mathematics.*
* *believe that all children can be successful mathematicians, regardless of social background or other circumstances and that this is their moral purpose as educators.*
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| **Phase** | **Learn that…** | **Learn how to…** |
| **Phase 1** | **Trainees will know:**  | **Trainees will be able to:**  |
| * The three aims of the mathematics curriculum.**LT3.1**
 | * Identify their developmental needs as mathematical educators and independently address these. This will be consolidated whilst on professional practice.
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| * One of the key aims of the mathematics curriculum is for pupils to become fluent in the fundamentals of mathematics, including through varied and frequent practice with increasingly complex problems over time, so that pupils develop conceptual understanding and the ability to recall and apply knowledge rapidly and accurately. **LT3.1, LT4.8**
* This will specifically link to understanding of declarative and procedural knowledge. **LT3.3, LT3.5, LH3.11**
 | * Plan, teach and assess a sequence of lessons developing both conceptual and procedural understanding of number, including counting, place value and both mental and written calculation. This will be consolidated whilst on professional practice. **LH2.3, LH2.7, LH2.9, LT3.5, LH3.3, LH3.7, LH3.8, LT6.1, LT6.3, LT6.4, LH6.1, LH6.3**
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| * One of the key aims of the mathematics curriculum is for pupils to reason mathematically by following a line of enquiry, conjecturing relationships and generalisations, and developing an argument, justification or proof using mathematical language. **LT3.1**
 | * Plan, teach and assess times tables using effective strategies without just using drill and practice and use these strategies to enable pupils to make connections between this knowledge and the inverse operation of division. This may be consolidated whilst on professional practice. **LT2.1, LT2.5, LT2.7, LT2.8, LH2.9, LH3.3, LH3.11, LT4.2, LT6.1, LT6.3, LT6.4, LH6.1, LH6.3**
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| * One of the key aims of the mathematics curriculum is for pupils to solve problems by applying their mathematics to a variety of routine and non-routine problems with increasing sophistication, including breaking down problems into a series of simpler steps and persevering in seeking solutions. **LT3.1**
* This will specifically link to understanding of conditional knowledge.
 | * Promote the use of mathematics specific vocabulary across all areas of mathematics. This will be consolidated whilst on professional practice.
 |
| * The 5 counting principles.
 | * Plan to utilise appropriate concrete and visual resources to support number sense and a conceptual understanding of calculation strategies considering the CPA approach. This may be consolidated whilst on professional practice.**LH2.3, LH2.9, LH3.12, LT4.3, LH4.8, LH5.9**
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| * The declarative and procedural subject knowledge required to plan, teach and assess the following areas effectively and confidently: counting, place value, common mental calculation strategies, common informal written calculation strategies, the formal written calculation strategies as defined in the **appendix of the National Curriculum document.LT2.2, LH2.3, LH2.7, LT3.3, LT3.5, LT4.2, LT6.1, LT6.3, LT6.4**
 | * Promote a mathematical mindset for pupils irrespective of background or ability. This may be consolidated whilst on professional practice. **LT1.1, LT1.2, LT2.1**
 |
| * The advantages of talk and language in mathematics lessons **LH1.2, LT4.7**
 |
| * Key features of effective mathematical games to support learning and teaching of number and calculation.
 |
| * The cognitive factors leading to mathematical difficulties. **LT2.4**
 |
| * The 5 big ideas to promote the teaching of Mastery (NCETM).**LT3.3**
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| * Mastery is misunderstood and not all teachers are clear about it what it actually means.**LT3.3**
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| * Mastery was popularised after its success in East Asia, but it was explicitly based on theories from around the world.

**LH2.3, LT3.3** |
| **Trainees will understand:**  |
| * The three aims of the mathematics curriculum and how they relate to each other.**LT3.1**
 |
| * The term fluency in relation to mathematical progression and the declarative and procedural knowledge associated with number and calculation. **LT3.1, LT3.3, LT3.5, LH3.11**
 |
| * The progression sequence through calculation and place value. **LT2.2, LT2.6, LH2.3, LH2.7, LT3.7**
 |
| * Fluency is not just rapid number recall it is developing a sense of number.**LT2.5, LH3.11**
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| * There are specific areas of mathematics that do require mental recall – number bonds, times tables and how this links to working memory and long term memory.**LT2.3, LT2.4, LT2.5, LH3.11**
 |
| * There is specific technical vocabulary used within counting, place value, calculation and statistics**. LH1.2**
 |
| * That mental strategies inform the informal and formal written strategies to calculation – procedural knowledge **LT2.6, LH2.7, LT3.5, LT3.7, LH3.8, LT4.2**
 |
| * The purpose and presentation of the Multiplication Tables Check (MTC) – declarative knowledge **LT3.3, LT3.5, LH3.11**
 |
| * What constitutes mathematical reasoning.
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| * Mastery is an approach to teaching mathematics ensuring all children achieve to their full potential.**LT3.3**
 |
| * Develop an understanding of a mathematical mindset in relation to the work by Carol Dweck and more recently, Jo Boaler. **LT2.1**
 |
| * The Concrete, Pictorial, Abstract (CPA) approach, in relation to Bruner’s principles of enactive, iconic, symbolic and the value of dual coding. **LH3.12, LT4.3**
 |
| * The conditional knowledge required by pupils to reason mathematically and problem solve in relation to number and calculation**. LT2.1, LH2.7, LT4.2**
 |
| * There are a number of types of problem solving, not just word problems.
 |
| * There are a number of skills required to become an efficient problem solver. **LH2.3, LT3.5**
 |
| * There are different stages to the problem-solving process.
 |
| * The conditional knowledge required by pupils to reason mathematically and problem solve across all areas of the mathematics curriculum. **LT2.1, LH2.3, LH2.7, LT4.2**
 |
| * How their own mathematical schema have developed over time, particularly in relation to calculation strategies. **LT2.9, LT3.7**
 |
| **Composite knowledge / understanding / skills***By the end of this phase trainees will* ***know:**** A range of strategies to support pupil understanding of how to calculate successfully, using mental, informal and formal written methods, including the relevant declarative and procedural knowledge associated with number and calculation.**LT2.2, LT2.7, LT2.8, LT2.9, LH2.3, LH2.7, LH2.9, LT3.3, LT3.5, LT3.7, LH3.8, LT4.2, LH4.3**

*By the end of this phase trainees will* ***understand:**** A secure knowledge of place value underpins the ability to calculate both mentally and use formal written methods.**LT2.2, LT2.6, LT2.7, LT2.8, LT2.9, LH2.3, LH2.7, LT3.2, LT3.7, LH3.7, LH3.8, LT4.2**

*By the end of this phase trainees will* ***be able to:**** Plan, teach and assess a high-quality number (counting, place value, calculation) lesson.**LH2.9, LH3.3, LH3.7, LT6.1, LT6.3, LT6.4**
 | **Assessment pertaining to phase 1*** Assessment will take the form of NNC at the start of the phase and a computer marked assessment at the end of the taught element to assess what has been learned through centre based training. A written submission will evaluate a mathematical game created by the student to support teaching and learning in number and calculation. The game will be evaluated against the key principles explored in the 2018 article by Russo, Russo and Bragg – “Five principles of educationally rich mathematics games.”
* Assessed during PP1a
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| **Research, literature and resources supporting the curriculum design of Phase 1.** | * **Mathematics explained for primary teachers (6th Edition), Derek Haylock & Ralph Manning, 2019**
* **Five principles of educationally rich mathematics games, James Russo, Toby Russo & Leicha Bragg, 2018**
* **Research Review: Mathematics, Ofsted, 2021**
* **Ready to Progress materials, DfE and NCETM, 2020**
* **NCETM Progression maps, NCETM, 2021**
* **NCETM videos**
* **NCETM Mastery materials**
* **CPA approach as proposed by Jerome Bruner 1966**
* **National Curriculum, 2014**
* **Nrich website**
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| **Phase 2** | **Trainees will know:**  | **Trainees will be able to:** |
| * Children may transition from EYFS with varying needs mathematically.
 | * Promote resilience and perseverance when problem solving, whist considering the role of long term memory, working memory and CLT- conditional knowledge. This should be consolidated whilst on professional practice. **LT2.3, LT2.4, LT2.5, LT2.7, LT7.4**
 |
| * The difference between an error and a misconception.**LH1.3, LT2.6**
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| * Strategies for addressing common misconceptions across all areas of the mathematics curriculum.**LH1.3, LT2.6, LH2.6, LT3.4**
 | * Adapt the teaching of number sense to meet the needs of SEN/D pupils, in particular dyscalculic children. This may be consolidated whilst on professional practice. **LT1.3, LT5.1, LT5.2, LT5.3, LT5.7, LH5.2**
 |
| * The names and properties of common 2d and 3d shapes and the associated vocabulary – declarative knowledge and developing associated schema. **LH1.2, LT3.5, LT3.7**
 | * Plan, teach and assess a sequence of lessons following a mastery approach. This should be consolidated whilst on professional practice.**LT2.7, LH2.3, LH2.9, LH3.3, LH3.4, LH3.7, LH4.1, LH5.6, LT6.1, LT6.3, LT6.4, LH6.1, LH6.3**
 |
| * Conversion procedures for common measurements.- procedural knowledge and the links to place value and calculation**.LT2.2, LT3.5**
 | * Plan, teach and assess a guided group session. This may be consolidated whilst on professional practice.**LH2.8, LH3.3, LT4.9, LH4.1, LH5.8, LT6.1, LT6.3, LT6.4 , LH6.1, LH6.3**
 |
| * How to convert between fractions, decimals and percentages. Have a secure understanding of ratio and proportion and use this to teach these concepts in creative ways.- procedural knowledge **LT3.5, LT4.2**
 | * Plan for pupils to have opportunities to learn and develop reasoning skills by including a variety of teaching and learning approaches.- conditional knowledge. This will be consolidated whilst on professional practice.**LT2.7, LH2.8, LT3.5, LH3.3, LH4.1**
 |
| * The cognitive factors leading to mathematical difficulties. **LT2.4**
 | * Assess reasoning skills through questioning, observation and scaffolded conversations. This will be consolidated whilst on professional practice.**LH2.8, LT3.5, LT4.6, LH4.14, LH4.15, LH5.12, LT6.1, LT6.3, LT6.4, LH6.1, LH6.3, LH6.6**
 |
| * Polya’s 4 step process for problem solving.
 | * Implement a problem-solving culture into every mathematics lesson where pupils are engaged by the challenge and demonstrate resilience.- conditional knowledge. This should be consolidated whilst on professional practice. **LT1.1, LT1.2, LT3.2, LT7.4**
 |
| * Van Hiele’s levels of geometric thinking.
 |
| * The 5 big ideas to promote the teaching of Mastery (NCETM).**LT3.3**
 |
| **Trainees will understand:**  |
| * The role of EYFS strategies for mathematics in supporting transition into key stage 1.
 |
| * The progression sequence through Fractions, Decimals and Percentages (FDP), geometry, measure and algebra.**LH2.3**
 |
| * There is specific technical vocabulary used within fractions, decimals and percentages, geometry, measure and algebra and the role of the long term memory in storing this information.**LH1.2**
 |
| * The difference between tiling and iteration and the implications for measuring accurately.
 |
| * The terms transitivity and conservation and how to use these concepts to assess children’s basic understanding of measure.
 |
| * The concept of procedural and conceptual variation.
 |
| * How subitising can support the development of counting skills. **LT2.2, LT3.5**
 |
| * The advantages of talk and language in mathematics lessons. **LT4.7**
 |
| * Collaborative learning and mathematical dialogue are effective approaches to developing reasoning skills and present effective assessment opportunities.**LT3.5, LT6.1, LT6.3, LT6.4**
 |
| * There are different forms of questioning that can elicit different response. **LT4.6, LH4.14, LH4.15, LH5.12**
 |
| * There is specific vocabulary associated with reasoning that will develop as children progress through the curriculum. **LH1.2**
 |
| * There are a number of types of problem solving, not just word problems.
 |
| * There are a number of skills required to become an efficient problem solver. **LH2.3, LT3.5**
 |
| * There are different stages to the problem-solving process.
 |
| * The conditional knowledge required by pupils to reason mathematically and problem solve across all areas of the mathematics curriculum.**LT2.7, LT3.7, LT4.2**
 |
| * Spaced learning can benefit cognitive load, working memory and long term memory. **LT2.4, LT2.8, LH2.11, LH3.10**
 |
| **Composite knowledge / understanding / skills***By the end of this phase trainees will* ***know:**** Common misconceptions across all areas of the mathematics curriculum. **LH1.3**
* The relevant declarative and procedural knowledge associated with extended number, geometry and measure.**LH1.3, LT3.4, LT3.5, LT4.2, LH4.3, LH6.4**

*By the end of this phase trainees will* ***understand:**** How to address common misconceptions across all areas of the mathematics curriculum.**LH1.3, LT2.6, LH2.6, LT3.4, LH6.4, LH6.5, LH6.7**

*By the end of this phase trainees will* ***be able to:**** Plan and teach lessons a series of lessons to avoid misconceptions occurring.**LH1.3, LH2.8, LH2.9, LT3.4, LH3.3, LH4.1, LH6.4**
 | **Assessment pertaining to phase 2**At three interim points throughout the module, non graded assessments will require a demonstration of subject knowledge within the areas of geometry, measure and FDP. Within each assessment students will consider their learning in each area, including common misconceptions, how to address these, relevant and current research, key skills, relevant modelling strategies, effective resources to support understanding, links to reasoning and problem solving.At the end of the module a written assignment will assess students’ understanding of effective teaching in one of three afore-mentioned topics.Assessed during PP1b |
| **Research, literature and resources supporting the curriculum design of Phase 2.** | * **My math lessons are all about learning from your mistakes”: how mixed-attainment mathematics grouping affects the way students experience mathematics, Tom Francome & Dave Hewitt, 2017**
* **Children’s errors in mathematics, Alice Hansen, 2020**
* **Mathematics explained for primary teachers (6th Edition), Derek Haylock & Ralph Manning, 2019**
* **Research Review: Mathematics, Ofsted, 2021**
* **Ready to Progress materials, DfE and NCETM, 2020**
* **NCETM Progression maps, NCETM, 2021**
* **NCETM videos**
* **NCETM Mastery materials**
* **CPA approach as proposed by Jerome Bruner 1966**
* **National Curriculum, 2014**
* **Nrich website**
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| **Phase 3** | **Trainees will know:**  | **Trainees will be able to:** |
| * Mastery is misunderstood and not all teachers are clear about it what it actually means.**LT3.3**
 | * Plan, teach and assess creative and engaging mathematics lessons. This will be consolidated whilst on professional practice.**LH3.3, LH4.1, LH6.1, LH6.3**
 |
| * Mastery was popularised after its success in East Asia, but it was explicitly based on theories from around the world.

**LT3.3** | * Engage parents in their child’s mathematical development. This may be consolidated whilst on professional practice.**LH1.4, LT8.4**
 |
| * How to apply their previous knowledge to link different areas and skills of mathematics - conditional knowledge **LT2.2, LT3.5, LT4.2**
 | * Plan for pupils to have opportunities to learn and develop reasoning skills by including a variety of teaching and learning approaches. This will be consolidated whilst on professional practice. **LT3.5, LH4.1**
 |
| * The difference between a working wall and a passive display.
 | * Plan and assess using a mastery approach, supported by the NCETM materials. This may be consolidated whilst on professional practice.**LT2.8, LH2.3, LH2.8, LH2.9, LT3.3, LH3.3, LH3.4, LH3.7, LH4.1, LT6.1, LT6.3, LT6.4, LH6.1, LH6.3, LH8.3**
 |
| * Promote resilience and perseverance when problem solving, whist considering the role of long term memory, working memory and CLT- conditional knowledge. This should be consolidated whilst on professional practice. **LT1.1, LT1.2, LT7.4**
 |
| **Trainees will understand:**  | * Design an effective and interactive working wall. This may be consolidated whilst on professional practice. This will be consolidated whilst on professional practice.
 |
| * The value of the graphical representations children produce and how these demonstrate development of schema from early years and throughout primary school. **LH3.7**
 | * Identify their developmental needs as mathematical educators and independently address these. This will be consolidated whilst on professional practice.
 |
| * The advantages of creating a mathematics working wall.
 | * Identify common “symptoms” of maths anxiety and propose strategies to support children with their learning with reference to the latest research and support networks (Maths Anxiety Trust). This may be consolidated whilst on professional practice.**LT1.1, LT1.2**
 |
| * The importance of supporting parents and how to engage them effectively.**LH1.4, LT8.4**
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| * How to incorporate drama to promote mathematical thinking and how to incorporate different mathematical topics into longer projects and activities such as “murder mysteries” and “real world” problems.
 |
| * The term “maths anxiety” in relation to cognitive load theory and the possible impact on learning and progress. **LT1.1, LT1.2**
 |
| **Composite knowledge / understanding / skills***By the end of this phase trainees will* ***know:**** Approaches to teaching mathematics creatively.

*By the end of this phase trainees will* ***understand:**** A creative approach to mathematics teaching supports understanding of the relevance of mathematics in the real world, promotes engagement and develops enthusiasm. **LT1.1, LT1.2, LT3.2**

*By the end of this phase trainees will* ***be able to:**** Confidently and effectively plan, teach and assess children’s mathematics skills and understanding through a series of lessons. **LT3.5, LH3.3, LH4.1, LT6.1, LT6.3, LT6.4**
 | **Assessment pertaining to phase 3**Pass/ fail assessment of their learning in this module that asks for students to focus on one area of maths learning, consider how it can be taught creatively and also consider the relevance of 3 of the following (metacognition, working memory, CLT, schema, interleaving, dual coding).Assessed during PP2 |
| **Research, literature and resources supporting the curriculum design of Phase 3.** | * **The Effects of Mathematics Anxiety on Primary Students Theodosia Prodromou & Nick Frederiksen 2018**
* **Mathematics explained for primary teachers (6th Edition), Derek Haylock & Ralph Manning, 2019**
* **Research Review: Mathematics, Ofsted, 2021**
* **Ready to Progress materials, DfE and NCETM, 2020**
* **NCETM Progression maps, NCETM, 2021**
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