Congratulations on your offer of a place on the Primary Programme. We are looking forward to working with you in the coming academic year. The following course preparation is designed to support you in developing your knowledge and understanding about teaching and learning.

A key aspect of being an effective teacher is having good subject knowledge and we will support you through the programme to develop your own knowledge, skills and understanding in each area of the curriculum. You will also develop your understanding of how children learn and develop, and how the effective teacher anticipates barriers to learning so that all children can progress.

There will be a focus on extending your subject knowledge in English and mathematics and you will be expected to take the lead role in identifying your own strengths and weaknesses and in addressing any gaps. You will be supported in this by your university tutors. Please do not assume you need to know everything at this stage. If you do not feel confident in an area it really does not matter. The important thing is for you to recognise where you need to focus your own professional development needs.

The Initial Education Team has put together a few activities to help you prepare for your course. Please complete as much as you can.

Section 1: English Course Preparation
Section 2: Mathematics Course Preparation
Section 3: Science Course Preparation
Section 4: Languages Course Preparation
Section 5: The National Curriculum 2014
Section 6: Educational matters in the primary sector
Section 1: English course preparation

Welcome to the English at UH. There are three English tasks for you to complete.

Preparatory Task 1: Children’s literature

A key factor in successful English and literacy teaching is good knowledge of children’s literature, and the best teachers of English and literacy are those who have a good knowledge of children’s books. With a great knowledge of children’s books, teachers can plan exciting and engaging English lessons as well as effectively promote reading for pleasure.

During the programme you will compile a log of children’s books. In order to start you off on this children’s literature log we suggest that you choose from the list below (you don’t have to complete the list – unless, of course, you want to!) This will enable you to revisit texts from your childhood and also introduce you to some new ones! Come ready to talk about the books and other texts you have read, why you chose them and what you like or don’t like about them in your first English session.

- 5 award winning picture books e.g. from http://www.carnegiegreenaway.org.uk/greenaway/recent_winners.php
- 3 ‘classic’ children’s books
- 2 novels written for ‘young adults’
- 1 non-fiction text aimed at young children and one on the same subject aimed at older children.
- 1 recent children’s film and the book on which it is based
- 1 comic or magazine aimed at primary-aged school children
- A graphic novel for children
- 10 poems by 10 different poets from http://childrenspoetryarchive.org/
- Access and explore Poetry line at https://www.clpe.org.uk/poetryline

Please check the websites below for information about children’s literature:
http://www.booktrust.org.uk/Home
http://readingagency.org.uk/
http://booksforkeeps.co.uk/

Here are some suggested author websites for you to browse:
http://www.roalddahl.com/
http://www.michaelrosen.co.uk/
http://www.emilygravett.com
http://www.michaelmorpurgo.com/
http://www.juliadonaldson.co.uk/

It would be great if you could come with some recommendations for us.
Preparatory Task 2: English Subject Knowledge Audit

Successful teachers of literacy and English have good knowledge of this curriculum subject, plus a good understanding of how to teach it and also of children’s development and progress. There is a current focus on grammar, spelling and systematic synthetic phonics in the English primary curriculum. In order to understand the expectations for primary aged children in English please complete the activities below:

2(i) Please complete the 2019 KS2 Grammar, punctuation and spelling test, accessed from the webpage below:


2(ii) Please read through the 2014 National Curriculum vocabulary, grammar and punctuation glossary and highlight the terminology that you are unsure of or unfamiliar with:


Once you have completed the GPS test and read through the National Curriculum vocabulary, grammar and punctuation glossary please reflect on your own knowledge of spelling and grammar. Perhaps note down some specific areas that you wish to explore further. You will be working on your English subject knowledge throughout your time studying with us so you do not have to feel confident with everything now!

2(iii) An introduction to phonics teaching. Please read the first 2 chapters from this website for an overview. We will be revisiting and building on this during the course.

2 (iv) Articulation of phonemes

It is also important that you develop your skill in articulating the ‘pure’ sounds in the English language. Please see this YouTube clip to see how phonemes are articulated. Have a go at articulating phonemes yourself so that you begin to feel more confident.

https://www.youtube.com/watch?v=BqhXUW_v-1s Articulation of Phonemes

For ideas on how to improve your English subject knowledge we would also recommend.


After identifying areas for development during activities 1-3, please set some English targets by using the English Action plan proforma below.
English Subject Knowledge Action Plan

Construct an action plan to show what areas of English subject knowledge you feel you need to address. Also, begin to think about how you will address these areas for development – what sources and resources will help you (don’t forget that the teaching on the course will support you)? You will need to write sharply focused targets to develop your English subject knowledge. These targets must be achievable in a short space of time (1-2 weeks) and, when achieved, replaced with new targets. At any one time, you should not have more than 3 tightly written targets. Aim for SMART (Specific, Measurable, Achievable, Realistic, Time limited) targets. Please be aware that completing English module units will support you, so include any relevant module units on your action plan.

Please bear in mind that you are responsible for developing your subject knowledge, with the help and guidance of your course tutors, teacher mentor and visiting tutor, so it is important that you actively seek to investigate areas for development.

Please store any work that you complete to develop your English subject knowledge in your English Portfolio.

<table>
<thead>
<tr>
<th>Targets to develop English subject knowledge (SK1-4)</th>
<th>How will you address these targets? What sources of information will help you (books, websites, people you know, university modules etc.)?</th>
<th>By when?</th>
</tr>
</thead>
</table>

Trainee’s signature............................................................ Date........................................

Tutor’s signature ................................................................. Date........................................
Preparatory Task 3: Your personal reading history and experiences

Reading has probably played a larger role in your lives than you imagine. In order to understand the importance of reading you need to go back through past experiences and think about your relationship with written texts: paper based and electronic.

Do you remember the first book you ever read? 
What is your favourite book of all time and why? 
Did anyone read to you as a child? Who? How did you feel about that? 
At what age did you read the most? And in what situations? 
Who taught you to read? Can you remember learning to read? 
What have you read recently? And why? 
Do you always like reading? Why or why not? When do you enjoy it and when does it feel like a chore? 

Please consider these questions to get you thinking about your relationship with reading, in preparation for making an A3 poster of your personal reading history and experiences. Please print your poster and bring it to the first seminar for English (part of your Curriculum Studies module) when we will display your posters and share your ideas.

Aim to include some reflection on your reading experiences. For example, you could consider the different strategies that you use for reading different types of texts. Do you read non-fiction in the same way as a novel? Do you use the same reading skills for text messages and text books? Finish your poster with a concluding sentence:

*When I review my personal reading history, it is clear that books and stories are . . .*

You can create the poster on paper or on screen, and you can use any style or design. Aim to include some images to illustrate your reading history.

We are focusing on reading in this activity as learning to read is one of the most important areas of learning for young children. As a beginner teacher this will be a crucial area of subject knowledge for you to develop.
The English Team recommends…

Below is a list of some of the Primary English Team’s favourite books to get you started on familiarising yourselves with quality children’s literature. There is no need to buy these books – they will be available for loan in the children’s section of your local public library. Happy reading!!!

**Picture books: please read 5 from this list:**

- The Man on the Moon Simon Bartram
- Gorilla Anthony Browne
- The Very Hungry Caterpillar Eric Carle
- Beegu Alexis Deacon
- The Gruffalo Julia Donaldson and Alex Scheffler
- Snail and the Whale Julia Donaldson
- Diary of a Wombat Jackie French
- Meerkat Mail Emily Gravett
- The Incredible Book Eating Boy Oliver Jeffers
- The Tiger who came to Tea – Judith Kerr
- Aaaaargghh, Spider! Lydia Monks
- We’re Going on a Bear Hunt Michael Rosen
- I am Henry Finch Alexis Deacon
- The Dark Lemony Snicket
- The Fox and the Star Coralie Bickford-Smith
- The Promise – Nicola Davis and Laura Carlin
- The day the crayons quit – Drew Daywalt
- The storm whale - Benji Davies
- Ruby’s worry - Tom Percival

**Children’s novels: please read 5 from this list:**

- Pig Heart Boy Malorie Blackman
- The Boy in the striped Pyjamas John Boyne
- The Legend of Spud Murphy Eoin Colfer
- Fantastic Mr Fox Roald Dahl
- The Diary of a Killer Cat Anne Fine
- Stormbreaker Anthony Horowitz
- Diary of a Wimpy Kid Jeff Kinney
- Private Peaceful Michael Morpurgo
- The Firework Maker’s Daughter Phillip Pullman
- Percy Jackson and the Lightning Thief Rick Riordan
- There’s a Boy in the Girls’ Bathroom Louis Sachar
- Varjak Paw S. F. Said
- The boy in the dress David Walliams
- Lola Rose Jacqueline Wilson
- Goodnight Mr Tom Michelle Majorian
- The Wolf Wilder Katherine Rundell
- To the edge of the World – Julia Green
- Little Bits of Sky – S.E. Durrant
- The house with chicken legs- Sophie Anderson
Successful teachers of mathematics have a good knowledge of this curriculum subject, plus a good understanding of how to teach it and how to monitor children’s development and progress. One of the key aspects of effective maths teaching, however, is the attitude towards the subject portrayed by the teacher: a confidence in their own subject knowledge plus an appreciation of strong pedagogy will enable teachers to teach maths in meaningful contexts so that children can appreciate its relevance and value in their own lives.


There is a companion website with some really useful information that will support you in thinking about learning and teaching mathematics: https://study.sagepub.com/haylock5e

Further recommended reading


At the University of Hertfordshire, our belief about the best way to approach mathematics teaching and learning is captured very well by Haylock (our core text, above):

“Being a successful learner in mathematics involves constructing understanding through exploration, problem solving, discussion and practical experience – and also through interaction with a teacher who has a clear grasp of the underlying structure of the mathematics being learnt. For children to enjoy learning mathematics it is essential that they should understand it; that they should make sense of what they are doing in the subject, and not just learn to reproduce procedures and recipes that are low in meaningfulness and purposefulness.” Haylock (2019: 3)

To prepare you for the course, please complete the following four preparatory tasks which will give you a good flavour of mathematics teaching in primary schools today as well as help you identify areas in your own knowledge (SK1) that you need to develop.
Preparatory Task 1:  Orientation Reading

Go to NCETM website (National Centre for Excellence in the Teaching of Mathematics) at www.ncetm.org.uk. This organisation produces magazines for each school phase which contains teaching ideas, subject knowledge enhancement and commentary on latest research. Follow the links on the homepage and read one issue of the Primary Magazine and one issue of the Early Years Magazine (which may be from the archive).

Take this opportunity to register with the NCETM. It is free. In terms of keeping up to date with maths-related initiatives, this is the organisation to use. You might even start following them on Twitter.

Please also read the attached article, ‘Effective Teachers of Numeracy in Primary Schools’ and then consider what this means for you as a teacher of mathematics. How would you characterise your experience of learning mathematics and how has your view of mathematics as a subject been affected by your own school experience?

Preparatory Task 2:  Mathematics subject knowledge audit

Complete the Mental Maths Audit below. This audit will help you to identify your strengths and gaps and, therefore, will support you to identify your development needs. You will need to begin working on these before the course begins. Your maths tutor will ask to see this audit.

Preparatory Task 3:  Mathematics Diagnostic Audit

Complete the Mathematics Diagnostic Audit below which will help you decide which areas of arithmetic you may need to brush up on before you join the programme.

Passing the numeracy professional skills test will have given you a good foundation on which to build your mathematics subject knowledge but this diagnostic audit, which focuses on key areas of arithmetic, asks you to interrogate your knowledge and understanding in a different way.

Preparatory Task 4:  Mathematics Subject Knowledge Action Plan

Use the results from Tasks 2 and 3 to compile an action plan focusing on the key areas of mathematics where you feel less confident. At this stage, your plan should contain at most 3 items, and these items should be sharply focussed – for example ‘improve my knowledge of fractions’ is too broad to be achievable in a short space of time and would be better expressed in the first instance as ‘remind myself how to find equivalent fractions’. Once this tighter target is achieved, another can replace it which continues to develop the area of fractions.

<table>
<thead>
<tr>
<th>Targets to develop mathematics subject knowledge</th>
<th>How will you address these targets? Sources of information to be used: support material, module units, etc.</th>
<th>By when?</th>
</tr>
</thead>
<tbody>
<tr>
<td>To develop my knowledge of equivalent fractions.</td>
<td>Read relevant chapter of Haylock. Use the internet to find explanations which I understand. Discuss with a friend – and see if I can explain in my own words.</td>
<td>2 weeks’ time</td>
</tr>
</tbody>
</table>
Mental maths audit

The following questions will help you to assess where your strengths and gaps are in your mental maths. These questions are taken from the previous Year 6 end of KS2 SAT tests, in which the questions were read out loud and children had a given amount of time to write the answer. **You are not allowed to use a calculator.**

This activity should not be viewed as a test but, rather, a tool for you to use in your subject knowledge development. You are asked to:

1. Read the question twice, after which be aware of the time that passes – have you answered it in the time available? Record whether you (broadly speaking, no need to time yourself) felt you could comfortably do the question in that amount of time (put a tick or cross in the third column).
2. Put your answer in the box provided.
3. Think about what key piece of knowledge you used in order to arrive at your answer within the allotted time (whether or not you got the answer right). If you could not do the question, what key piece of knowledge was missing (eg I couldn’t remember what ‘oct’ meant in octagon)? Record this in the fourth column.
4. Mark your work (an answer sheet is provided) and put your score out of 20 in the box below.
5. Consider what gaps you have, or where you think you would benefit from further work. How will you fill these gaps? Use the Action Plan to record your ideas and begin working on your development.

<table>
<thead>
<tr>
<th>Name:</th>
<th>Score:</th>
<th>/20</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Question</th>
<th>My answer</th>
<th>Can I do this kind of question in…</th>
<th>What key piece of knowledge is needed?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. What is one hundred and twenty add eighty.</td>
<td>5 seconds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. What is half of ninety pence?</td>
<td>p 5 seconds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. How many sixes are there in thirty-six?</td>
<td>5 seconds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. What is double one point seven?</td>
<td>5 seconds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. What number is 100 less than ten thousand?</td>
<td>5 seconds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Add three hundred and eight to four hundred and two.</td>
<td>10 seconds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. What is three times one hundred and fifty?</td>
<td>10 seconds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Question</td>
<td>Answer</td>
<td>Time</td>
<td></td>
</tr>
<tr>
<td>-------------------------------------------------------------------------</td>
<td>--------</td>
<td>--------</td>
<td></td>
</tr>
<tr>
<td>8. I had one pound. I bought two cartons of drink and got thirty pence change. How much did a carton of drink cost?</td>
<td></td>
<td>10 seconds</td>
<td></td>
</tr>
<tr>
<td>9. How many millimetres are there in fifteen centimetres?</td>
<td>mm</td>
<td>10 seconds</td>
<td></td>
</tr>
<tr>
<td>10. Imagine a triangular prism. How many faces does it have?</td>
<td></td>
<td>10 seconds</td>
<td></td>
</tr>
<tr>
<td>11. Add together two and a half and three and a half and four and a half</td>
<td></td>
<td>10 seconds</td>
<td></td>
</tr>
<tr>
<td>12. What temperature is ten degrees lower than seven degrees Celsius?</td>
<td>°C</td>
<td>10 seconds</td>
<td></td>
</tr>
<tr>
<td>13. A rectangle measures 12 centimetres by four centimetres. What is its area?</td>
<td>cm²</td>
<td>10 seconds</td>
<td></td>
</tr>
<tr>
<td>14. What fraction of two pounds is twenty pence?</td>
<td></td>
<td>10 seconds</td>
<td></td>
</tr>
<tr>
<td>15. Divide nought point nine by one hundred.</td>
<td></td>
<td>10 seconds</td>
<td></td>
</tr>
<tr>
<td>16. Add together eight and seven, then multiply the result by four.</td>
<td></td>
<td>15 seconds</td>
<td></td>
</tr>
<tr>
<td>17. Put a ring around the smallest number</td>
<td>0.7</td>
<td>15 seconds</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.077</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.707</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.77</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>7.007</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18. I think of a number, subtract ten and double the result. The answer is forty-four. What is my number?</td>
<td></td>
<td>15 seconds</td>
<td></td>
</tr>
<tr>
<td>20. In a group of forty-five children, there are twice as many boys as girls. How many girls are there?</td>
<td>girls</td>
<td>15 seconds</td>
<td></td>
</tr>
<tr>
<td>Question</td>
<td>Answer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------------------------------------------------------------------</td>
<td>--------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. What is one hundred and twenty add eighty.</td>
<td>200</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. What is half of ninety pence?</td>
<td>45p</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. How many sixes are there in thirty-six?</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. What is double one point seven?</td>
<td>3.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. What number is 100 less than ten thousand?</td>
<td>9 900</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Add three hundred and eight to four hundred and two.</td>
<td>710</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. What is three times one hundred and fifty?</td>
<td>450</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. I had one pound. I bought two cartons of drink and got thirty pence change. How much did a carton of drink cost?</td>
<td>35p</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. How many millimetres are there in fifteen centimetres?</td>
<td>150 mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Imagine a triangular prism. How many faces does it have?</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Add together two and a half and three and a half and four and a half.</td>
<td>10.5 / 10 ( \frac{1}{2} )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. What temperature is ten degrees lower than seven degrees Celsius?</td>
<td>-3 °C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. A rectangle measures twelve centimetres by four centimetres. What is its area?</td>
<td>48 cm(^2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14. What fraction of two pounds is twenty pence?</td>
<td>(\frac{1}{10}) / 10% / 0.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15. Divide nought point nine by one hundred.</td>
<td>0.009</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16. Add together eight and seven, then multiply the result by four.</td>
<td>60</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17. Put a ring around the smallest number</td>
<td>0.7 0.077 0.707 0.77 7.007</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18. I think of a number, subtract ten and double the result. The answer is forty-four. What is my number?</td>
<td>32</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20. In a group of forty-five children, there are twice as many boys as girls. How many girls are there?</td>
<td>15 girls</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Question: **What is the sum of 14 and 28?**

<table>
<thead>
<tr>
<th><strong>Step 1:</strong> Read the question and consider whether you are clear about what you are being asked to do.</th>
<th>I know that ‘sum’ means ‘add’ so I am being asked to add 14 and 28.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 2:</strong> Work out the answer, writing down the method you are using as clearly as you can.</td>
<td>I did it in my head in two stages: I started with 28, added 10 first ((28 + 10 = 38)) and then I added 4 ((38 + 4 = 42)).</td>
</tr>
<tr>
<td><strong>Step 3:</strong> Think about how you would explain to another person why your method works. (Notice that this is different from saying what you did – the emphasis here is on why.) If at all possible, try your explanation out on somebody!</td>
<td>I started with the biggest number because I know that when you add two numbers it does not matter in which order you do so. I reasoned that adding 14 would be easier than adding 28 because it is a smaller number. I broke it down into two parts that I could manage – I added 10 first and then I added the remaining 4, so in total I added 14.</td>
</tr>
</tbody>
</table>
| **Step 4:** What other methods can you think of to work out the answer. (You might even ask people you know how they would work it out and compare it to your own method). | \[
\begin{array}{c|c}
14 + 28 & 14 \\
= 14 + 30 - 2 & + 28 \\
= 44 - 2 & 42 \\
= 42 & 1 \\
\end{array}
\] |
Questions for you to try, using the four steps:

1. What is the difference between 1000 and 10?
2. What is the change when you buy something which costs £5.99 and you pay with a ten pound note?
3. If six people share 342 counters, how many will they have each?
4. What is the total length of 42 ribbons which are each 1.2 metres long?
5. An index on an international stock market was 200 at the beginning of last month and rose by 15%. What was its value at the end of the month?
6. What is \( \frac{6}{8} \) ths of 52?

Support materials
For ideas on how to improve your subject knowledge we would recommend:


Resources on:
www.NCETM.org.uk
www.bbc.co.uk/schools/gcsebitesize/maths
https://study.sagepub.com/haylock5e
**Mathematics Subject Knowledge Action Plan**

You will now need to construct an action plan to show how you will address any areas for development.

Please bear in mind that you are responsible for developing your subject knowledge, with the help and guidance of your teacher mentor and visiting tutor, so it is important that you actively seek to develop any areas of weakness. As you achieve targets on this action plan, you will need to replace them.

Please file any work that you complete to develop your mathematics subject knowledge in your Mathematics Portfolio.

<table>
<thead>
<tr>
<th>Targets to develop Maths subject knowledge</th>
<th>How will you address these targets? What sources of information will you (books, websites, people you know, university modules etc.)?</th>
<th>By when?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Trainee’s signature......................................................... Date..................................

Tutor’s signature..................................................................... Date..................................

Name:
Effective Teachers of Numeracy in Primary Schools: Teachers' Beliefs, Practices and Pupils' Learning.

Mike Askew, Margaret Brown, Valerie Rhodes, Dylan Wiliam, David Johnson
King's College, University of London

Paper presented at the British Educational Research Association Annual Conference
(September 11-14 1997: University of York)

Abstract

This paper reports on part of a study examining the links between teachers' practices, beliefs and knowledge and pupil learning outcomes in the development of numeracy with pupils aged five to eleven. From a sample of 90 teachers and 2000 pupils, we developed detailed case studies of 18 teachers. As part of these case studies we explored the teachers' beliefs about what it means to be numerate, how pupils become numerate and the roles of the teachers. From the data three sets of belief orientations were identified: connectionist, transmission and discovery. Results from pupil assessments suggest that there was a connection between teachers demonstrating strong orientation to one of these sets of beliefs and pupil numeracy gains.

1 Aims of the study

The aims of the study Effective Teachers of Numeracy, funded by the UK's Teacher Training Agency (TTA) were to:

1. identify what it is that teachers of five to eleven year olds know, understand and do which enables them to teach numeracy effectively;
2. suggest how the factors identified can be more widely applied.

The working definition of numeracy used by the project was a broad one:

Numeracy is the ability to process, communicate and interpret numerical information in a variety of contexts.

Evidence was gathered from a sample of 90 teachers and over 2000 pupils on what the teachers knew, understood and did and outcomes in terms of pupil learning.

Studies have pointed to the importance of establishing a particular classroom culture (Cobb, 1986), raising the issue of teachers' belief systems about mathematical knowledge, how it is perceived as generated and learnt, and the impact upon pupils' learning. It may be that beliefs about the nature of the subject are more influential than mathematical subject knowledge per se (Lerman, 1990; Thompson, 1984).
Many studies, particularly in the USA, focus on effective classroom practice and routines (Berliner, 1986) but research demonstrates the difficulty that teacher experience in adopting new practices without an appreciation of and belief in the underlying principles (Alexander, 1992). Further, teachers may have adopted the rhetoric of 'good' practice in teaching mathematics without changes to their actual practices (Desforges & Cockburn, 1987). While teachers' classroom practices and subject knowledge were also foci of this research, this paper concentrates on the findings related to teachers' belief systems. (For full details of the research see Askew et al., 1997).

2 Identifying effective teachers of numeracy

Careful identification of teachers believed to be effective in teaching numeracy was crucial to this study. The idea that effective teachers are those who bring about identified learning outcomes was our starting point for the project. **We decided that as far as possible the identification of effective teachers of numeracy would be based on rigorous evidence of increases in pupil attainment, not on presumptions of 'good practice'.**

From an initial sample size of all the primary schools in three local education authorities (some 587 schools), together with Independent (private) schools, we selected eleven schools, providing a sample of 90 teachers. We selected the majority of these eleven schools on the basis of available evidence (national test scores, IQ data, reading test scores and baseline entry assessments) suggesting that the teaching of mathematics in these schools was already effective.

A specially designed test ('tiered' for different age ranges) of numeracy was administered to the classes of these 90 teachers, first towards the beginning of the autumn term 1995, and again at the end of the spring term 1996 (classes of five year olds were only assessed the second time). Average gains were calculated for each class, providing an indicator of 'teacher effectiveness' for the teachers in our sample.

In order to broadly classify the relative gains, the teachers were grouped into three categories of **highly effective**, **effective**, or **moderately effective**. This classification was made by putting the classes in rank order within year groups according to the average gains made (adjusted to take into account the fact that it was harder for pupils to make high gains if their initial test score was high). The cut-off points between high, medium and low gains were made on pragmatic grounds, so that classes in each year group fell into three roughly equal groups but avoiding any situation where classes with nearly equal adjusted gains were allocated to different groups. The groups were not based on any predetermined quantitative differences between the classes based on expectations of what a 'medium' gain should be.

3 Teacher case study data

Research on the links between knowledge, beliefs and practice suggested a mix of techniques to elicit teachers' knowledge and understanding backed up by classroom observation to examine actual practices. From the sample of 90 teachers we worked closely with 18 teachers who formed our case study teachers providing data over two terms on classroom practices together with data on teacher beliefs about, and knowledge of, mathematics, pupils and teaching. These teachers were identified in advance of the second round of pupil assessment, and chosen through discussion with head teachers and, where appropriate, with advice from the LEA inspectors and advisors. While the
emphasis was on identifying effective teachers, the group of 18 were chosen so that their pupils were evenly distributed across ages 5 to 11 (year groups 1-6).

3.1 Classroom observations

In total, 54 lessons were observed, three for each of the case study teachers. Data gathered included a focus on:

- organisational and management strategies - how time on task is maximised, catering for collective and individual needs, coping with range of attainment
- teaching styles - intervention strategies, questioning styles, quality of explanations, assessment of attainment and understanding, handling pupil errors
- teaching resources - sources of activities, range of tasks, resources available, expected outcomes
- pupil responses - ways of working, evidence of understanding.

3.2 Case study teacher interviews

Fifty-four interviews were conducted, three for each case study teacher:

- background interview: providing evidence on training and experience as well as information on beliefs, knowledge and practices in teaching numeracy; teachers own perceptions of what has made them successful teachers of numeracy, and reasons for factors identified
- 'concept mapping' interview: this interview was based around a task that explored the teachers understanding of aspects of mathematics related to teaching numeracy.
- 'personal construct' interview: this interview was structured around a task that focused on the particular group of pupils that the teacher was currently teaching in order to explore the beliefs and knowledge about pupils and how they came to be numerate.

The data were analysed using qualitative coding methods and the constant comparative method to build up models of belief systems (Lincoln & Guba, 1985; Miles & Huberman, 1984; Strauss & Corbin, 1990)

4 Orientations in teachers' beliefs.

From the analysis of the case study data three models of sets of beliefs that emerged as important in understanding the approaches teachers took towards the teaching of numeracy:

- connectionist - beliefs based around both valuing pupils' methods and teaching strategies with an emphasis on establishing connections within mathematics;
- transmission - beliefs based around the primacy of teaching and a view of mathematics as a collection of separate routines and procedures;
- discovery - beliefs clustered around the primacy of learning and a view of mathematics as being discovered by pupils.

<table>
<thead>
<tr>
<th>Beliefs about what it is to be a</th>
<th>Connectionist</th>
<th>Transmission</th>
<th>Discovery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Being numerate involves:</td>
<td>Being numerate involves:</td>
<td>Being numerate involves:</td>
<td></td>
</tr>
<tr>
<td>• Using both efficient and effective</td>
<td>• The ability to perform set</td>
<td>• Finding the answer to a calculation by</td>
<td></td>
</tr>
<tr>
<td>numerate pupil</td>
<td>methods of calculation</td>
<td>procedures or routines</td>
<td>any method</td>
</tr>
<tr>
<td>----------------</td>
<td>-----------------------</td>
<td>-----------------------</td>
<td>------------</td>
</tr>
<tr>
<td></td>
<td>• Confidence and ability in mental methods</td>
<td>• Confidence and ability in paper and pencil methods</td>
<td>• Confidence and ability in practical methods</td>
</tr>
<tr>
<td></td>
<td>• Selecting a method of calculation on the basis of both the operation and the numbers involved</td>
<td>• Selecting a method of calculation primarily on the basis of the operation involved</td>
<td>• Selecting a method of calculation primarily on the basis of the operation involved</td>
</tr>
<tr>
<td></td>
<td>• Awareness of the links between aspects of the mathematics curriculum</td>
<td>• Confidence in separate aspects of the mathematics curriculum</td>
<td>• Confidence in separate aspects of the mathematics curriculum</td>
</tr>
<tr>
<td></td>
<td>• Reasoning, justifying and eventually proving results about number</td>
<td>• Able to ‘decode’ context problems to identify a particular routine or technique</td>
<td>• Being able to use and apply mathematics using practical apparatus</td>
</tr>
</tbody>
</table>

| Beliefs about pupils and how they learn to become numerate | Becoming numerate is a social activity based on interactions with others: | Becoming numerate is an individual activity based on following instructions | Becoming numerate is an individual activity based on actions on objects |
|-----------------------------------------------------------|---------------------------------------------------------------|---------------------------------------------------------------|
| Pupils learn through being challenged and struggling to overcome difficulties | Pupils learn through being introduced to one mathematical routine at a time and remembering it | Pupils need to be ‘ready’ before they can learn certain mathematical ideas |
| Most pupils are able to become numerate | Pupils vary in their ability to become numerate | Pupils vary in the rate at which their numeracy develops |
| Pupils have calculating strategies but the teacher has responsibility for helping them refine their methods | Pupils’ strategies for calculating are of little importance – they need to learn standard procedures | Pupils’ own strategies are the most important; understanding is based on working things out yourself |
| Misunderstandings need to be recognised, made explicit and worked on | Misunderstandings are the result of failure to ‘grasp’ what was being taught and need to be remedied by reinforcement of the ‘correct’ method | Misunderstandings are the result of pupils not being ‘ready to learn the ideas |

| Beliefs about how teaching and learning are seen as complementary | Teaching is seen as taking priority over learning | Learning is seen as taking priority over teaching |
Table 1: Key distinctions between connectionist, transmission and discovery orientations towards teaching numeracy.

These orientations are "ideal types". No one teacher is likely to fit exactly within the framework of beliefs of any one of the three orientations. Many will combine characteristics of two or more.

However, it was clear that those teachers with a strong connectionist orientation were more likely to have classes that made greater gains over the two terms than those classes of teachers with strong discovery or transmission orientations.

Analysis of the data revealed that some teachers were more predisposed to talk and behave in ways that fitted with one orientation over the others. In particular, Anne, Alan, Barbara, Carole, Claire, Faith (the teacher initial matches the school code, so Anne and Alan are from same school), all displayed characteristics indicating a high level of orientation towards the connectionist view. On the other hand, Beth and David both displayed strong discovery orientations, while Elizabeth and Cath were both clearly characterised as transmission orientated teachers.

Other case study teachers displayed less distinct allegiance to one or other of the three orientations. They held sets of beliefs that drew in part from one or more of the orientations. For example, one teacher had strong connectionist beliefs about the nature of being a numerate pupil but in practice displayed a transmission orientation towards beliefs about how best to teach pupils to become numerate.
The connection between these three orientations and the classification of the teachers into having relatively high, medium or low mean class gain scores suggests that there may be a relationship between pupil learning outcomes and teacher orientations.

5 Links between orientation and practice

5.1 Orientation and the role and nature of mental strategies in pupils becoming numerate

All the teachers, whether leaning towards a connectionist, transmission or discovery orientation saw some aspects of mental mathematics as important. Knowing basic number bonds and multiplication facts provided a baseline of expectations within all three orientations.

However, the connectionist orientated teachers viewed mental mathematics as going beyond this recall of number facts. Mental mathematics did not involve simply knowing number bonds but having a conscious awareness of connections and relationships to develop mental agility.

This mental agility meant that for the connectionist teacher’s mental mathematics also involved the development of flexible mental strategies to handle efficiently number calculations. Working on mental strategies, they believed, laid foundations that extended the pupils' levels of competency. Developing confidence in flexible mental methods meant that pupils would be able to tackle calculations for which methods had not been taught.

5.2 Orientation and teacher expectations

The connectionist orientated teachers placed strong emphasis on challenging all pupils. They believed that pupils of all levels of attainment had to be challenged in mathematics. Being stretched
was not something that was not restricted to the more capable pupils. They had high levels of expectations for all pupils irrespective of ability. Intelligence was not seen as static and all pupils were regarded as having the potential to succeed.

In contrast the transmission and discovery orientated teachers may provide challenge for the higher attaining pupils but structured the mathematics curriculum differently for lower attaining pupils.

5.3 Orientation and style of interaction

The connectionist teachers' lessons were generally characterised by a high degree of focused discussion between teacher and whole class, teacher and groups of pupils, teacher and individual pupils and between pupils themselves. The teachers displayed the skills necessary to manage effectively these discussions. The teachers kept pupils focused and on task by organising these discussions around problems to solve, or sharing methods of carrying out calculations.

In school A, one of the most effective schools, there was a consistent approach to interacting with pupils throughout the years. Right from age five pupils were expected to be able to explain their thinking processes. Because the pupils were explaining, rather than simply providing answers to questions that the teacher already knew the answer to, the lessons were characterised by dialogue. In this discussion both parties, teacher and pupils, were having to listen carefully to what was being said by others. The result was pupils who, by eleven, were confident and practised in sharing their thinking and challenging the assumptions of others.

5.4 Orientation and the role of mathematical application

For the discovery or transmission orientated teachers, application of knowledge involved pupils putting what they had previously learnt into context. Problems presented 'puzzles' where the pupils already have the required knowledge and the challenge is only to sort out which bit to use. Alternatively, problems were a means of demonstrating to pupils the value of what they are learning.

The connectionist orientated teachers also recognised the importance of being able to apply computational skills. But over and above this they did not see it as a necessary pre-requisite that pupils should have learnt a skill in advance of being able to apply it. Indeed, the challenge of an application could result in learning.

6 Discussion

The importance of these orientations lies in how practices, while appearing similar may have different purposes and outcomes depending upon differences in intentions behind these practices.

We would suggest that these orientations towards teaching mathematics need to be explicitly examined in order to understand why practices that have surface similarities may result in different learner outcomes. While the interplay between beliefs and practices is complex, these orientations
provide some insight into the mathematical and pedagogical purposes behind particular classroom practices and may be as important as the practices themselves in determining effectiveness.

Other teachers may find it helpful to examine their belief systems and think about where they stand in relation to these three orientations. In a sense the connectionist approach is not a complete contrast to the other two but embodies the best of both them in its acknowledgement of the role of both the teacher and the pupils in lessons. Teachers may therefore need to address different issues according to their beliefs: the transmission orientated teacher may want to consider the attention given to pupil understandings, while the discovery orientated teacher may need to examine beliefs about the role of the teacher.

References

This document was added to the Education-line database 28 November 1997
Section 3: Science course preparation

As a primary school teacher, you will teach elements of biology, chemistry and physics and you will need to develop your knowledge, skills and understanding in all three areas so that you can teach this exciting and dynamic subject with confidence and competence.

There are three tasks to undertake:

Preparatory Task 1 – Personal Reflection

- Reflect on your experience as a learner of science in primary and secondary school. When reflecting we would like you to focus on 2 events; 1 which you view as being a positive experience and another which you view as being less positive. When making notes on these two experiences consider the following:
  - How did you feel about science as a learner at that time? Was science a subject that interested/excited you? Do you feel that influenced your experiences at that time?
  - Why do you feel each experience was either positive/negative? What was it the teacher was doing? What were you doing?
  - What do these reflections tell you about quality learning and teaching in science?

Preparatory Task 2 – Virtual Learning/Online supportive material

There is a wealth of supportive websites available to support science learning and teaching within the primary classroom. For the purpose of this task we would like you to focus on one; Explorify.

1) Create an account with Explorify, it is free to use. Follow the following link to their website: https://explorify.wellcome.ac.uk/
2) Explore the website and its functionality. When doing so identify what you like about the site. Equally, what do you not like about the site? As a teacher you have a professional voice to be able to critique resources and select those that will be of benefit to you and your class of individual learners.
3) Select a lesson to engage with more fully. Begin to unpick how the lesson is develops learning. What structures/mechanisms are there in the lesson to support knowledge and/or skills acquisition.

Preparatory Task 3 – Science, what is the Big Idea?

The science National Curriculum sets out the statutory subject coverage requirements for all state funded primary schools in England, available at https://www.gov.uk/government/publications/national-curriculum-in-england-science-programmes-of-study/national-curriculum-in-england-science-programmes-of-study. This task is asking you to engage with the National Curriculum and one other document which support a teacher in ensuring subject coverage.
The second document is the ‘Working with Big Ideas’ document. Please follow the link to obtain a copy of this document:

The full document is quite weighty, so we have also included a summary of the ‘Big Ideas’ as a word document below to use when engaging with the task.

- How has the National Curriculum for primary science separated learning out? How does it support progression?
- How does the ‘Working with Big Ideas’ material support and strengthen the National Curriculum and help show progression in conceptual understanding?
- Within the ‘Big Ideas’ supporting word document add your thoughts about the National Curriculum themes that may be appropriate to link to each ‘Big Idea’ from 1 – 10

As a primary school teacher, you will teach elements of biology, chemistry and physics and you will need to develop your knowledge, skills and understanding in all three areas so that you can teach this exciting and dynamic subject with confidence.

**Section 4: Languages course preparation**

You will no doubt be aware that the government is having a renewed emphasis on primary aged children learning languages and it is now compulsory for 7-11 year-olds to learn a modern or ancient foreign language.

In many primary schools, specialist language teachers are often used. Even if that is the case in the school you will teach in, it is important that you develop the skills to support acquisition of a foreign language by using, for example, standard classroom routines as a means of practising. Moreover, you will want to show you value the cultural diversity of your pupils and that may well lead you to embracing the languages of children in your class who are, for example, bilingual.

Therefore, we would like to set you a challenge before you start the course. By undertaking these tasks, we hope you will begin to explore the many resources that are available – many of them online – which support the teaching of languages.

**Preparatory Task 1**

See if you can begin to teach yourself some of the basics in French or in Spanish. Download the app Duo Lingo and try and learn the numbers 1-10, some colours, the months of the year, days of the week, family members and basic greetings. Be prepared to have a go in September.

**Preparatory Task 2**

Have a go at the free trial on the website called “Babelzone”. Have a look at the activities, phonics, stories and songs. Have a look also at the website Mama Lisa World at some of the traditional songs from France, Spain and Germany. These are just two of the resources available to generalists who are beginning to teach languages.

**Section 5: The National Curriculum 2014**

The current National Curriculum came into effect from September 2014 for Key stage 1 and 2. You
need to start to become familiar with this important document as it sets out the statutory framework which teachers must deliver.

You can access the National Curriculum 2014 at https://www.gov.uk/government/publications/national-curriculum-in-england-framework-for-key-stages-1-to-4

Before September you need to familiarise yourself with the primary National Curriculum 2104:

- Read Sections 1-6 which set the context for the National Curriculum.
- Scan Section 7 to understand how the programmes of study and attainment targets are set out for the curriculum subjects.
Section 6: Educational matters in the primary sector

Have a read through of the following key areas. You may find it useful to make your own notes about what you are reading and your thinking as it emerges. Do remember you may question what you are reading – i.e you can engage critically with the material here.

**Behaviour for learning**

**Special Educational Needs in mainstream schools**
EEF (2019) Special Educational Needs in mainstream schools

**Understanding ‘the child’ and child development**
Module 1.1
Sections 2, 4, 6, 8, 11, 12, 13, 14 and 15
www.complexneeds.org.uk/modules/Module-1.1-Understanding-the-child-development-and-difficulties/All/m01p010a.html

**Tackling educational disadvantage**