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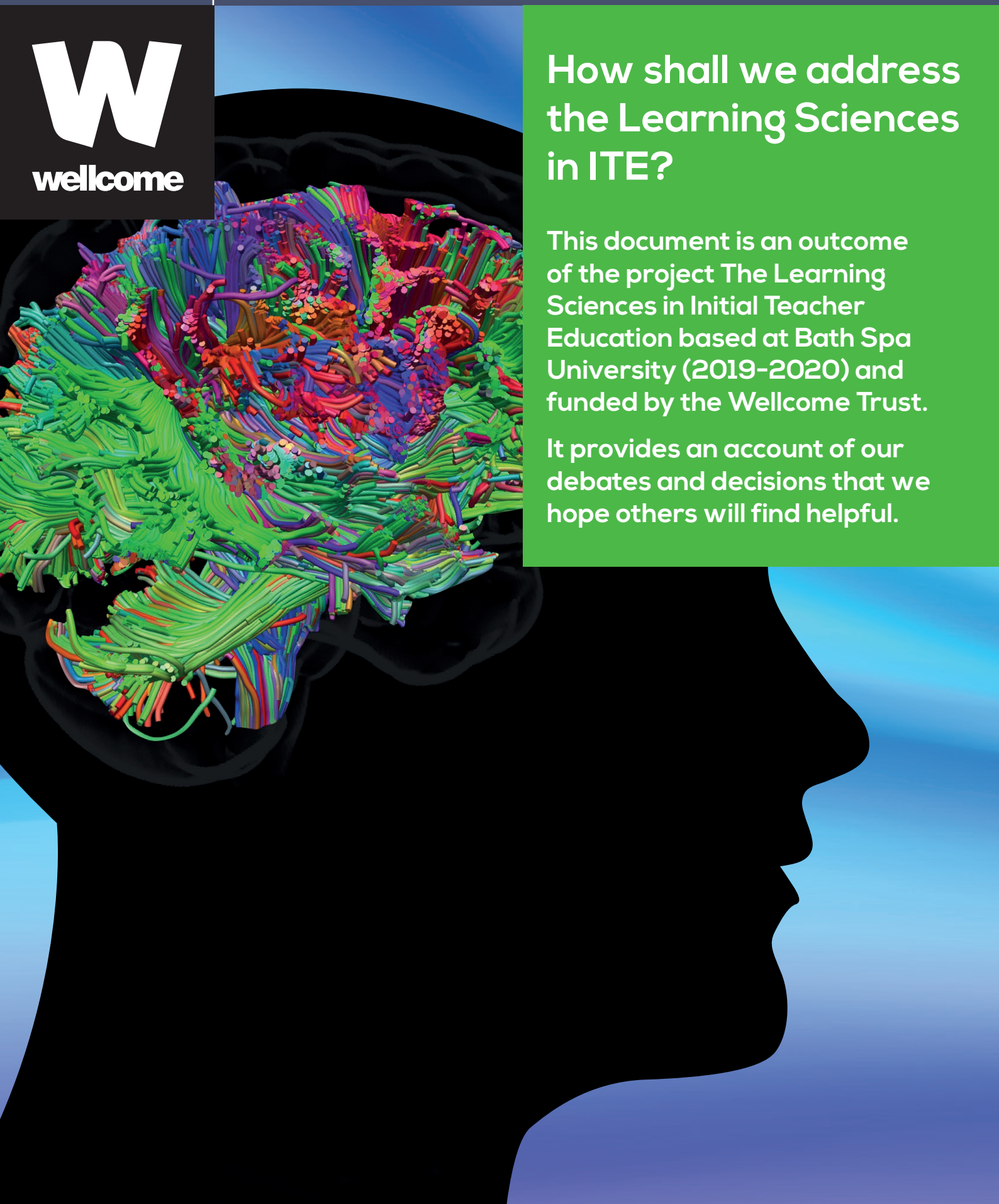


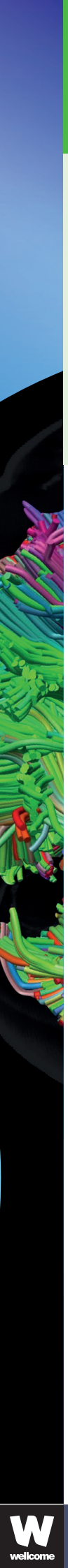
# How shall we address the Learning Sciences in ITE?

This document is an outcome of the project The Learning Sciences in Initial Teacher Education based at Bath Spa University (2019-2020) and funded by the Wellcome Trust.

It provides an account of our debates and decisions that we hope others will find helpful.

# Introduction
# Exploring the Issues and Developing a Rationale (Intent)

**Cognitive psychology and neuroscience don't provide definitive answers to complex educational questions. We see them as offering new information, frameworks and perspectives that should be examined in relation to other educational ideas and aims. We take a positive view of the new possibilities for understanding learning: research from the learning sciences could extend existing ideas or offer different kinds of explanations. If in this process contradictions appear we can and should use that as a provocation for debate. Initial Teacher Education (ITE) could play a key role in this through the ways in which we position research, literature and theory in the curriculum and discuss it with trainee teachers. In this document we share our experience of curriculum development within a Primary PGCE course.**



*"This is a lens that helps us look at learning theory in a different way."*
(PGCE tutor)

In England, the introduction of the Initial Teacher Training Core Content Framework (ITT CCF) (DfE, 2019), which particularly draws on literature from cognitive psychology to shape a view of how children learn, makes this challenge immediate and gives it a particular form.

However, the challenge of the place of the learning sciences in teacher education is a global issue, being addressed internationally (see for example: The Science of Learning Research Centre in Queensland, Australia, the BrainU programme for teachers in Minnesota USA; and more locally in Cambridge Centre for Neuroscience in Education |, London Centre for Educational Neuroscience and Bristol Science of Learning – Engage Build Consolidate**)**. Some universities now offer specialist masters degrees in educational neuroscience.

There are concerns about scientific frameworks being applied to education. These include that learning is conceptualised as acquisition not participation and that 'evidence informed practice' positions teachers as passive recipients of technical knowledge when professional action by teachers requires contextual value-based judgements (e.g. Biesta, 2007; Hordern, 2019). There are also concerns within the education neuroscience community that the CCF for ITE takes a partial view of cognitive neuroscience research and calls for a more nuanced view that addresses sensory, emotional and social dimensions of learning (Turvey et al., 2019). As research into the brain continues we can expect discussion about how this should relate to education to develop over the coming decades.

**Our response has been to:**

1. Locate cognitive psychology within the broader 'Science of Learning', and the even broader 'Learning Sciences' and with reference to existing educational ideas.
2. Develop open-access material which supports ITE curriculum development that addresses and goes beyond the ITT Core Content Framework.
3. Embrace the possibilities of new lenses on learning.

This response is explained and detailed over the following pages. With a pragmatic eye to the Ofsted Inspection Framework (Ofsted, 2020:22), we have noted where the structure of this document pertains to Intent, Implementation and Impact.

# Ways forward for addressing the Learning Sciences in Primary ITE (Implement)

## 1. Locate cognitive psychology within the broader 'Science of Learning', and the even broader 'Learning Sciences' and with reference to existing educational ideas.

The approach that we have taken is to educate ourselves more broadly about the learning sciences. This has included a recognition that this is a huge and complex body of research encompassing biological, psychological and educational research into the brain, nervous systems and learning.

For most tutors in ITE this venture into cognitive psychology and neuroscience takes us beyond the literature with which we are familiar. In many cases it requires knowledge that we don't currently have in order to judge the quality of research and the value of ideas and literature in this new domain. There are considerable challenges for university ITE tutors in coming to a sufficiently robust critical understanding of this field. Many tutors express the very real concern that they might introduce misunderstandings and perhaps create new neuromyths (Howard-Jones, 2014). In our experience, interdisciplinary working was essential to developing a sufficiently robust understanding of concepts and their limitations (McMahon and Etchells, 2018).

## Exploring Meanings - Terms and Definitions

### What shall we call it?

There are many different terms for these overlapping content areas of science and education. They carry slightly different meanings that are worth exploring. In particular it is worth considering how educational knowledge and practice is related to the science; issues of 'bridging' have been a point of discussion, but a consensus seems to be emerging that the more biological dimension of brain research in the form of neuroscience can make a contribution to education both in its own right and by informing psychology (Thomas and Ansari, 2020). Debates on the relationship between theory and practice are not new to teacher education (see for example Winch et al., 2015). Education is already a multidisciplinary field drawing on sociology, philosophy, linguistics, as well as psychology and arguably neuroscience simply adds another dimension. It is worth recognizing however, the power of 'neurorealism' in popular discourses in which neuroscience seems to have the final word on controversies (Gruber, 2017). This may articulate the intuitive discomfort of some ITE tutors.

Sociologists of education Furlong and Whitty (2017) make a helpful distinction between the 'New Science' of Education, and the relatively new 'Learning Sciences' arguing that the former takes a stance in which theory is applied to practice, whereas the Learning Sciences takes a more integrated view of knowledge. The 'New Science of Learning is characterised by randomised control trials and systematic reviews to establish 'what works'. Although the 'Learning Sciences' also have an empirical basis, they are overtly interdisciplinary, conceiving learning broadly and aiming to support learning in real world contexts through design-based research (Furlong and Whitty, 2017). Another term, the Science of Learning (SoL), based on cognitive neuroscience, is less about 'what works' and more about teachers understanding 'how it works' (Howard-Jones et al., 2020). A selection of terminology and some (contestable) definitions are presented below.

## Different terms used and their meanings:

**Cognitive Psychology:** the scientific study of mental abilities such as learning, attention, memory, language, perception, thinking.

**Science of Learning:** knowledge based on cognitive neuroscience that is applicable to education

**Learning Sciences:** '...interdisciplinary empirical investigation of learning as it exists in real-world settings and to how learning may be facilitated…' and 'includes members from cognitive science, educational psychology, computer science, anthropology, sociology, information sciences, neurosciences, education, design studies, instructional design, and other fields.'(https://www.isls.org/).

**Cognitive Science:** 'an interdisciplinary science that draws on many fields (such as psychology, artificial intelligence, linguistics, and philosophy) in developing theories about human perception, thinking, and learning.' (Merriam-Webster online dictionary)

**Neuroscience:** the scientific study of the structure and function of the nervous system.

**Mind, Brain and Education (MBE):** a transdisciplinary academic field that brings together education, biology and cognitive science (International Mind, Brain and Education Society)

**Educational neuroscience:** 'is an emerging field whose goal is to translate new insight, garnered from the study of neural mechanisms underpinning learning, into practical applications in the classroom in order to improve educational outcomes'. (Thomas and Ansari 2020: 1)

**The 'New Science' of Education:** 'promises significant improvements in educational outcomes by finding out 'what works' through the application of 'rigorous research' - typically defined as RCTs (Randomised control trials)and/or systematic reviews.' (Furlong and Whitty, 2017:28).

In this document we are using the term Science of Learning to mean the knowledge from cognitive psychology and neuroscience that is relevant to education and 'The Learning Sciences' as an aspirational view of how many disciplines could relate to practices in developing knowledge.

In the process of getting to grips with the Science of Learning we also found it helpful to gain a quick introduction to some terms from cognitive psychology and neuroscience. They are summarised in the glossary below and considered in more depth in our document The Core Content Framework for ITE and the Learning Sciences.

### Glossary of key concepts:

**Neuroplasticity:** The continuous changing of connections between brain cells in response to experience.

**Spaced practice:** Spacing learning of information over repeated sessions over time.

**Retrieval practice:** Bringing learned information from long-term memory to working memory.

**Elaboration:** connecting new information to existing knowledge; asking (and explaining) why and how.

**Interleaving:** Tackling different problems or ideas in a sequence, as opposed to attempting multiple versions of the same problem in one go (i.e., blocking).

**Concrete examples:** When studying abstract concepts, illustrate them with specific examples; providing supporting information to supplement content.

**Dual Coding:** Combining verbal information - words (as speech or text or) with visuals.

**Cognitive load:** The cognitive load involved in a task is the cognitive effort (or amount of information processing) required by a person to perform the task (Reif, 2010).

**Neuromyth:** Common misunderstandings of how the brain works e.g some children are left brained? learners and some are right brained learners.

## 2. Develop open-access material which supports ITE curriculum development that addresses and goes beyond the ITT Core Content Framework.

**Open access material is available at: https://www.bathspa.ac.uk/learning-sciences.**

We have developed a document, also available in the form of web pages: The Learning Sciences and the Core Content Framework for ITE. This is intended to support ITE tutors in the process of understanding some important ideas from the learning sciences but also to 'get a feel for' the kinds of research that are going on and where there are some points of debate. Other open access resources explain the cognitive psychology principles that are evident in the ITT CCF (see for example the Learning Curriculum offered by the Ambition Institute https://www.ambition.org.uk/blog/explaining-science-learning-teachers/ ), but we have aimed to do something different by locating these ideas within the broader context of the field of education and of the learning sciences. This has been an ambitious undertaking! Selection has been necessary that will inevitably reflect our values and perspectives. We intend that this will be refined and developed over time and feedback is welcomed.

Taking literature and ideas from the learning sciences into account also requires changes to curriculum planning. Given the short time that post-graduate trainees have for university-based training (typically 12 weeks), decisions have to be made about what content to include and what to leave out. University tutors have rightly raised concerns about what might be lost if more content from the learning sciences is included. In particular there are concerns that social perspectives on learning and knowledge may be sidelined. We are clear that this must not happen; going beyond cognitive psychology to explore other neuroscience perspectives has opened up new possibilities for understanding the social and emotional dimensions of learning.

In England, the ITE Core Content framework (DfE, 2019) provides a statutory minimum curriculum content. The evidence base for this has been made explicit (OfSted, 2019) and this includes reference to the 'Learning Sciences' (p 16) defined as 'cognitive science'. In going beyond that minimum in designing the curriculum, it seems a reasonable expectation that university-based ITE provides a clear rationale for the ways in which academic literature and professional expertise underpin the course and how selections have been made. Knowledge is not static; research and debate are on-going, and courses with a secure academic foundation will reflect this.

The ITT CCF is structured using the same headings as those in the Teachers' Standards (DfE, 2013). It is Teachers' Standard 2 - How Pupils Learn that is the main focus for the document that we have developed here, although we look at some other statements where we judge that the learning sense has something particular to offer. The section How Children Learn is based on a cognitive psychology view of learning as memory. This is in line with the view of Willingham (2017) that teachers would benefit from a single coherent model of learning and that the multiplicity views on learning in the academic field of education are unhelpful to teachers and quickly forgotten as irrelevant. In an explanation consistent with his position, he argues that too much complexity contributes to the cognitive overload of new teachers. We agree that trainee teachers must be presented with a manageable account of learning. However, we don't agree that this needs to be a singular view as this is not an 'intellectually honest' (Bruner, 1960) representation of the state of knowledge. It follows that teacher educators should have a deeper understanding in order to be able to select the most appropriate content for the curriculum at this stage of teachers' careers. A selection of SoL concepts is presented by Paul Howard Jones and colleagues at the University of Bristol (Howard-Jones et al 2020) and explained on their website scienceoflearning-ebc.org.

Given that the ITT Core Content Framework clearly states that the 'Providers should ensure their curricula encompass the full entitlement described in the ITT Core Content Framework, as well as integrating additional analysis and critique of theory, research and expert practice as they deem appropriate.' (DfE 2019: 4), there are decisions to be made within each ITE institution about how to frame the view of learning presented in the CCF and what kinds of critique are included. For most university -based ITE providers this is likely to include considering how to reconcile existing teaching about how children learn, often based on presenting accounts of learning such as constructivism with Piagetian and Vygotskian perspectives (e.g. Wray, 2018) with the memory-based model in the ITT CCF.

## 3. Embrace the possibilities of new lenses on learning - considering the Learning Sciences across the ITE curriculum

In primary ITE, curriculum planning is complex; subject-specific expertise and domain-related bodies of literature and professional experience have to be brought together into a coherent whole that educates future teachers to teach across the curriculum, develop supportive relationships with children and play a key role within school communities and the wider structure of the education system. Most primary ITE courses reflect this by having both subject -based teaching (English, Science, Art, etc) and sessions such as 'Professional Studies' and 'Inclusion'.

In this project we took this existing structure and moved iteratively between considering the overarching 'key concepts' of SoL we wanted to be addressed in the PGCE and how ideas from SoL relate to existing bodies of knowledge in the subject/content areas/domains of Professional Studies, English, Maths, Science, ICT, and SEND. It is worth noting that considering English in the ITT CCF requires a deep understanding of the teaching of reading and we felt we did not have sufficient expertise and time within this project to do this justice and so have not addressed this in full. (Time did not permit us extending this to all curriculum subjects.)

| ITE curriculum strand/subject | Possible ITT CCF elements to address | Possibilities for exploring broader Learning Sciences perspectives |
|---|---|---|
| Professional Studies | Learning explained in terms of working memory and long term memory<br>Attention (focus and engagement)<br>Motivation<br>Challenging the myth of Learning Styles<br>Teachers as role models - understanding our cognitive biases | Critical consumers of neuroscience (VAK myth, Left brain/Right brain myth, Mindset, 'Brain Training', retrieval practice)<br>Neuroplasticity - we grow our own brains through our actions in our environment<br>Connectivity - the brain operates as networks<br>Emotion and cognition are intertwined<br>Automatic and controlled processing<br>The social brain - knowledge of the minds of others (mentalizing), knowledge of our own minds, self regulation<br>Teachers as researchers - understanding our own cognitive biases when interpreting research. |
| Inclusion and Diversity | Cognitive Load Theory - Considering demands on working memory<br>Pupils learn at different rates and need different support e.g. receptive language, processing time | Neurodiversity - every brain is unique,<br>Cognitive biases - what are our biases in relation to different groups of people? |
| Science | The importance of prior knowledge<br>Integrating new ideas with existing knowledge<br>Developing misconceptions<br>Modelling makes abstract ideas concrete | Elicitation and memory formation - connecting to existing ideas<br>Critical review of a specific neuromyth through developing scientific literacy: fish oils<br>Locating the brain within the whole body<br>Embodiment - why hands-on matters |
| English | Purposeful practice<br>retrieval practice and spaced learning<br>Scaffolding and 'guidance fading'<br>Guidance for group work | Phonology and rhythm |
| Maths | Cognitive load theory - retrieval practice and spaced learning<br>Worked examples<br>Pupil beliefs about learning (Mindset) | Elaboration (building wider connections) and a relational view of knowledge<br>Maths anxiety (cognition and emotion are interrelated)<br>Early maths -space and the body, finger gnosis |
| Computing | Critical thinking requires subject knowledge<br>The challenges of transferring learning to a new context | What is the evidence on the impact of 'screen time'? |

| ITE curriculum strand/subject | Possible ITT CCF elements to address | Possibilities for exploring broader Learning Sciences perspectives |
|---|---|---|
| Trainee Resilience | Metacognitive Strategies<br>Self regulation of emotions | The social brain - knowledge of the minds of others (mentalizing), knowledge of our own minds, self regulation<br>Understanding anxiety<br>Metacognitive processes in reflection and teaching |
| Early years | Self-regulation | Development of the social brain - joint attention, tracking biological motion, copying movements, neuroscience of attachment, sensitive periods, self-regulation, sense of self |

**This approach seems a productive way forwards because:**

- Tutors are interested in their own specialisms
- Focusing on a few aspects of the learning sciences that were of particular relevance to tutors' day to day work makes it more manageable to address in depth
- In the process, the science of learning is juxtaposed with educational literature, enabling tutors to identify where it supports, extends, shifts or challenges existing ideas.
- Tutors who have developed a particular expertise in the learning sciences and debates around it can share this wider knowledge with all students in professional studies.

There is still much work to do to provide a coherent, critical discussion of the learning sciences from the perspective of education theory and pedagogy across different subject areas, examining where ideas are contested and where there is congruence.

## Impact

**We have evidence for the first project that the modified ITE curriculum led to trainees who are more uncertain about neuromyths and are more critical consumers of neuroscience. (McMahon et al. 2019).**

External Feedback suggests that the Critical Consumer of neuroscience workshop was useful to other ITE institutions who have used it: e.g.

*I did the neuromyths session, complete with the 'experiment', which I was quite nervous about in case it didn't 'work'. But, the whole session was fab and the students not only enjoyed it but learned a lot too. So thanks for being so generous with your resources.*
Elizabeth (Liverpool John Moores PGCE Primary course leader Sept 2019).

*We had some excellent feedback from students informally – they appreciated the opportunity to work through ideas together and found the materials useful and challenging. Thanks for all your hard work.* (Susan Chapman ITE tutor Aberystwyth University Oct 2019)

Within Bath Spa we are investigating the impact of our more recent curriculum developments on our trainee teachers' accounts of learning and will report on this in future publications.

**We welcome feedback on how you are using these ideas and resources in your own institution and suggestions for improvement.**

**Please email your thoughts to Kendra McMahon k.mcmahon@bathspa.ac.uk.**

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**Project Team 2019-2020:**

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Report prepared by Kendra McMahon (2020)

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