TEACHING AND LEARNING ABOUT EPISTEMIC INSIGHT

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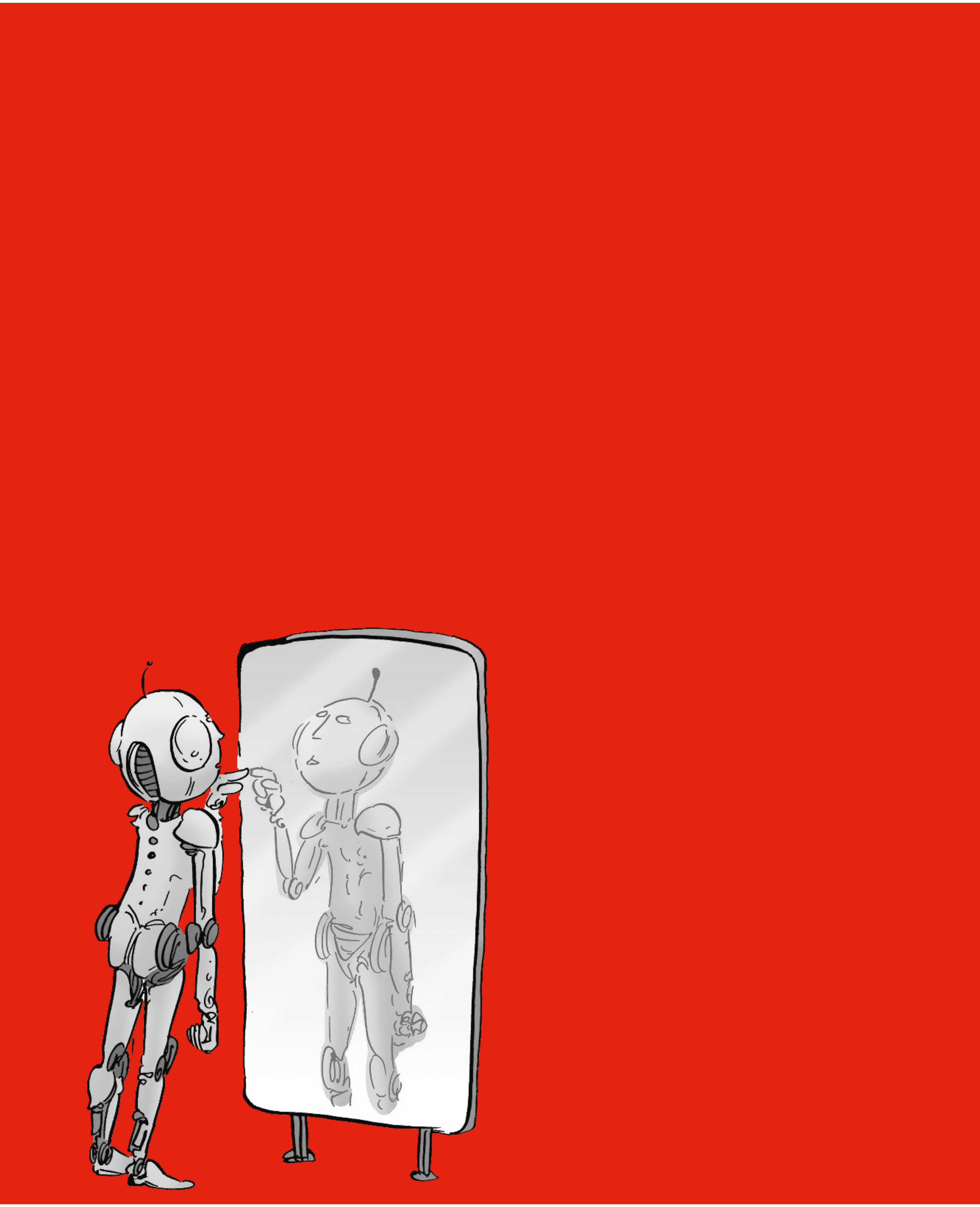

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FOREWORD

The Epistemic Insight Research and Education Initiative gets to the heart of some key and critical issues in curriculum and the learning experiences of children in the compulsory school sector. England has one of the most fragmented national curricula across the 5-18 age range of any developed countries, according to OECD and PISA studies. In particular, it is one of a very small handful of jurisdictions in the world to teach separate humanities subjects from ages 5-11. This, combined with the lack of connectivity in the design of the separate subject curriculum statements, can lead to a learning experience for pupils in which teachers are unable to make meaningful connections between key concepts and knowledge across curriculum disciplines.

The scale of our engagement with Epistemic Insight, both in terms of the numbers of teacher educators (both in University and in school) and the number of beginner teachers who will be involved, can create a step change in understanding about these issues. This, combined with Professor Billingsley's strong existing contacts into national policy debate, creates a groundswell of voices that will influence local curriculum design and a national policy debate.

William Stow
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The Epistemic Insight research project is key to us harnessing 'in house' research to inform our Initial Teacher Education provision as well developing our primary and secondary students as teacher-researchers.

Our Initial Teacher Education provision is in the process of being comprehensively revised with our new programmes planned for implementation in September 2018. The Epistemic Insight project is playing into that review and will help develop teacher-researchers at two scales. Firstly at the scale of a formal piece of academic research for undergraduate and postgraduate student teachers to help students to enquire deeply into an area of interest. Such enquiry will deepen our student teachers' knowledge and understanding of both their own and their pupils' Epistemic Insight with further potential for this to enlighten their practice as early, primary or secondary phase teachers.

Secondly it is vital that we generate teachers who are curious and who question and reflect upon their own practice and the learning of their pupils as well as the contexts within which both teaching and learning operates. Within our undergraduate and postgraduate provision Epistemic Insight will provide a lens, along with other research projects within the Faculty, to aid student teachers' reflection upon teaching and learning and through short guided reflective tasks to deepen their use of Epistemic Insight as a means to gain further understanding about the rich and complex nature of teaching and learning. An example is illustrated below.

As part of your induction to your second school placement shadow a pupil for a day. Observe the range of lessons and the ways that teachers' and pupils' questions alter between different subjects. What sort of questions are asked in some subjects but not in others? Reflect on the nature of the subjects you have observed and how this influences the approach to understanding knowledge in these subject. How do the pupils you observe navigate their learning across the diversity of subjects experienced in a day?

Initial Teacher Education within the School of Teacher Education and Development at Canterbury Christ Church University is the fourth biggest in the country spanning undergraduate and postgraduate provision in early, primary and secondary phases as well as post-compulsory and in a wide range of routes and subjects.

The scale of our provision means that the Epistemic Insight project is likely to influence teaching and learning on a huge scale, not just from the almost 4000 individuals who are here on teacher education courses but further through the thousands of pupils whom those individuals teach. The example task outlined above is one that will draw the aims and concerns expressed in the Epistemic Insight project to teachers' and head teachers' notice in thousands of schools. As the project builds year by year – it illustrates the powerful impact of research projects that harness initial teacher education at Canterbury Christ Church University.

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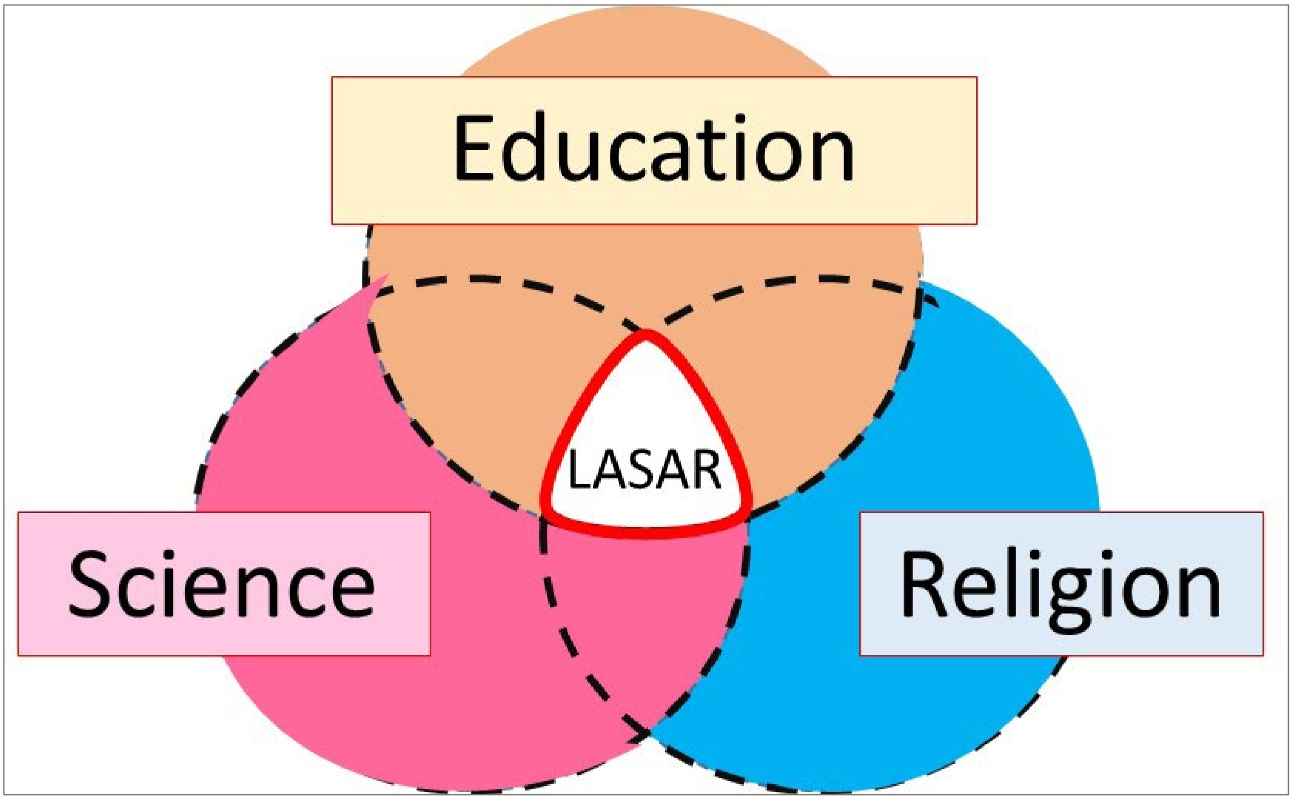
INTRODUCTION

This proposal describes a rich and complex project which is designed to have a significant impact on schools education. The project is centred in teacher education and is intended to run for six years. During that period our plan is to enlarge the scale of the activity -through the recruitment of collaborating institutions.

The project will be led by LASAR (Learning about Science and Religion).

Our research – and our interest in Epistemic Insight – sits at the intersection of three circles – science, religion and education. Not everyone else in research cares as much about all three – but this niche has given us a unique perspective on many of the questions that other education researchers engage with:

> How can schools, universities and other educational institutions nurture young people's intellectual curiosity?
>
> How can science education ensure that future great minds of science are given the inspiration and stimulus they need – as well as the key content and skills?
>
> How can teachers prepare future citizens for a world that is awash with false facts and exaggerated headlines - and equip them with ideas, attitudes and strategies that will help them make decisions rationally and compassionately?
>
> What is important and currently widely overlooked in the preparation that future teachers are given for their roles in the classroom?



EPISTEMIC INSIGHT

The focus of the current proposal is Epistemic Insight. Epistemic Insight is a phrase to refer to 'knowledge about knowledge' or in other words students' scholarly expertise, their appreciation of scholarship and their capacities to be wise about knowledge claims in the real world.

Survey to probe teenagers' reasoning about what it means to be human

Teaching young people how to be more scholarly and of the impacts of scholarly advances for and in everyday life takes place across many curriculum subjects. To date, educational research to understand how epistemic insight develops has mostly focused on the picture within individual subjects. For example there is a vast body of research which looks at the significant influences of science teachers' pedagogies on students' developing ideas about the nature of science and their perceptions of what it means to be a scientist. There are far fewer studies which have broadened the scope a little to look at students' reasoning about knowledge and scholarship across subject compartments – but this is the approach that LASAR (Learning about Science and Religion) has taken.

LASAR was established in 2009 to look at how questions and themes bridging science and religion are managed in schools. The first project gathered data from students and teachers to find out how schools approach teaching about the origins of life and the universe. Our more recent research has looked at students' learning, questions and reasoning about what it means to be human. This has included looking at students' perceptions of what science says about behaviour and personality – and whether students perceive science to be compatible with what they believe for themselves; the project also ran workshops to explore questions with students like whether a robot can and should one day have the status of electronic person.

To gather data, the project uses surveys, interview studies and workshops to discover students' reasoning and questions about themes that bridge science and religion. We are interested in their perceptions of what science and religion say and also in whether they see science as compatible with their own beliefs. We also interview and survey teachers to find out the pressures and opportunities that shape how they approach these topics. Thirdly we use focus groups and classroom games to try to find out how students are making sense of the pedagogies they experience.

Classroom game devised to look more closely at the impacts of subject compartmentalisation. Children in Year 6 (age 10) tell us what's making them giggle when they see this timetable. Why does the school timetable they expect to see have some of these 'boxes' and not others.

"Here is your timetable for next year"

Monday	Tuesday	Wednesday	Thursday	Friday
Registration	Registration	Registration	Registration	Registration
Maths	Hugging teddy	Science	Art	Maths
French			Art	TV watching
Break	Break	Break	Break	Break
Geography	History	Science	Hunting sharks	Science and Geography
English	English			
Lunch	Lunch	Lunch	Lunch	Lunch
History	Sharing Secrets	Science	Science and Religion	Eating sweets
Science				History

THE ESSENTIAL RESEARCH BACKGROUND

The motivating conundrum

LASAR (Learning about Science and Religion) was established in 2009 in response to the findings of research looking at how university students think about the so-called Big Questions of life the universe and everything (see Billingsley 2004).

These are questions like whether life has an underpinning purpose; whether there's something that sets humans apart from other entities and whether one day robots could and should have the status of persons, whether it's appropriate to trust and value our own inner thoughts or whether our internal philosophies are just sugary myths produced by our evolved and material brains; whether the universe exists by chance alone; why – if there's a god who loves us – there are natural disasters and diseases; whether science is consistent with a view that people have moral agency and can make choices.

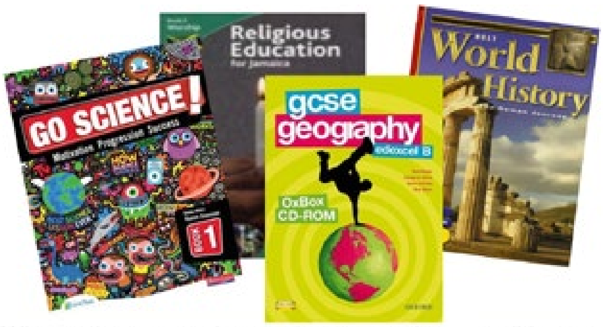
The Australian study found that most students said they found these questions exciting, important and thought provoking and that they had pondered them at various points in their lives. What was also noted was that students also widely reported that their experiences at school had not encouraged or helped them to address these questions.

Indeed students' reports were peppered with recollections of how and why their curiosity had been redirected or dampened. The majority of students saw science and religion as 'either/or'. Some students felt that the battles were over – with one saying that "I'm an evidence girl. I'd like to believe religion but another part of me says no, it's just a fairy tale" (p. 279). There were also students who said that their thinking was in a stalemate while they waited for the conflicts to be resolved. One student said, "I'm interested but I feel like a spectator. I'm watching to see which one wins" (p. 99).

These findings with tertiary students have chimed with the findings from further studies carried out with a range of age groups from primary to tertiary and across two continents (England and Australia).

There is not one education story that all children share – there are many stories and many different outcomes. What the LASAR research found, however, is that there are some common experiences and perceptions across the student population – as the next section outlines. Further – what unites these experiences, common perceptions and missed opportunities is that they all relate to students' attitudes and beliefs about scholarship and knowledge. In other words – Epistemic Insight is the common golden thread.

Entrenched Compartmentalisation



What makes a question a science question ... well it says it's science in the timetable, it says science on the front of the book – and in secondary – it's the name on the door and the job title of the teacher!

The first of the key findings from the research is the significance of subject compartmentalisation on students' experiences and what they are learning to think. For many decades the practice at almost every level of education has been to teach students about scholarship and knowledge via a compartmentalised system of individual curriculum boxes. The compartments are sustained by subject-specific curriculum documents, examinations, teacher education and – in secondary schools –specialist teacher recruitment and subject specific classrooms (Cloud 1992; Ratcliffe 2009)

Immersing students in the questions, methods and norms of thought of a single discipline at a time is critically important to help students get a feeling for how each discipline works and there is no intention here to do away with subject compartments. At the same time however students also need opportunities to see the value and significance of questions which do not sit neatly in one subject or another;

Further they also need frameworks and bridges to enable them to move successfully between their subject compartments – and this need can also become lost when compartmentalisation becomes entrenched. There is for example a lack of a cohesive framework to help students make sense of words and ideas like 'evidence' that are referred to in many subjects and modules.

When compartmentalisation is entrenched it means that organisational, social and pedagogical practices have become habits and now dictate students' and teachers' expectations about what should happen in the classroom (Tylack and Tobin 1994).

The impacts are particularly noticeable in the case of students learning about science as the science classroom tends to have the most impermeable boundary of all (Bernstein 2000). Questions which students perceive would push the lesson off course tend to be withheld and students' curiosity is hidden from their teachers. Fourteen year old David was one of many students participating in our research who explained that in science lessons students resist asking questions they perceive as 'off-topic' and/or culturally sensitive: "We don't ask science teachers questions any more at the moment, because we don't think that they'd answer them ... [pause] oh they won't answer that because it's not on their topic." (Billingsley et al. 2013, 1725).

In this way pedagogy can squeeze students' curiosity and channel their thinking away from creative activities such as identifying good questions to ask and devising ways to address them. This is unfortunate as metaphysical enquiry cuts across discipline boundaries to acknowledge the scale of the universe, the complexity of real life and gives an important perspective on where we are in our intellectual journey so far.

The popularity of sessions run by projects such as God and the Big Bang and LASAR indicates the value that schools place on giving students opportunities to engage with these questions – however arguably - these opportunities should be embedded into the standard education that all students can access.

(Hansson and Redfors 2007; Billingsley, Nassaji, and Abedin 2016).

Scientism has multiple definitions and broadly speaking is a commitment to the view that science is the only valid way to construct knowledge and that nothing exists beyond the material universe (Stenmark 2013). Scientism can be a considered position but students also have a tendency towards uncritical scientism. Our surveys and interview studies with primary school children suggest this stance may begin to develop in this stage of education. Some of comments made by students aged 10 included:

"Well, if it wasn't for science we wouldn't know much about the world or anything, really."

"I only believe science and logical answers and theories"

"I think the universe was up to science and science did everything."

We turn now to way that these perceptions might be fostered and the impact they can have on students' reasoning about questions bridging science and religion. At the end of a lesson that has nominally explored what science can tell us about human personality and the choices we make, it may not occur to the teacher or the students to ask whether a question they are addressing in science could also be explored in another discipline (Billingsley et al. 2016).

The importance of learning about the nature of science is already recognised in the science curriculum in England and more widely – however the need to provide explicit teaching to address these objectives is frequently neglected because of the boundary already placed around the subject compartment. For students in upper secondary the current science curriculum in England explicitly states that children should develop an appreciation of 'the power and limitations of science' (DfE 2014). There is a basis to say that this objective is also often neglected in favour of those that are seen to be more straightforward to teach and assess. In particular there are findings from our own research as well as in other research which indicates a tendency among upper secondary students to respond with a kind of uncritical scientism when they encounter a 'Big' (cross-discipline) question

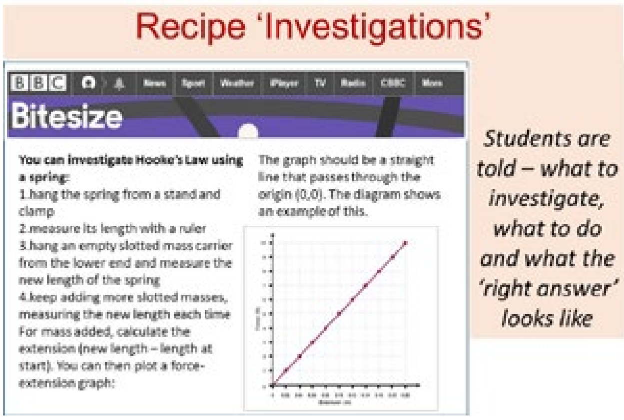
For students – who are inferring the characteristics of scholarship from their experiences in their lessons – the constraints that exist because of pedagogical pressures to move quickly through content are mixed in with experiences to help them get a feel for science and it may be difficult to always tell these messages apart. This 'silent treatment' can seem to some students to support the idea that science is or at least purports to be exclusive. In other words some students have conceptualised science as not only reductionist and materialist in methodology, but also as asserting that the types of questions science asks and the methods science uses are all we need in order to understand life and the universe. In interviews and surveys we often find examples of students saying they feel uncomfortable what they perceive to be the position that science takes.

Jack (age 16) said he was drawn to questions about what it means to be human and in his view "we are more than just a pack of neurons, I think we are much more special than just that." At the same time he reflected that the picture from science and for scientists is that "It would be very difficult for them" to believe that a person has a spiritual side or a soul and that "if you just look at the physical state of us, we are really are just a pack of neurons really" (Billingsley 2016, 287).

Further the opportunity to find out how students are situating their science in a wider frame may also not occur to a science teacher who is mindful and constrained to develop and assess students' reasoning to a narrow set of outcomes.

So far then we have identified entrenched compartmentalisation as a barrier to students' developing epistemic insight. We've explained how it constrains students' intellectual curiosity and also that it leaves unchallenged the misperception that a scientific mind-set is synonymous with accepting that science is all we need in order to understand life and the universe. It follows that strategies to bridge subject silos and to encourage intellectual curiosity are "win-win" ways to progress students' epistemic insight in valuable ways.

The nature of science in a multidisciplinary arena



The first questions we often ask students in our research interviews are, 'What is science' and 'What is religion?'

Students know that the interview will look at both science and religion and it is reasonable to suppose that this directs their attention to how to characterise each one in relation to the other. Students' characterisations of science are consistent from student to student - for students in both primary and secondary. We almost invariably hear that science is about "facts", "experiments" and "proof" and that there is always a single and agreed "right answer" which the teacher will give you.

For secondary school students this characterisation extends to their teachers – so one student, Dean said of his science teachers that,

> *"they want to tell you facts – they want to get you to learn equations, sort of thing. They d-don't want to talk about things that (pause) can change from individual to individual" (Billingsley et al. 2011).*

Similarly in the view of Ewan (Year 7), if students put forward a number of different ideas in a science lesson . . . "at the end of the day if something like that happens our science teacher will overrule." (Billingsley 2016, 473)

Experiments stand out for students as something special that they do in science and not any other subject – and this perception is established from primary. One ten year-old interviewee told us "It's cool how the experiments work and most lessons are fun as we get to get involved in them, it's not just the teacher doing the things."

The characterisation of science as experimental and as a discipline concerned with getting proof has been highlighted many times in research spanning several decades (Driver et al. 1996; Leach, Hind, and Ryder 2003).

The concern raised in research is that students tend to suppose that asking a question, doing an experiment and obtaining scientific 'proof' is unproblematic. These perceptions in turn stem from students' experiences in their lessons. Frequently students are told to carry out pedagogically engineered investigations in which students follow a set of instructions using a carefully vetted experimental setup designed to produce a particular outcome (Lederman, Antink, and Bartos 2014).

The BBC Bitesize summary of an "investigation" students can do to confirm Hooke's law is an example (in the illustration above). These quick fire 'recipe' investigations are included in students' education not so much to teach them what it is like to be a scientist but rather to reinforce and support content teaching about scientific concepts and relationships (Fensham 2015). All the groups of students in the classroom are following the same instructions and arrive at the same finding which disrupts and oversimplifies their understanding of experimental design.

Students conducting experiments tend to all work with the same 'ingredients' and all follow the same set of 'recipe' instructions. Students' experiences suggest to them a kind of positivistic, simple view of science in which (apparently) a question is introduced from elsewhere, it is directly investigated by the scientists using a one-size-fits-all experiment and this produces measurements which lead irrefutably to an answer.

The impact on students' perceptions of science is apparent not only in students' comments in interviews but also in the findings of a largescale survey with 2613 secondary school students in Years 7-11. When given the statement, 'Science is a reliable source of information.' we found 69% agreement with 7% disagreement. For the statement, 'In science, theories become facts once they are proved' the agreement was 70% with 7% disagreement (Billingsley et al. 2011).

We found similar findings with primary students with 68% of ten year olds agreeing that "In science, theories become facts once they are proved" (Billingsley and Abedin 2016).

Students' appreciation of the reliability and validity that science can provide is welcome; what is not welcome is where they are also supposing that any questions can be addressed in this way. By identifying epistemic insight as an important idea in students' learning, we can draw teachers' and student teachers' attention to the wider multidisciplinary and real world arenas where we see and can address these gaps, confusions and misconceptions.

Permeable classrooms walls and teacher collaboration

Monday	Tuesday	Wednesday	Thursday	Friday
Registration	Registration	Registration	Registration	Registration
Maths	History	Biology	Physics	English
Break	Break	Break	Break	Break
Geography	English	Art	Maths	Chemistry
Lunch	Lunch	Lunch	Lunch	Lunch
History	Science	Sport	R.E.	Maths

We've noted already that opportunities for dialogue between the classrooms are limited by the challenges of timetabling, courses and other organisational factors. The practice of working alone is so entrenched in teachers' approaches to designing their lessons that teachers of RE and science rarely if ever speak with each other to share strategies to develop students' reasoning about how science and religion relate. For one of the earlier studies we interviewed science and RE teachers in eight schools to discover their experiences of teaching topics bridging science and religion (Billingsley et al. 2014). This highlighted the separation of the two classrooms with the comments below typical:

> *"We've had no cross-curricular sessions here since I've been here – which is (pause) 19 years. [laughs] I think they may be useful, so that at least we know what [the] teacher there is teaching" (science teacher).*

> *"There is no relationship between Religious Studies and science ... it is very hard for pupils to actually see where those two can work together" (science teacher)*

> *"I'm not terribly familiar with the science curriculum; I don't think they're terribly familiar with mine" (RE teacher).*

We noted that the pressure on students to stay 'on-topic' means that students' curiosity is dampened, redirected or at least hidden. In addition to constraining students' curiosity these pressures can also mean that when students are confused – they may feel it is better to 'muster on' and to find strategies to manage apparent conflicts rather than draw attention to them. Thus, for example Andrea (age 13 in England) said of her experience of addressing our survey that for most questions, "I put 'not sure', because there's the science part of me that says 'no it's the big bang', and then there's the religious part of me that said 'it was God' so it was quite confusing" (Billingsley et al. 2013, 1726).

Irma (age 13) said of the scientific and religious explanations of why the universe exists that "I think they do contradict each other. Sometimes I believe in God and his creation but sometimes I'm more convinced to the science side of it." (Billingsley et al. 2016, 472)

Christine (age 13) said that while she could see that both science and religion are addressing questions about origins, "When I'm in science, I don't think about religion sometimes, because […] it just doesn't come into your head" (Billingsley et al. 2013, 1726).

"Science is facts and proof … religion is opinions and you can believe what you want"

Findings of the 'Being Human' Survey

Participants were 623 students aged 13-15

Science and religion have conflicting view about what it means to be human:	The scientific view is that God does not exist:
Agree: 57.4% Disagree: 18.8%	Agree: 38.8% Disagree: 24,1%

We noted that in interviews, students tend to characterise science as facts, experiments and proof. In contrast when they characterise religion, the vast majority say that religion is about "beliefs", "opinions" and "choices" – and that in religion "you can believe what you want". So for example, Giselle (Year 12) said of her science and RE teachers:

> *"A science teacher may just sort of say, "This is what happened" and that it's definitely true, whereas RE teachers, more would say like that, you know, "Some people believe that it happened like this, whereas others believe it happened like that."*

Isobel (Year 9) explained that

> *"In RE lessons it's an open discussion . . . there's still that freedom in RE to choose your own beliefs . . . whereas in science there is much more taking notes and 'This is how it is,'" (Billingsley et al. 2016, 473)*

This means that these secondary school students are inclined to see science and religion as not only making contradictory claims on common topics – but beyond this – as mutually exclusive approaches to providing knowledge. This proposition was supported by the findings of an interview study with science and RE teachers in eight schools to discover their experiences of teaching topics bridging science and religion (Billingsley et al. 2014).

The teachers of religious education told us that in their lessons a majority of students voiced the view that science and religion are 'either-or' with little or no insight into any other possibilities. One characterised a typical student position as, 'Do you want to follow the facts of science, or do you want to follow the faith and belief of religion?' (p. 387). Further teachers found that they could not move students from this position. Religion, the RE lesson and the RE teacher were all held by students to be advocating an alternative framework for contemplating truth.

Interviews with students suggest that students frequently also see the decision about which to believe for themselves as a choice to make on faith grounds. Brenda age 14 told us,

> *"I think God created the universe, but if you don't have a religion, then you might think that it was the Big Bang. Because I have a religion, I think it was God who created it." (Billingsley et al. 2013)*

This notion that science and religion are alternative stances which different groups of people take has been echoed in comments by students approaching the end of the statutory phase of secondary education:

> *"It was a bit confusing at first because obviously before I'd always thought that there were either people that believed that God created the universe or the people that believed it was all science." Eric Year 11 (age 16)*

> *"There were a few things which I didn't know beforehand, like whether religion and science can actually coexist." Benjamin, Year 10 (age 15) (Billingsley, Nassaji, and Abedin 2016)*

Primary school children's reasoning about science and religion

More recently we have begun to survey and interview children in primary school (see for example Billingsley and Abedin 2016; Billingsley and Fraser In press).

Our research suggests that by age 10, a significant proportion of children perceive science and religion to be conflicting and mutually exclusive ways to think about the world. Survey findings (n=712) with children in this age group found that about a third (34%) agreed with the statement, "Science and religion disagree on so many things that they cannot both be true" while just under a third (27%) of the cohort disagreed.

Fewer than one in five (16%) of children agreed that "Science and religion work together like friends" while almost a half (46%) of those surveyed disagreed.

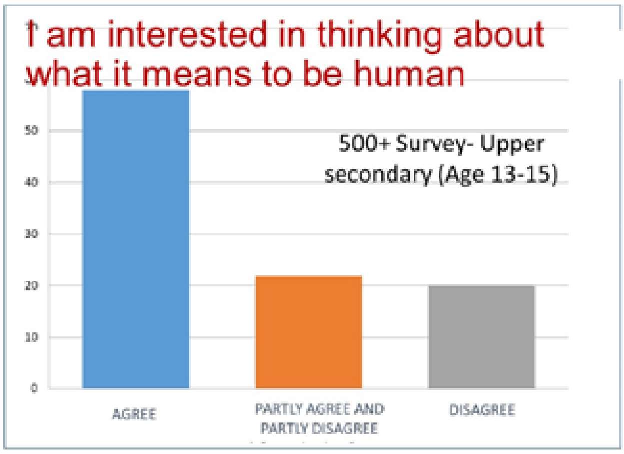
An interview study conducted with ten year old children drawn from this cohort helps to explain how and why they have reached these conclusions. We concluded from the interviews that:

- Children are keen to know more about science and religion but have little or no access to spaces or people to help them.
    - Very few have someone they can talk to about science and religion at the same time. Comments included. "I ask my teacher about science and our Reverend about religion"; "my mum believes in God and my dad is quite sciencey" "My brother talks about science. No one at home talks about religion".
    - Children perceive the people they know to be committed either to science or to religion, such as "Our Dean believes that God created the beginning of the universe… [the other children in my class] would think that maybe the Big Bang created it and not God" (Patrick).
    - Similarly children are finding out about science and about religion in different social spaces – such as "I do science at school and religion at home".
    - A proportion (about a third) of children at this stage express uncertainty or confusion about what they do think: "I don't understand my beliefs yet"; "I believe there is something but it's so hard for me to comprehend" (survey comments).
- Science and religion are perceived to address the same territory:
    - Topics that science covers - "I would say everything is science - because science quite literally is everything and it makes everything." (Sebastian, interview). In our survey 40% of students perceive that "the scientific view is that God does not exist" while less than a quarter (24%) disagreed.
    - Because children see science and religion as competing for one territory, some children have begun to identify themselves as being on one side or the other: "I'm a down-to-earth person", "I believe in facts more than story", "I don't believe in anything I don't see" (survey comments).
- Science has proof, religion is what you're entitled to believe:
    - Science is widely seen as facts and proof "To me, science is probably, like, it's - well, it proves everything, so to speak" (Michael, interview); "Science proves religion wrong" (survey comment).

- Many children express concern that they lack first-hand and experimental evidence for truth-claims in religion, such as, "I hope to believe in miracles but it never has happened before in my life time" "I don't believe in God because there is no 100% proof that he's alive …" (survey comments)
- Children often describe religious ideas as entitlement, opinion, belief or guesswork – "Science is what we know; Religion is what we guess" (survey comment). "In any reason, you SHOULD always believe in God or another greater being. Stick up for your faith!" (survey comment).

This research has helped us to design the strategies that we are proposing for the current project. In particular for primary, we are proposing a combination of teacher education and also resources and activities for school and for home. More details follow later in the proposal.

Further ramifications



The impacts of these misperceptions and missed opportunities extend beyond students' reasoning about how science and religion relate. Indeed some of the other ramifications may for some educators provide the greater incentive to make changes.

We have indicated already the way that pedagogy can squeeze students' curiosity and channel their thinking away from scholarly practices such as identifying good questions to ask and devising ways to address them. This is unfortunate as metaphysical enquiry cuts across discipline boundaries to acknowledge the scale of the universe, the complexity of real life and gives an important perspective on where we are in our intellectual journey so far.

The value of big questions and their importance as a framework to help students to develop their scientific literacy is also widely neglected. This neglect affects students' capacities to respond knowledgably and wisely to questions about advances in genetics, robotics and neuroscience – to give some examples.

There is also a basis to say that students who enjoy multidisciplinary ways of thinking are more strongly drawn to science when they see it contextualised in a wider cross-discipline arena (Billingsley and Chappell 2016). Data collected from 263 students in secondary school revealed that more than half of students agree that 'I like it when teachers in one subject make a link to something we're learning in another subject' while the level of disagreement was 12%.

The findings of this survey also suggest that girls in particular are engaged or disengaged depending on the breadth of the discussion. While almost 50% of boys agreed with the statement that 'given a choice, I prefer to learn how a machine works rather than thinking why it matters', less than 25% of girls agreed with the same statement. Girls are also more inclined to think critically about the power and limitations of the scientific explanations they are taught and the attitudes they present tend to be less scientistic than those presented by boys. This is reflected in their responses to questions about the influence of genetics on personality. Asked whether 'intelligence' is determined by genes, 13% of boys and 6% of girls (less than half of boys) answered yes.

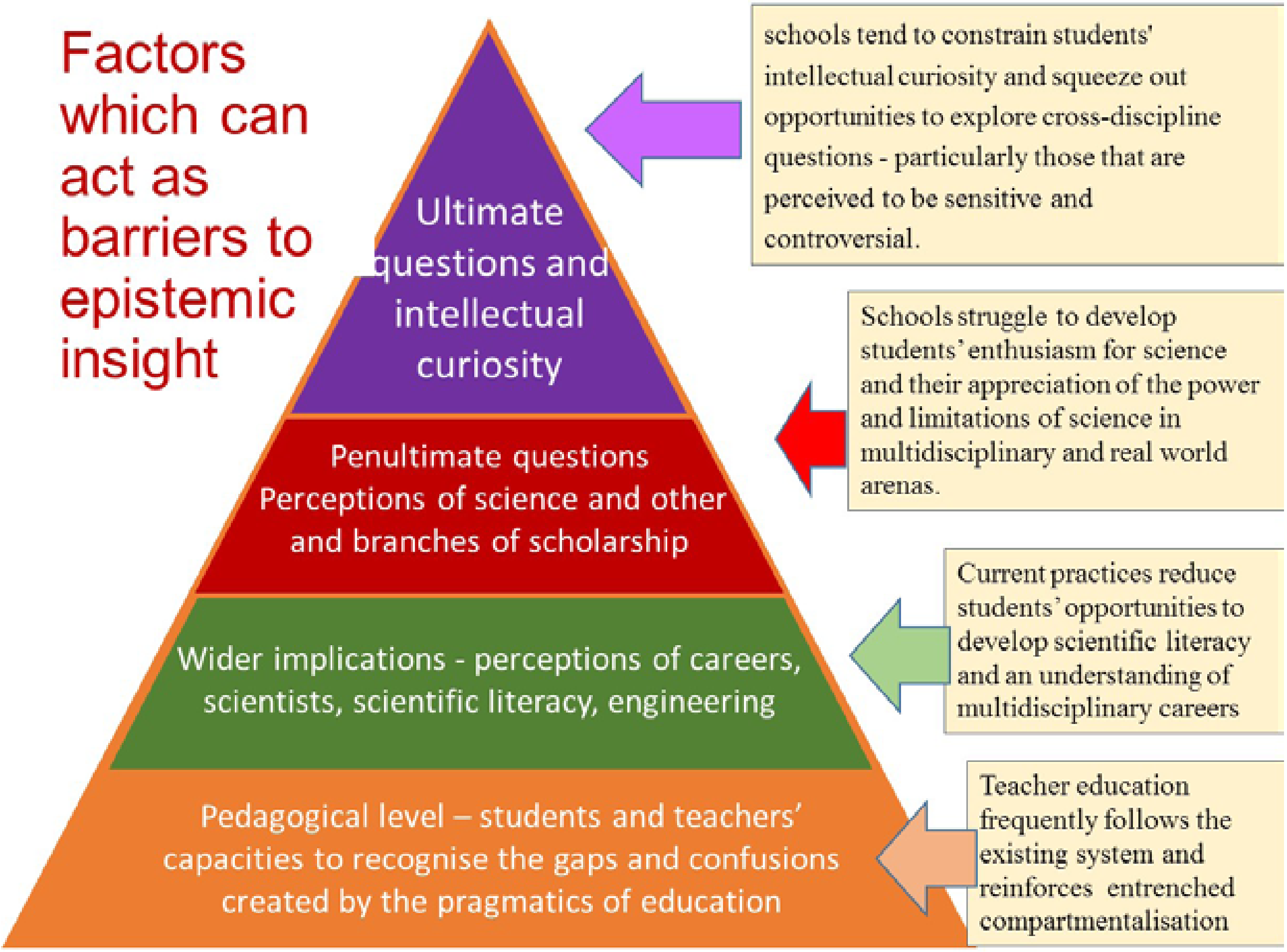
These findings resonate with other research which shows that boys appear to be more comfortable with teaching that is focused on explaining physics concepts in scientific terms whereas girls are more likely to want to know why this matters in their lives and will often resist saying they understand a concept until they have considered its meaning in a broader context (Stadler et al., 2000).

Finally here there were comments made by students throughout the research which suggested that many students perceive that someone with a faith would be less likely to pursue a career in science. Joy (age 14) explained that "I'm a Christian, I'm quite religious" and expressed the view that, "I don't think that if you were religious it would be easy to be a good scientist … they may feel that they're being turned against their religion if they became a scientist … every day you're trying to prove your religion wrong. So I don't think that would really work out." (Billingsley and Riga 2010).

Teacher Education

Teacher education is important for two reasons here. One is that there are teachers and student teachers who hold some of the reservations, misperceptions and misconceptions that are apparent in school students' comments. Workshops are useful then as ways to identify, discuss and address these gaps. In addition, teacher education workshops are opportunities to draw teachers' attention to our research and to enrich teachers' perceptions of the ways that their approaches to teaching can impact on children's lives in the context of this research. This kind of activity in teacher education is pivotal as a way to lever change. While teachers are in training they have opportunity and motivation to look at the research and to develop their own strategies to improve the experiences they provide to the children they teach.

SUMMARY AND NEXT STEPS



Based on this research – it is clear that as students make their educational journeys from early years to the end of secondary, there is no one pivotal moment at which students' intellectual curiosity in Big Questions is suddenly dried or snuffed out.

Similarly there is no one single point where students arrive at a perception that science and religion must be 'either/or' – instead for both of these mind-sets, the explanation is an accumulating and reinforcing combination of factors and missed opportunities.

These perceptions, factors and missed opportunities all have something in common. They all relate to students' developing attitudes towards and appreciation of scholarship and knowledge – thus – students' **Epistemic Insight.**

AIMS

Our aims are ..

TO FOSTER INTELLECTUAL CURIOSITY, DRAW PUBLIC ATTENTION TO THE VALUE OF BIG QUESTIONS AND COUNTER THE PERCEPTION OF SCIENCE AND RELIGION AS NECESSARILY OPPOSED

- Students' intellectual curiosity is frequently squeezed and hidden from their teachers by pressures to stay 'on-topic' and to avoid potentially senstive questions. Via exciting high profile events and action research projects for student teachers and more - we aim to change this!

TO ENGAGE MORE STUDENTS' SCIENTIFIC CURIOSITY, COUNTER UNCRITICAL SCIENTISM AND WIDEN THE PIPELINE FROM SCHOOLS TO CAREERS IN SCIENCE AND SCIENCE-RELATED PROFESSIONS

- Piaget identified that there is a natural scientist in each of us – every child wants to explore the natural world around them and test out ideas. But for too many students, as they journey through school, their enthusiasm for science is eroded by perceptions of science as metaphysically reductive, scientistic, lacking in creativity and frozen in time. Via compelling resources for students such as home-school science activities and a bespoke STEM Ed D for science leaders and more – we aim to address this!

TO CREATE AND ESTABLISH OPPORTUNITIES FOR SUBJECT-SUBJECT DIALOGUE AND COLLABORATION …

- Important themes and qeustions includign many which students love to explore such as whether robots can one day achieve personhood fall between the gaps of a system of entrenched compartmentalistion. Subject silos also mean that opportunities to develop students' scientific literacy and appreciation of the power and limitations of science through interdepartmental bridges and collaborations are lost. Via strategies that range from question boxes in classrooms to fresh approaches in science teacher education and more– we aim to change this!

TO ENHANCE TEACHERS' AND STUDENT TEACHERS' SCHOLARLY CHARACTERS AND SELF-ESTEEM BY ENHANCING THEIR APPRECIATION OF HOW EDUCATION, SCHOLARSHIP AND KNOWLEDGE WORK

- Courses for teachers and student teachers in an academic institution are an opportunity to develop professional and scholarly expertise that is difficult to acquire while in school. But on too many occasions, sessions in teacher education can feel like an extension of school. By providing a rich culture of research and by engaging our student teachers with ways to markedly and positively influence school education, we aim to address this!

‘WIN-WIN’ RECIPE FOR SUCCESS

Theory of change

The Epistemic Insight initiative is informed by our previous research and levers for changes across the education ecosystem. These changes are designed to improve attitudes to intellectual curiosity and to transform schools into to fertile grounds for intellectual curiosity and dialogue. Further teachers will be better placed to wise their students up to a more informed understanding of the nature of science in relation to other disciplines – particularly religion. Finding themselves in open and exciting spaces which foster intellectual curiosity, students will progress to deeper appreciations of science, religion and their relationships.

The changes are embedded and locked in place by changing educational practices espoused in teacher education, curriculum, resources, classroom pedagogy and educational research to reflect the ambition of raising students’ epistemic insight.

As the golden thread of EI moves into each setting, its characterisation shifts accordingly – but the initiative can always be recognised via its ultimate aims – to foster intellectual curiosity, reduce uncritical scientism and counter the perception of science and religion as necessarily opposed.

These changes are a ‘win-win’ recipe for success. Some of the many related advantages we anticipate are greater enthusiasm and appetite for science and working in science, higher levels of scientific literacy, greater awareness of science related careers and more positive attitudes among teenagers for education.

In this way the Epistemic Insight initiative will work with schools to help them to enhance their capacities to be valuable and useful as a way to prepare young people with the insights and strategies they need for the next steps of their lives.

Epistemic Insight Research Activities

Research in Teacher Education – includes evaluation of strategies designed to boost professional esteem and scholarly character

The initiative is centred in Teacher Education. Through teacher education and the interactions between teacher education and schools – we will research and disseminate strategies to raise Epistemic Insight across the education ecosystem.

The initiative will provide free research tools and support to like-minded researchers and will expand the research base year by year.

Creation and Evaluation of Intervention strategies in schools

The initiative will create and evaluate resources and events designed to help students to appreciate the power, relevance and limitations of science in real world and multidisciplinary arenas.

The initiative will provide free strategies, resources and pedagogies for schools and other teacher education institutions.

Research to design and support a proposal for a broader spiral Curriculum

We will carry out research to develop a spiral curriculum to show how epistemic insight builds up as students move up through school, through college, through university and beyond.

The initiative will communicate this research via international forums to catalyse global curriculum reform.

AIMS AND PROJECT ACTIVITIES

1) TO FOSTER INTELLECTUAL CURIOSITY, DRAW PUBLIC ATTENTION TO THE VALUE OF BIG QUESTIONS AND COUNTER THE PERCEPTION OF SCIENCE AND RELIGION AS NECESSARILY OPPOSED

… so that students are prepared to be independently creative and strategic
… and so that students feel encouraged to voice their questions and so that teachers are well placed to respond

e.g.

- Head teacher / Vice Chancellor whole-school charter
- Early years: Exploration activity cards where children encounter a surprise to stimulate curiosity
- Year 4: home-school bags where a daily hands-on activity rasises bigger questions to ponder with parents and carers
- Yr 6 Never-off topic event days where students are off-timetable to address a Big Question
- Yr 8 and 10 robotics workshops which are designed to raise metaphysical questions
- Yr 12-13 Sixth form conferences
- Teacher education to develop expertise – for example early years teachers learn about the perspectives of different disciplines and secondary science teachers explore historical and philosophical links to science;
- Teacher educators co-construct research with us to discover and embed strategies to promote Big Questions in schools and public forums. This activity is developed through the the research theme groups.
- Faculty wide focus on EI means that students on Teach First and other post-grad programmes are progressed along a 'natural' professional development pathway that begins with sampling the research in their first year and then advances through Masters and Ed D – to create the next generation of EI ambassadors and researchers
- Media publicity around the key events such as the 'Never off topic' day to encourage public interest in BQ
- Resources are available for free online to facilitate sharing and spin-offs.
- Collaborations with key organisations including BBC to enhance public profile

2) TO ENGAGE MORE STUDENTS' SCIENTIFIC CURIOSITY, COUNTER UNCRITICAL SCIENTISM AND WIDEN THE PIPELINE FROM SCHOOLS TO CAREERS IN SCIENCE AND SCIENCE-RELATED PROFESSIONS

... so that schools can more effectively develop students' appreciation of the power and limitations of science in a multidiscipline arena and widens the pipeline to careers in science
... and so that educators can counter uncritical scientism and perceptions of scientists as necessarily atheistic

e.g.

- Assessment reform to pay more attention to existing nature of science objectives
- Curriculum reform following research to support a spiral curricluum which outlines expected progress in interdisciplinary EI as well as in-discipline EI. Objectives will describe learning that is teachable, transferable and assessable.
- Early Years: Exploration activity cards begin with a science stimulus activity
- Year 4: 'We love science' home-school science bags give students an activity to try at home and a website with follow-up ideas
- Year 6: Never off topic – gives students first-hand experiences of what science is really like and transforms the 'recipe' investigation into an interactive session about a key moment in history
- Year 8 and 10 robots workshops teach that some questions are more amenable to science and (for Yr 10) that some questions are more metaphysicall sensitive than others
- Student teachers support the research and their own development when on placement by for example gathering data about the extent to which teachers collaborate.
- STEM Ed D advanced science teachers co-construct research with us to discover and embed strategies to situate science in a wider context

3) TO CREATE AND ESTABLISH OPPORTUNITIES FOR SUBJECT-SUBJECT DIALOGUE AND COLLABORATION …

... so that schools develop students' capacities to be wise and critical about the knowledge claims they meet in the real world
... and so that RE and science teachers can counter students' tendencies to conflate scientific and religions explanations and further to see science and religion as 'either/or'

e.g.

- Year 6: Never off topic – a collaborative day for the whole school working across subjects and age groups
- Year 8: classrooms with permeable walls – strategies such as a question box in each classroom and teachers paired for a day to created conduits between subjects
- Research to ascertain capacity of a more 'joined-up' approach to improve Yr 8 students' attitudes to learning and attainment
- Teacher education for science and RE teachers to address common misperceptions and promote a collaborative mind-set.
- International conferences and special issue journals specialising in science, religion and education for like-minded researchers to foster international research and education policy change

4) ENHANCE TEACHERS' AND STUDENT TEACHERS' SCHOLARLY CHARACTERS AND SELF-ESTEEM BY ENHANCING THEIR APPRECIATION OF HOW EDUCATION, SCHOLARSHIP AND KNOWLEDGE WORK

... so that the cycle of entrenched compartmentalisation is broken
... and so that the EI strategy is self-sustaining beyond the project and continues to grow

e.g.

- Student teachers and teacher educators engaged in action research to develop their own expertise and capatalise on the project research opportunities.
- A model of expansion whereby the initiative brings new teacher education insitutions on board at key steps
- Year 6: Never off topic – gives students first-hand experiences of what science is really like and transforms the 'recipe' investigation into an interactive session about a key moment in history
- Year 8 and 10 robots workshops teach that some questions are more amenable to science and (for Yr 10) that some questions are more metaphysicall sensitive than others

WHY CANTERBURY CHRIST CHURCH AND WHY TEACHER EDUCATION?

Graphic to show all the components of the project and how they interact.

To develop the spiral curriculum, research is carried out in schools as within teacher education

Teacher education is itself an arrangement of 'cogs' – where courses for student teachers then line up with interventions in schools.

Teacher education institutions as levers of change

Teacher education is a natural first choice when it comes to levering a global change across the education ecosystem.

Student teachers are not only the teachers of tomorrow; they are also agents of change moving repeatedly between the university and their placement schools. By timing the school based interventions to coincide with student teacher placements we will capitalise on our potential to take each planned intervention directly into schools. Further like all university courses – our courses for student teachers emphasise that they are not only here to learn how to teach but also to learn how to be research-scholars. As such our research team consists not only of a small cohort of dedicated LASAR researchers but also of a vast cohort of student teacher-researchers together with their school based mentors and their university tutors.

Once these student teachers become professional teachers – they become responsible for ensuring that children succeed when assessed using the existing measures. In contrast while they are learning to teach, they are encouraged and assessed on their abilities to observe and to think critically about what they are seeing. At the end of each placement they return to the university to share experiences and consolidate their ideas. A typical assignment asks the student teacher to make links between what research tells them to expect and what they can see for themselves is happening in schools. All of these motivations and activities mean that student teachers are well placed to engage with and progress our research.

For example the habits of entrenched compartmentalisation are so engrained that children learn to accept them as part of their school lives. As we know from our research – if we show ten year old children a timetable of random subjects dispersed in boxes – this is what they are expecting to see. If we show children a timetable that has two subjects in a box – they quickly show their surprise. To see children's responses is in itself an eye-opening experience for a student teacher – who similarly is likely to have experienced and accepted the system as it stands. Experiences like these while learning to teach will help to ensure that when our student teachers do become professionals their approaches in the classroom will be distinctive from the norm and transformative as a result of their direct contact with the key messages of our research.

Similarly whereas in other parts of the ecosystem, the significance and value of a spiral curriculum to develop Epistemic Insight is only appreciated in fragments – here within teacher education we can exemplify and develop future teachers' understanding of the importance of the full story – by taking them through the research base, the aims, the associated resources and opportunities and the anticipated value and benefits for young people.

Reach and potential for impact

Canterbury Christ Church is the fourth largest teacher education institution in the UK. All the participants of our courses will be involved to various extents with the Epistemic Insight Initiative.

To give an idea of scale, in all we have almost 4000 individuals on various teacher education courses. We work in some capacity with 3,051 schools – mostly in the South East - and have some level of influence with 1,068,425 pupils.

Our 'Teach First' course for future secondary teachers has a yearly allocation of 240 participants. This includes 50 future science teachers. The course is 2 years and hence we have 100 future science teachers currently training on this course. Teach First students are associated with a school from the beginning and expect to stay with that school once their training finishes. Our catchment area for schools takes in the Isle of Wight, Norwich, Southampton, Dover, Great Yarmouth … it includes schools that are coastal, city, rural, advantaged and disadvantaged. Partnership schools also receive training and updates for teacher mentors – who are experienced teachers in schools.

There are more than 600 future primary school student teachers on our primary courses. CCCU also runs the teacher education programmes with an Early Childhood/ Early Years education focus for more than 800 future early years' teachers.

We also provide conferences for our many hundreds of mentors and other leaders in education to inform them about major initiatives sweeping through education. The focus for this summer's conference will be Epistemic Insight.

GUIDING GRID OF RESEARCH QUESTIONS

The research questions for schools are:

	SCIENCE AND RELIGION	SCIENCE EDUCATION	MULTIPLE CLASSROOMS
KS5 Yr 12-13	What is the impact of workshops on EI and Big questions on Yr 12-13 students' intellectual curiosity in ultimate questions and perceptions of how science and religion relate?	Can workshops on EI and Big questions boost Yr 12-13 students' scientific curiosity and reduce uncritical scientism?	What is the impact of workshops on EI and Big questions on Yr 12-13 students' scholarly curiosity and self-esteem as learners?
KS4 Yr 10-11	What is the impact of workshops on multidisciplinary and real world approaches to robotics, genetics and the soul on Yr 10-11 school students' intellectual curiosity in ultimate questions and appreciation of how science and religion relate?	What is the impact of workshops on multidisciplinary and real world approaches to robotics, genetics on students understanding of science and enthusiasm for STEM careers?	What is the impact of multiple classrooms collaborating to teach workshops on robotics, genetics and the soul on students' scholarly curiosity and their attitudes to learning?
KS3 Yr 7-8-9 combat the year 8-9 dip	1. Can a school intervention creating classrooms with permeable walls raise Yr 7-8-9 school students' appreciation that different disciplines favour different types of questions 2. What is the impact of cross-discipline workshops on robotics, genetics and the soul on Yr 7-8-9 school students' intellectual curiosity in ultimate questions and appreciation of how science and religion relate?	1. Can a school intervention creating classrooms with permeable walls raise Yr 7-8-9 school students' understanding of scientific evidence and reduce uncritical scientism? 2. What is the impact of cross-discipline workshops on robotics, genetics and what it means to be human on Yr 7-8-9 school students' scientific curiosity and enthusiasm for STEM careers? Do girls in particular show high levels of interest?	1. Can a school intervention creating classrooms with permeable walls raise Yr 7-8-9 school students' scholarly curiosity and attitudes to learning and help counter the Yr 8-9 dip?
KS2 Yr -6	Can exploring the question of why so many 10 year olds sprain their wrists foster and future-proof school students' intellectual curiosity in ultimate questions and appreciation of how science and religion relate?	Can exploring the question of why so many 10 year olds sprain their wrists boost students' scientific curiosity, raise enthusiasm for studying science and counter uncritical scientism?	Can exploring the question of why so many 10 year olds sprain their wrists boost students' appreciation of how scholarship works when scholars from many disciplines collaborate?
KS2 Yr 3-4	Can an intervention using take-home science bags foster and future proof Yr 3-4 school students' intellectual curiosity about Big Questions and appreciation of how science and religion relate?	What is the impact of an intervention using take-home science bags on Yr 3-4 students' scientific curiosity and enthusiasm for science and engineering?	What is the impact of an intervention using take-home science bags on Yr 3-4 students' confidence as learners and appreciation of how disciplines can work together?
Early yrs + KS1	Can stories and activities that explain that scholars can explore a big question through several disciplines foster and future proof very young students' intellectual curiosity about Big Questions and appreciation of how science and religion relate?	Can stories and activities that explain that scholars can explore a big question through several disciplines raise appreciation of the nature of science and help to counter uncritical scientism?	Can stories and activities that explain that scholars can explore a big question through several disciplines raise very young students' confidence as learners and appreciation of how disciplines can work together?

KEY WORDS AND KEY NUMBERS

Teacher Education Institution Consortium

This research project will work with 8 or more **universities that provide teacher education** – so Canterbury Christ Church is one. Winchester and Gloucester are confirmed examples of the additional members. The EI project will create a consortium of 8 institutions who are involved with **primary school education** for our project. The project will also create a consortium of 5 that are involved with **secondary school education**. So for example Winchester is one of our confirmed consortium members. Dr Helen Clarke is the Director of the Primary BA Ed and explains that Winchester is keen to collaborate with LASAR on the Epistemic Insight research initiative. Winchester has a full range of courses for primary with 750 student primary teachers on a 3-4 yr programmes, Sessions on Epistemic insight will begin with the Lead Lecture and will then be placed strategically within further modules etc.

The planned UK consortium will be: Gloucester, Winchester, Chichester, Leeds Trinity, Newman, St Mary's, Chester, Cumbria, Sheffield Hallum.

We will also work collaboratively with teacher educators/researchers in many more institutions – including Oxford, UCL, Kings, Durham, York and Southampton.

In the second phase of the project – we would like to expand the consortium to include additional overseas institutions – and have a list of proposed institutions that we are already working with in the US, Australia and Europe. During the first three years those international institutions will conduct some preliminary small scale and literature based research with us – leading up to an international conference in Year 3. For example Dr. Andrea Burrows is Associate Professor of Science Education at the University of Wyoming. Andrea explains that the Epistemic Insight project offers a unique perspective to investigate teachers' thinking and will mean that teachers are better placed to help young people navigate the boundaries between their subjects and appreciate the value and strengths of science. She will begin piloting Epistemic Insight research tools this summer with a group of 90 teachers who are on her campus for top-up teacher training.

Teacher educators and student teachers

A **teacher-educator** works in the Education faculty of a University and trains **student teachers**. This project will survey and work directly with 600 teacher educators. Our input will include whole staff coaching via seminars, online, conferences and research groups as well as deep and long term collaboration with selected individuals. A teacher educator typically teaches classes containing 30-200 **student teachers** in combinations of workshops and lectures. Student teachers are on courses for primary or secondary or both phases of school education.

The EI project will interact with more than 5000 student teachers. Student teachers' contact with the project will include teaching by their teacher educators, research work, seminars, conference, online resources to use in schools, podcasts, bespoke course books etc.

Partnership schools and school students

Each university has a large number of **partnership schools** – where they place their student teachers. Student teachers go into schools frequently during their training and teach **school students**. Universities can have many thousands of partnership schools – mostly in their region but some far afield. Partnership schools are supported by the University teacher educators directly too with CPD, conferences and resources. The EI project will gather baseline data in more than 2000 schools. We will carry out and assess intervention work in 200 intervention schools. The project will also have 10 schools working with our research team to develop and assess a whole-school approaches.

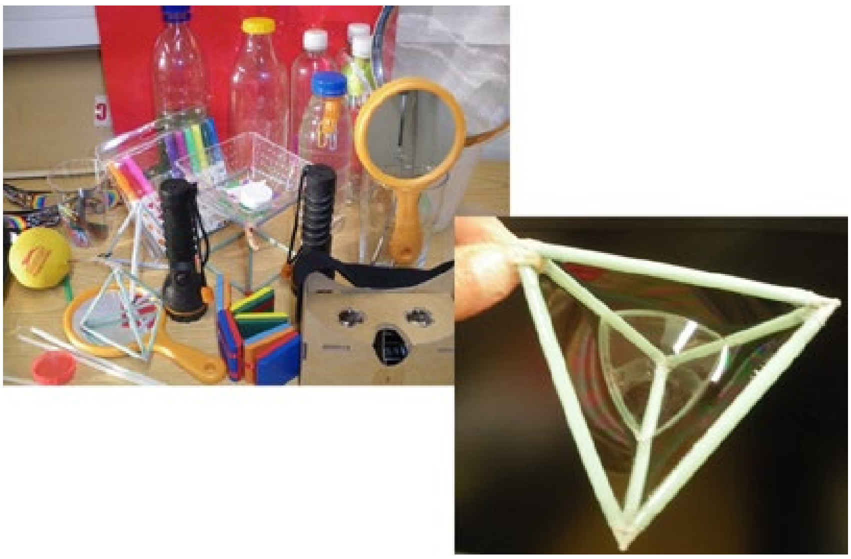
The table below is for Canterbury Christ Church and shows programmes that teach Primary Education.

Programme	Location	Student numbers	Average number of placements into schools
BA (Hons) Primary Education	Canterbury	600	600+
BA (Hons) Primary Education Part-time	Canterbury Blended/ online	50	50+
BA (Hons) Primary Education Progression Route	Medway	30	60
Postgraduate Primary Initial Teacher Education			
PGCE Primary	Canterbury	145	200
PGCE Primary Part-time	Medway	20	30
PGCE 7-14	Canterbury	30	25
PGCE Primary Modular	Canterbury Blended/ online	100	150+

School interventions for each Key Stage

To maximise the participation and research value of our work with schools – our intervention work in schools is supported by a suite of catchy and innovative learning experience for the school students. This includes take-home science bags for Year 4 primary students and robotics workshops for Year 8 secondary students.

The innovative learning experiences for school students have been developed to target our research questions and are designed to work internationally. Where RE is taught – we make use of the capacity to link science and RE classrooms. However we also create links between school and home such as via the home-school science bag to ensure that where RE is not taught we can introduce children to Big Questions that concern science and religion.



example of resources that go to and from school in Year 4 children's school science bags

Schools will also have opportunities to send teachers to **CPD** (continuing professional development) hosted in local areas by the ASE (Association for Science Education) and by us on campus and to make use of online support.

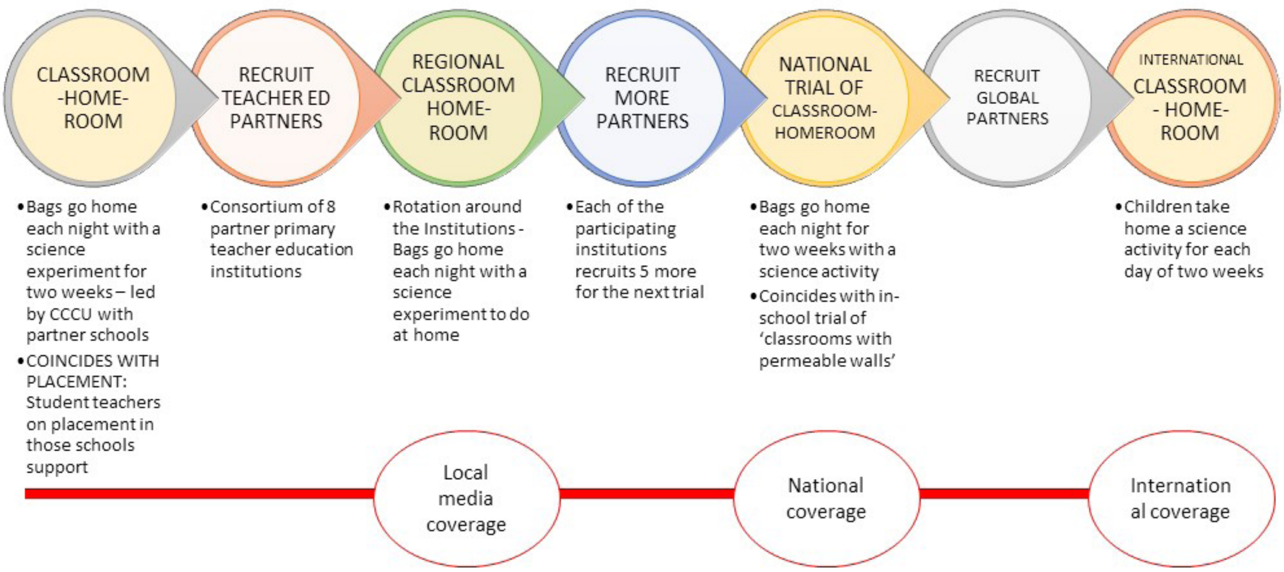
Longevity and big vision

By embedding a greater focus on epistemic insight strategically across the range of teacher education programmes at CCCU, it will be possible to ensure that the work keeps developing and continues beyond the life cycle of the project and becomes a sustainable model. Participation in the project will help CCCU establish robust and complementary research and primary teacher education infrastructures, which can steadily involve other teacher networks in the UK and make significant policy recommendations. The table below is an indicative plan for the Primary Education work:

22 June 2017	Partnership ITE Conference 2017 - Working together: how research and inquiry impact on teacher development- Networking and building partnerships ahead of the launch of the project
January/ February 2018	Launch Epistemic Insights in primary teacher education programmes and modules, including BA (Hons) in Primary Education and Postgraduate Primary Initial Teacher Education
March-July 2018	Recruit and train staff for resource building, preparation and participation in the intervention, pilot studies
September 2018-19	Primary student teachers to work on EI project and submit research reports attached to their research modules and host student conference and seminar; dissemination of findings
September 2019-20	Primary student teachers to work on EI project and submit research reports attached to their research modules and host student conference and seminar; dissemination of findings

This timeline in turn fits into the wider 6 year plan – so below for example is how the Year 4 science bags activity grows across the six years:

Sample Timeline



Policy and Spiral Curriculum

What is taught in schools is largely shaped around teachers' perceptions of what is likely to be tested in public examinations. Because the nature of science is only tested in a very narrow way in those examinations – this is a key factor in preventing the science classroom from explicitly teaching about how science relates to other disciplines. As such a key part of our proposed project is to develop a 'Spiral Curriculum' which will address the gap between the objectives of giving students a greater epistemic insight into how science relates to other disciplines and what is tested by science examinations corresponding to the Nature of Science. The findings from all the work in schools and with teachers will support this.

The project will be working with a number of curricluum policy groups including in particular the Royal Society of Biology, to develop and recommend a new 'spiral curriculum' for the Nature of Science strand within the Science National Curriculum in UK – with a view to then disseminating this internationally. The revision from old to new is to take the notion of 'nature of science' and to transpose and widen this via the 'Epistemic Insight' framework so that there are not only objectives which discuss how science works within its own frame but also additional objectives to help students to appreciate the nature of science in multidisciplinary and real world arenas. In parallel we will work with schools to design ways to teach and assess the existing nature of science objectives which are currently widely neglected in schools. Working with exam boards like OCR/Cambridge Assessment we will introduce assessment of these objectives into exams to motivate a wider group of schools to give these objectives more attention.

SAMPLE STRANDS

The Year 8 package

The research project begins with the LASAR team giving whole-staff coaching to more than 600 Teacher Educators on Epistemic Insight and Intellectual curiosity at Canterbury Christ Church and 5 of our 8 collaborating institutions. (This is directed at the teacher educators.

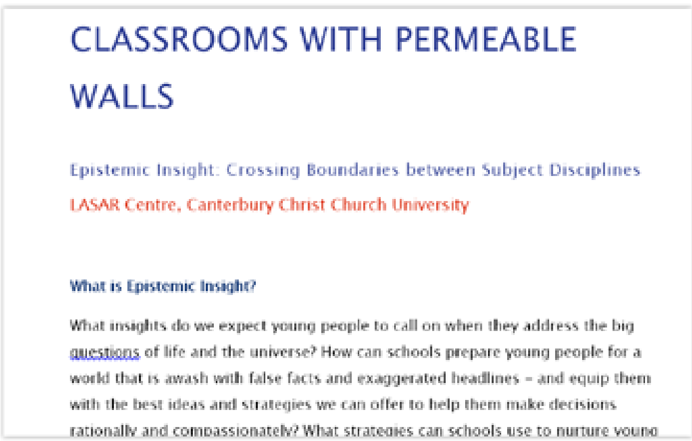
Then 20 teacher educators who teach courses like PG secondary science and Teach First secondary each collaborate with 3 LASAR researchers to create learning experiences for student teachers.

Those teacher educators teach student teachers with some support from researchers (helping us reach a total for the project of 850 student secondary school teachers).

Those student teachers go to schools for placements and cement our link with each school – where we gather baseline data (2000 plus schools via all the links and programmes). Student teachers also deliver and help deliver interventions – supporting our total reach of 200 plus intervention schools.

Data is gathered via a combination of large-scale surveys and interview studies. The project will gather data at every level – so this includes teacher educators, student teachers, school students and for some strands in the project – also parents/carers.

Relevant tools for Year 8 strand

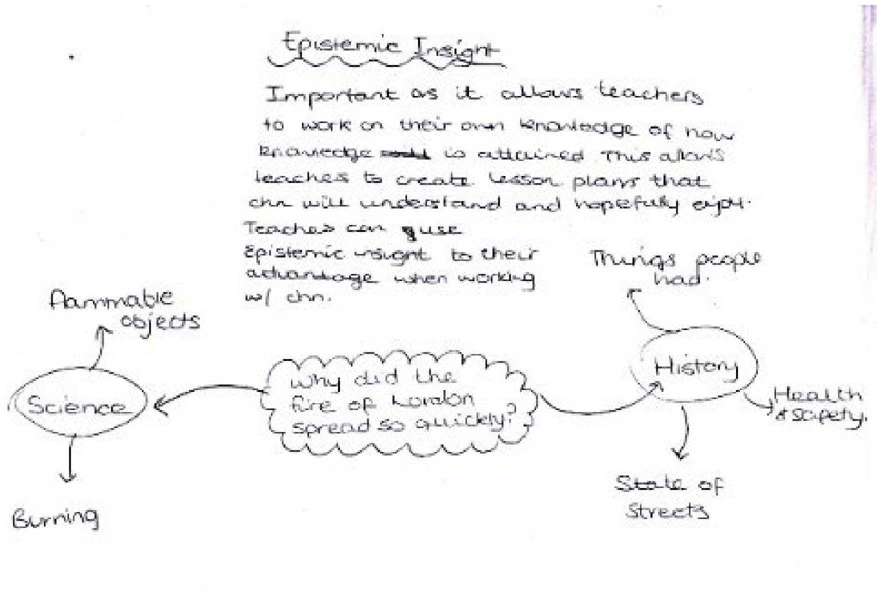

CLASSROOMS WITH PERMEABLE WALLS

Epistemic Insight: Crossing Boundaries between Subject Disciplines

LASAR Centre, Canterbury Christ Church University

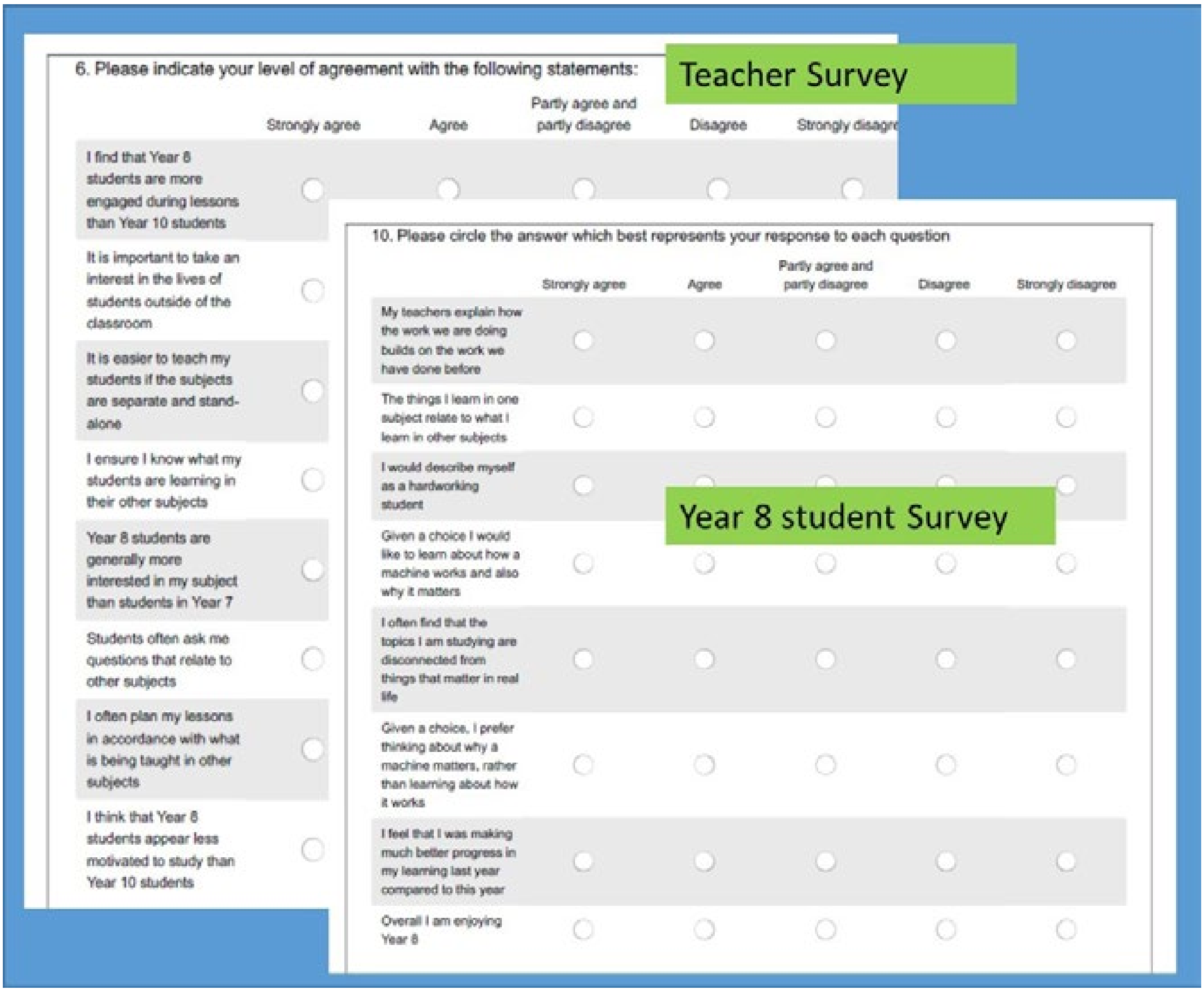
What is Epistemic Insight?

What insights do we expect young people to call on when they address the big questions of life and the universe? How can schools prepare young people for a world that is awash with false facts and exaggerated headlines – and equip them with the best ideas and strategies we can offer to help them make decisions rationally and compassionately? What strategies can schools use to nurture young



Sample of the type of activity included in student teacher workshops on Epistemic Insight.

The graphic shows the student teachers' appreciation that disciplines can give us complementary perspectives on a question.



Teacher Survey

6. Please indicate your level of agreement with the following statements:

	Strongly agree	Agree	Partly agree and partly disagree	Disagree	Strongly disagre
I find that Year 8 students are more engaged during lessons than Year 10 students					
It is important to take an interest in the lives of students outside of the classroom					
It is easier to teach my students if the subjects are separate and stand-alone					
I ensure I know what my students are learning in their other subjects					
Year 8 students are generally more interested in my subject than students in Year 7					
Students often ask me questions that relate to other subjects					
I often plan my lessons in accordance with what is being taught in other subjects					
I think that Year 8 students appear less motivated to study than Year 10 students					

Year 8 student Survey

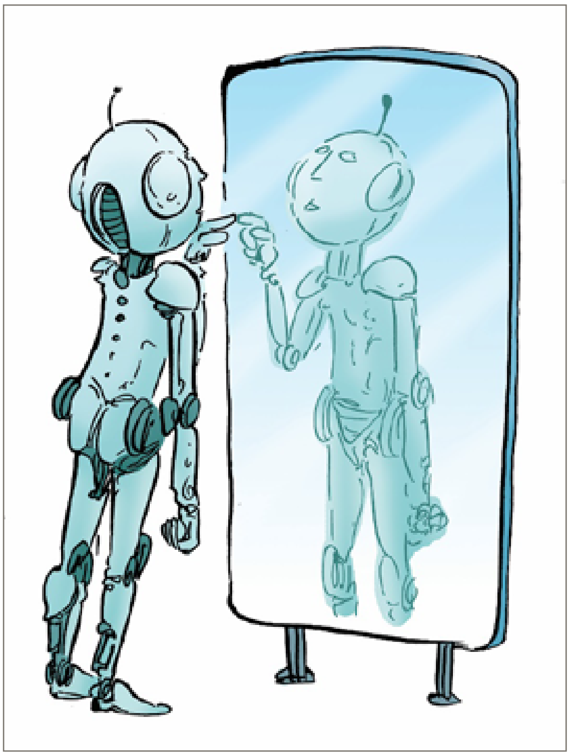
10. Please circle the answer which best represents your response to each question

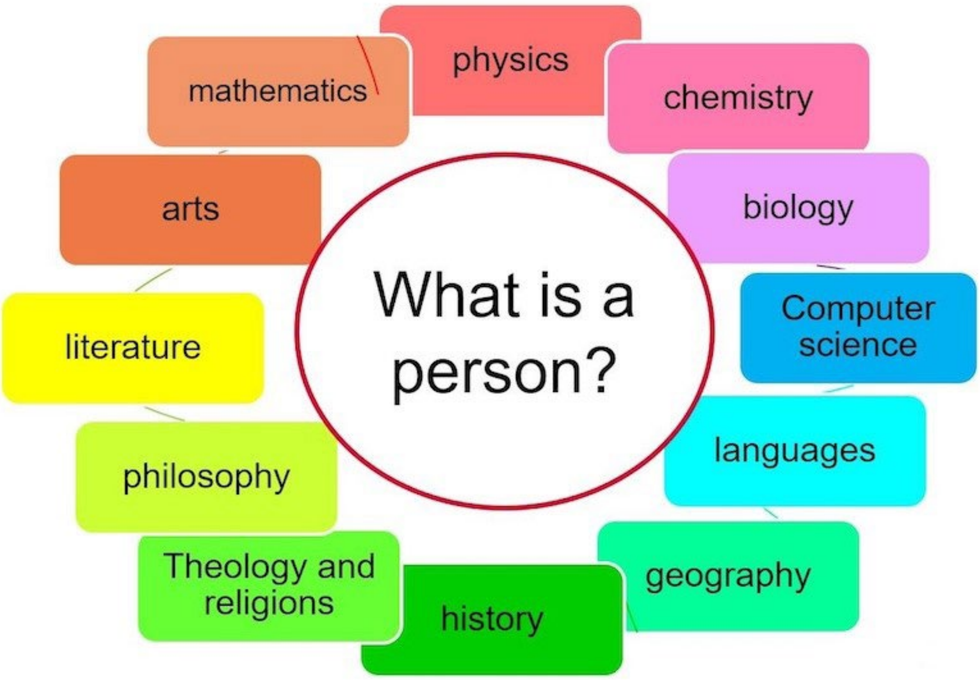
	Strongly agree	Agree	Partly agree and partly disagree	Disagree	Strongly disagree
My teachers explain how the work we are doing builds on the work we have done before					
The things I learn in one subject relate to what I learn in other subjects					
I would describe myself as a hardworking student					
Given a choice I would like to learn about how a machine works and also why it matters					
I often find that the topics I am studying are disconnected from things that matter in real life					
Given a choice, I prefer thinking about why a machine matters, rather than learning about how it works					
I feel that I was making much better progress in my learning last year compared to this year					
Overall I am enjoying Year 8					

Year 8 workshops exploring possible futures for humanlike machines

Advances in robotics towards increasingly humanlike machines raise many intriguing questions – questions which readily engage the minds of young people. Prompted by this opportunity, we devised a workshop on robotics for teenagers which aims to promote intellectual curiosity and develop students' capacities to reason about the power, relevance and limitations of science in multidisciplinary arenas.

In particular the workshop is designed to help students to appreciate that some questions are more amenable to scientific methods than others and that some questions are more metaphysically sensitive than others. The workshop also enhances scientific literacy by encouraging students to critically analyse the language used to describe human/robot behaviours, to draw attention to linguistic distinctions that enable further discussions about the progress of robotics towards humanlike machines. For the proposed project, we will take this very successful workshop and use it as a centrepiece in secondary science teacher workshops – for student teachers on our courses here and also for CPD workshops for practicing teachers.





Discipline wheel to help students consider how each discipline can bring an additional perspective to a big question. The project has different versions for different levels of students. This version is used in primary and lower secondary.

Year 6: Never off topic

The Year 6 in-school intervention is a day when the whole year group work together to address a ‘Big Question’. The strand is supported by resources on the project website.

An example is the question – Why do many ten year old children seem to fracture a wrist or arm? To address the question, students pursue a range of research lines and investigations, looking for example at evolutionary explanations, data to inform their thinking about who is most likely to take risks and many more angles besides. The day provides opportunities for students to contribute data to a national study and also to create a rich and multileveled response to the original question. In this way the intervention counters the notion that there has to be ‘one answer’ or ‘one way to answer’ a question.

Year 1	Plan and build the Never off topic website
Year 2	Trial the website and Never off topic day with CCCU partnership schools; in parallel recruit collaborating institutions to form consortium
Year 3	Media campaign and trial the website and Never off topic day with the consortium of institutions and associated schools; in parallel hold international conference and recruit international partners
Year 4	Repeat the campaign nationally;
Year 5	Repeat the campaign nationally and internationally
Year 6	International conference to share findings.

Professional Development for secondary Science and RE Teachers

Rationale

LASAR research demonstrates that if secondary school pupils are to develop epistemic insight, it is essential that they understand the relationship between science and religion. This can only be achieved if science and RE teachers work in harmony with each other; otherwise the conflict thesis is easily reinforced in pupils' minds. There are, however, very few opportunities for science and RE teachers to work together. This project will develop mechanisms for science and RE teachers in the same secondary school to meet with each other with a view to gaining an understanding of each other's work and to developing strategies for promoting epistemic insight in the way that they teach their respective subjects. The ideas developed would be published on a website.

Reach and Ripples

Our aim would be to reach 150 schools, which is roughly 5% of all secondary schools. The resulting website would then be promoted to secondary schools across England through significant networks in order to stimulate other schools to develop their own strategies for encouraging the development of epistemic insight.

Strategy

The focal point of the programme would be number of regional days, where science and RE teachers from schools in the region would be introduced to the LASAR research and approaches. They would then be asked to design a strategy for their school to promote the development of epistemic insight in their pupils. Each school would be asked to write up their strategy for publication on the website.

Longevity and Vision

The aim of this programme would be to promote a culture of conversation about epistemic insight between RE and Science teachers about promoting epistemic insight on secondary schools. Given the extensive and significant networks where NICER and LASAR staff are both well-connected and influential in both science and religious education, the potential for culture change is enormous.

Theme groups – embedding Epistemic insight into the research culture for all faculty staff

The Theme Leaders support the development of Research and Knowledge Exchange (RKE) activities for individuals and groups across the Faculty of Education. They design and run different types of workshops and seminars as well as three Educational Research Conferences over the academic year, where national and international speakers and experts from across the university are invited to share their latest work. There are eight RKE Themes led by at least two leaders. Each Theme has a distinct identity, however, they work together seamlessly to enhance staff skills, build RKE capacity, increase outputs and cultivate a thriving RKE environment.

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