Epistemic insight: promoting collaborative teaching between RE and science teachers

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Abstract The compartmentalisation of distinct disciplines limits the opportunities for teachers to work in a collaborative multidisciplinary manner. Workshops such as 'Saviour Siblings' from the Epistemic Insight Initiative encourage students to consider big questions from different perspectives and thus provide a bridge between the religious education (RE) and science curricula at key stage 4 (ages 14–16). This article reports on a collaborative teaching intervention between science and RE lecturers on a secondary PGCE initial teacher education programme. Discussing big questions with their peers proved to develop trainee teachers' beliefs about the power and limitations of science and the value of considering a diverse range of disciplinary perspectives.

The substantive question we explore in this article is whether it is right for a family to use genetic selection to create a child who is designed to save the life of an older sibling who has a life-limiting disease. This question is the focus of a workshop for upper secondary school students that bridges science and RE (religious education) and is designed to develop students' understanding of the power and limitations of science. This objective appears in the National Curriculum in England for science (Department for Education, 2014). However, there is a basis for saying that only a minority of teachers address this objective in practice (Billingsley *et al.*, 2018). The power and limitations of science can further be considered in RE lessons when students consider the ethical implications of science upon family dynamics, the sanctity of life and the extent to which this can be tailored to meet another person's needs.

Our context in this article is initial teacher education, and our aims were twofold. One aim was to create and teach the workshop on 'Saviour Siblings' in a format designed for teacher education. Until this point, the workshop had only run with school students. Secondly, we wondered how future teachers of science and RE would respond to an opportunity to work together to explore a question that is relevant to both of their subjects. Our interest was informed by previous research that outlines the organisational challenges of bringing teachers of science and RE together into one classroom in school (Billingsley *et al.*, 2014). The article also emphasises the importance of teachers' expectations and attitudes around cross-curricular teaching. It highlights concerns shared by many teachers that cross-curricular teaching can prevent clarity about the aims of the session and reduce the efficacy of the timetable to meet the aims of each subject (Billingsley *et al.*, 2014).

Importantly, we argue, the Epistemic Insight Curriculum Framework sets out teachable, assessable and transferable objectives to build students' disciplinary (epistemic) knowledge as they advance through the stages of school education. Epistemic insight is written into the National Curriculum (England and Wales), and in our work it is developed not only within each curriculum subject but also across subjects, to enable students to examine the nature of knowledge in wider contexts and through case studies of real-world problems. Here, we propose that questions that bridge two or more disciplines, including so-called 'big questions' about personhood and the nature of reality, can be brought into a shared classroom space to enable students to analyse and discuss them 'in the round' through a range of different perspectives (Billingsley, 2016). It is an approach that has been advocated as a springboard for teacher collaboration and interdepartmental planning. Consequentially, big questions provide a potential route to overcome entrenched subject compartmentalisation of young people's understanding of science (Billingsley, Nassaji and Abedin, 2017).

Nonetheless, when teaching topics that bridge science and religion, a collaborative teaching approach is not yet commonplace (Billingsley *et al.*, 2014). This article reflects upon how modelling that collaborative teaching informs our teaching practice and the views of the trainee teachers we teach. We describe and unpack a session that bridges science and RE and examine the proposition that a framework exemplifying that views from science and RE are not necessarily in conflict can be of merit to a teacher training programme.

Planning for collaborative teaching

In the initial planning stages of collaborative teaching it was paramount to identify how this intervention could be of mutual benefit to both science and RE trainee teachers.

In the most recent development of the National Curriculum for key stage 4 science (Department for Education, 2014) in England, there is an expectation that secondary students develop an increased understanding of the nature of science and the types of questions that are particularly amenable to scientific methods. Terms that are used to build understanding in schools and/or teacher education include scientism and metaphysics. Several forms of scientism are discussed in the literature; a common theme is a belief that only science contributes to knowledge acquisition (Stenmark, 2001). By extension, a commitment to scientism would suggest that there are no questions that cannot be entirely answered by science (Billingsley *et al.*, 2016). By identifying the limitations of science, students uncover the types of question where science informs our thinking but does not provide a complete answer. It is, therefore, perhaps surprising that Postgraduate Certificate in Education (PGCE) programmes have limited focus on supporting trainee teachers to develop skill sets to identify the limitations of science (De Carvalho, 2016). An understanding of the role of science is, however, not limited to the science curriculum. The GCSE RE curriculum has clear overlap with science, including topics such as the origins of the universe and origins of life. Previous research highlights how religious views can inform science teaching when discussing themes such as evolution (Yasri and Mancy, 2014) or the origin of the universe (Billingsley *et al.*, 2016). Nevertheless, science teachers tend to highlight scientific perspectives as factual (Billingsley *et al.*, 2016). This research, therefore, aims to support trainee science teachers to appreciate the role RE can play in developing answers to big questions, and empower RE teachers to consider the impact of science on a broader range of topics within the RE specification.

There are topics in the RE curriculum where the potential collaboration with science is more subtle. One such example is the '*nature of families, including: the role of parents and children*' (AQA, 2017:21). Recent changes in UK law that allowed parents to have children to save a sibling can affect the potential roles of children and parents within a family. It further provides an opportunity for students to consider the contribution science makes to answering ethical questions. This topic provided links to both the RE and science curricula and was thus the focus of collaborative teaching.

Methods

The research discussed in this article formed part of a secondary PGCE course. A total of 43 trainee teachers studying the PGCE with qualified teacher status (QTS) course took part in the intervention. The trainee teachers in the study had specialisms in secondary science ($n=34$) or secondary RE ($n=9$). The research aims to establish how teaching that utilises the epistemic insight framework informs both the practice of the trainee teachers we support and our teaching practice on a secondary PGCE course.

In advance of the formal intervention, an initial collaborative teaching session asked students to consider if RE and science education were necessarily in conflict. We describe that next and then move on to describe the format of the invention and the data-gathering tools we used to assess it.

The initial collaborative teaching session: contrasting epistemologies

The session was delivered ahead of trainees going on school experience in Autumn 2019. This was a deliberate choice as it forced our trainees to reflect on their schooling to date. The session introduced trainees to crucial terminology such as epistemology, nature of science and nature of religion. Working in mixed groups of RE and science trainees, students discussed their views on a series of statements to uncover whether RE and science teachers held similar or oppositional perspectives. Examples of the statements were: 'There is such a thing as absolute truth' and 'Trust in scientific data is a kind of faith'.

This session asks students for their initial ideas on what counts as valid evidence via questions such as '*Is quantitative data always more valuable than qualitative data?*' and '*How do you know for sure that someone is in pain?*' The session concludes by introducing trainees to the big question '*Are robots alive?*' and asking trainees how they would use different disciplines to answer that question.

Epistemic insight initial survey

The session on saviour siblings was selected from the Epistemic Insight Initiative's range of workshops for schools as a way to deepen trainees' epistemic insight and to introduce them to some of the tools and pedagogies that the initiative makes available. The trainee teachers completed the epistemic insight initial teacher pre-survey, which contained a mixture of 40 Likert scale questions and open-answer responses. After the intervention, trainee teachers ($n=19$) completed a post-survey. This approach enabled us to identify the initial beliefs held by the trainee teachers and how that affected their approach to answering multidisciplinary big questions. The survey used a mixture of Likert scale questions and open-answer responses to identify trainee teachers' perceptions of science. The questions focused on three distinct themes. Exemplar questions on each theme are outlined below:

- **Personal beliefs**
  How would you describe your position on religion?
  - One day science will be able to predict how a person will behave at every moment.

- God created the universe.
- Humans have a soul.

What makes science distinctive compared with other disciplines?

- **Their schooling as a child**
  In secondary school, I had some lessons where the science teacher and a teacher of another subject taught the lesson together.
  My school explained that science and religion are mostly concerned with different types of questions.
  I enjoyed science at secondary school.
- **Their experiences as a trainee teacher**
  I have seen research on the Epistemic Insight Initiative.
  I am familiar with the term epistemology.
  My experience of epistemic insight has been informed by:
  - school observations
  - feedback on my teaching
  - university whole cohort sessions
  - university subject-specific sessions

One part of the pre-survey attempted to ascertain whether scientism was also prevalent among trainee teachers. The survey included Likert scale statements that formed the following construct:

- One day science will be able to predict how a person will behave at every moment.
- One day we may be able to explain the whole universe using science alone.
- Science is the only valid way to investigate a question.

Analysis and discussion

Perceptions of the relationships between science and religion and attitudes to scientism

The frequency data reported in Table 1 suggests that most trainees are not scientistic when they discuss their attitudes to knowledge on big questions.

These findings corroborate the findings of a survey of 311 years 9, 10 and 11 (ages 13–16) students' perceptions of the power and limitations of science (Billingsley and Nassaji, 2019). The survey of school students found that the majority of those students are not scientistic in their attitudes to knowledge. At the same time, the majority of the 311 students surveyed slipped into scientistic language in their comments and also agreed with some scientistic statements at various points in the survey. These were interpreted as examples of 'uncritical scientism'. The study also reported that a fifth of participating students were labelled as strongly scientistic based on a commitment to scientism across a set of statements about personality and behaviour.

Student familiarity with the Epistemic Insight Initiative

The pre-survey also highlighted the potential benefit of the Epistemic Insight Initiative, with correlations between the statement 'I have seen research on epistemic insight' and the following statements:

- my course has addressed strategies to teach epistemic insight;
- my subject connects with other subjects in the school curriculum;
- I will introduce my students to 'big questions';
- my experience of epistemic insight is informed by university subject-specific sessions;
- science makes it hard to believe in God.

By contrast, as evident in Table 2, the correlations between statements are due to the majority either agreeing or strongly agreeing with the statement.

The aims for the collaborative session on saviour siblings

The second intervention ran in March of 2020. Trainees had completed two separate teaching placements in advance of this intervention. Owing to the global COVID-19 pandemic, the session was run online through university intranet platforms. The session focused on the big question, '*Should science be used to create saviour siblings?*' We adapted the session from a workshop delivered by the first author at the epistemic insight schools conference. The session introduced trainees to changes in UK law that allow parents to undergo *in vitro* fertilisation and use genetic selection of embryos

Table 1 Frequency of responses on sample Likert scale questions

Statement	Number of respondents who…				
	strongly disagreed	disagreed	neither agreed nor disagreed	agreed	strongly agreed
Science is the only valid way to investigate a question	10	22	7	4	0
One day we may be able to explain the whole universe using science alone.	10	12	6	12	3
My subject is best taught as a standalone	16	21	3	2	1
Science and religion disagree on so many things, they cannot both be true.	13	11	14	3	2

Table 2 Frequency of responses for statements that correlated to 'I am familiar with the Epistemic Insight Initiative'

Statement	Number of respondents who…				
	strongly disagreed	disagreed	neither agreed nor disagreed	agreed	strongly agreed
I have seen research on epistemic insight	2	4	15	21	1
My course has addressed strategies to teach epistemic insight	0	1	7	30	5
My subject connects with other subjects in the school curriculum	1	2	1	25	14
I will introduce my students to 'big questions'	1	0	7	22	13
My experience of epistemic insight is informed by university subject-specific sessions	1	1	3	28	10

to create a donor match for older siblings. By introducing trainees to both real-life and fictional stories, the session sought to illuminate the types of question that can be answered by science alone, RE alone and those that are interdisciplinary.

Post-survey

Ten science trainees and five RE trainees completed the post-intervention survey. Owing to the global COVID-19 pandemic, the trainees completed surveys online using a JISC survey platform. The survey used a blend of Likert scale and open-response question to identify shifts in students' beliefs around the interplay between science and religion. Responses to the open question, concerned with trainees' perceptions of the Epistemic Insight Initiative, indicated that trainees were now more confident in constructing big questions. This seemed to be in part linked to the experience of being part of a collaborative subject learning experience. The responses quoted below are indicative of the responses received.

What did you find most surprising about the Epistemic Insight Initiative?

The abundance of links between topics within different subjects. (Female physics trainee teacher)

Why have I not come across this term before? (Male biology trainee teacher)

The vast interconnected-'ness' of interdisciplinary approaches and how this can encourage learning in the classroom. (Male RE trainee teacher)

For me, it is the ability to be able to look at the same question from two different angles and question both sets of knowledge equally. I am surprised by how well it works and how well it could work in a school. (Female RE trainee teacher)

How has this epistemic insight project informed how you plan lessons?

Made me more confident initiating conversations for 'big questions' as there is no one correct answer. (Female physics trainee teacher)

I try to include discussion around moral questions where I can and have always tried to bring in points from other subjects (etymology, history, lining across the sciences even art). (Male biology trainee teacher)

I think I will take the chance to talk about epistemic issues that can be arisen when teaching science, no matter what my belief is, but only to show my students a different perspective, so that they can deduce their own conclusions. (Male physics trainee teacher)

I have been able to draw from areas like science and geography on issues like creation and stewardship and to consider where students may draw on bigger and linked questions. (Male RE trainee teacher)

What big questions would you like to explore in your teaching?

Why is there life in the universe?
Do we need to believe in something in order to do the righteous thing? (Male physics trainee teacher)

How do we find the 'optimum' family makeup? (Female RE trainee teacher)

When does life begin?
How far is too far? (Female chemistry trainee teacher)

These responses highlight that trainees can identify specific examples of how the Epistemic Insight Initiative may inform their teaching. It encourages us to continue to develop opportunities for collaborative teaching in the PGCE programme.

Summary and reflections on how the Epistemic Insight Initiative informs our teaching of a PGCE programme

The initial epistemic insight survey suggests that the trainees we taught are not scientistic in general when answering big questions. Trainees who were familiar with the Epistemic

Insight Initiative were more likely to identify connections with other subjects and aim to develop opportunities to introduce the students they teach to big questions.

Owing to the sample size of post-intervention questionnaires, the conclusions we can make about the impact of this intervention are limited. However, feedback from trainees, which implies that the intervention will inform their future teaching practice, gives increased confidence to continue to develop collaborative teaching opportunities on our PGCE course. Future research aims to add validity to the inferences made in this article.

Further, this research has highlighted how modelling collaborative teaching can foster an enthusiasm for a multidisciplinary approach to teaching. We have overcome the fear that trainee teachers will not see the benefit of a focus on epistemic insight in the same way they will on subject-specific sessions. Observations from those collaborative sessions and responses to statements such as 'science makes it hard to believe in God' have reminded us of the call for teachers and lecturers alike to account for superdiversity of the students they teach (De Carvalho, 2016). The positive findings from this study give us increased confidence to develop collaborative opportunities between science and RE further.

Our future teaching will build upon the sessions discussed in this article to foster opportunities to discuss questions such as '*What do we mean by life?*' In so doing, we aim to support trainee teachers to identify the importance of bridging subjects such as RE and science.

Additionally, the current global pandemic and the challenges of quarantine provide a stimulus to consider the types of question science can answer, such as '*Why have we been placed in lockdown?*', alongside those questions where knowledge from a variety of disciplines must be applied.

We argue, however, that the potential benefit of the Epistemic Insight Initiative is not limited to the overlap between religion and science. A multidisciplinary approach can utilise the overlap between history and science in approaching questions such as '*Why did the Titanic sink?*'

The epistemic insight framework offers opportunities to uncover the '*distinctive nature of science in comparison with another discipline such as history*' (Billingsley *et al.*, 2018: 1124). We plan to expand our collaborative teaching to science and history trainees. Document analysis of the history and science national curricula in the UK highlights that curiosity, enquiry and reference to evidence are themes that are evident in both subjects (Billingsley and Ramos Arias, 2017). We aim to exemplify how science and history define enquiry, the type of evidence they consider, and to encourage trainee teachers to reflect upon whether another discipline can inform their pedagogical practice.

Future directions for research

This project models the potential benefits of embedding cross-curricular teaching in a PGCE programme. To triangulate findings, interviews with PGCE lecturers will identify whether the introduction of collaborative teaching on the PGCE informs their teaching in subject-specific sessions.

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