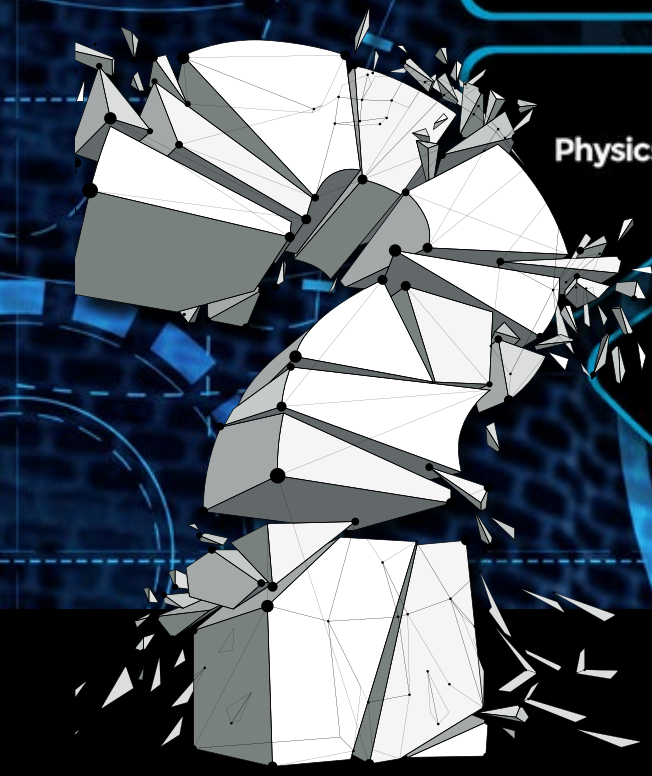
Epistemic Insight

THE EPISTEMIC INSIGHT DIGEST



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FACULTY OF
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CONTENTS

EDITOR'S WELCOME

The EI digest started out as a place where ITE students could showcase their work, many years ago in 2020, and I am proud to be a part of its continued success. A success that has been enabled through the continued contributions of educators, researchers, and students, who have worked collaboratively to bring you this current issue.

This edition celebrates these partnerships. With the hope of, the continued collaboration of scholars regardless of their place in their teaching journey. It is through partnerships like this, and the exchange of knowledge that we can better understand ourselves, one another, and the wide community.

A special thank you goes out to our contributors, Dr Agnieszka J. Gordon and Mina Cullimore, Laura Hackett, Buffy-Lucy Jennings, Anastasia Sofia Semaan, the entire LASAR team (with a special thank you to Professor Berry Billingsley), and Dr Martin Pickett. Thank you for your patience and for taking the time out to submit to this issue.

And a special thank you—to you the reader—for joining us on this journey.

Happy Reading,

Dr Dani Shalet
Editor, Research Fellow and Associate Lecturer in Education

The above word cloud illustrates the most frequently occurring words in this issue

SECTION 1

The following articles were written by Dr Agnieszka J. Gordon, Mina Cullimore and Laura Hackett research fellows at the LASAR centre. These write ups focus on work the team has done, over the last two years, in primary schools. They were chosen because they are a lovely demonstration of the wonderful collaborative works between academics, student teachers, parents, and professional teachers.

"WHY DO SPINNERS SPIN?" – USING INTERACTIVE RESOURCES TO BUILD SCIENTIFIC ENQUIRY SKILLS AND TEACHER CONFIDENCE IN PRIMARY SCIENCE EDUCATION

Dr Agnieszka J. Gordon and Mina Cullimore

Abstract

We reflect upon experiences of using hands-on activities during sessions we led with trainee primary teachers. This article identifies approaches in teaching and learning that enhances both primary teachers' skills in modelling 'working scientifically' and children's sense of agency to 'think like a scientist' as they learn more about the world around them. As classroom practice in schools continues to recover from the impact of the global pandemic, resources developed to engage children's curiosity to participate in sustained science activities are used to build confidence in teachers when preparing to deliver the national curriculum for science.

Introduction

Science, and the work of scientists, has a vital role in many aspects of our lives. Engagement with STEM (science, technology, engineering, and mathematics) is no longer exclusively important for those who are aspiring to be scientists. The recent pandemic has shown that the understanding of science, its nature, methods of enquiry as well as its power and limitations are key to understanding the world around us, and to developing effective responses to global opportunities and challenges. Ofsted's research review for science emphasised that the school science curriculum sets out what it means 'to get better' at science (Ofsted, 2021;6). How should those of us who are working in education respond to these recommendations – what does 'getting better at science' mean here?

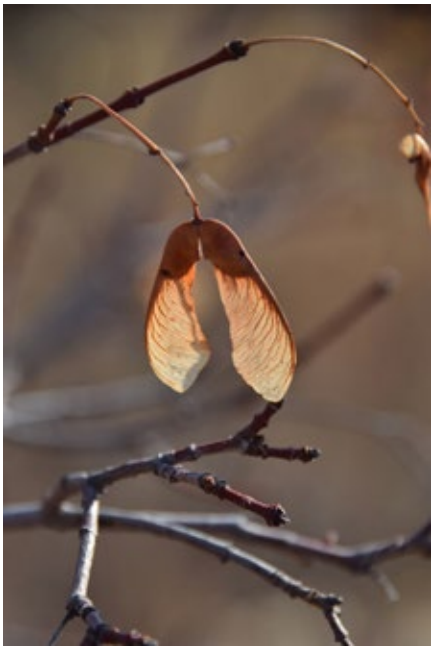


Figure 1 - Closeup Winged Seed Backlight Stock Photo

This article identifies key elements of England's national curriculum for science, outlines sessions that took place in two teacher training institutions employing the initial teacher training (ITT) core content framework (Department for Education, 2019) this year, and offers accessible approaches to enhance classroom experiences of 'working scientifically'.

In our sessions with trainee primary teachers and teachers we develop opportunities to raise their confidence in the planning and delivery of science in their primary classrooms, encourage hands-on activities, skilful use of questioning, and building children's sense of agency in working with science and 'thinking like a scientist'. These sessions make use of resources that were developed and tested by a team of researchers based in a consortium of four collaborating Universities working with hundreds of pupils across the country during the COVID-19 pandemic (Billingsley, 2020).

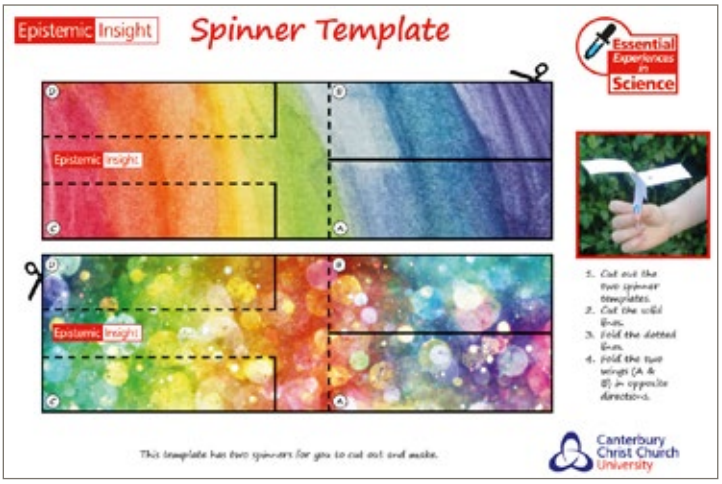
Context

The best teachers of science will 'set out to first maintain curiosity in their pupils' (Ofsted, 2013:4). Anyone who has spent time with young children will recognise the questions that arise early in language acquisition involves 'why?' questions. Children are curious… about everything (or at least, many things during the course of a day or a week). The challenge that one may encounter as a teacher is how to direct and sustain curiosity, build in strategies for working scientifically, and relate what may be abstract concepts into real-world contexts (as well as invite dialogue that can help resolve misconceptions).

The strategy we developed to respond to this challenge draws on the idea of a balanced approach in science teaching and learning; that focusing on only substantive knowledge (content) may lead to misconceptions, thereby highlighting the importance of disciplinary knowledge (understanding how science works… 'working scientifically') (Ofsted, 2021;9). Scientific enquiry ['working scientifically' in the national curriculum for science [DfE, 2013)] includes children being taught to ask questions that can be investigated scientifically, deciding how to find answers, and considering what sources of information they will use to try to answer scientific questions. It is clear that, for children to make progress in science, they need to have experiences when they can 'think like scientists'. Teaching science via enquiry engages children's curiosity and creativity. In the primary classrooms where children are encountering scientific, analytical and critical thinking, teachers are 'equipping learners with lifelong skills' (Ofsted, 2013). In parallel, primary school teachers frequently ask for support with building confidence in some areas of subject knowledge in science (Peacock and Sharp, 2014).

The resource for the sessions with ITT primary trainees

With these opportunities and challenges in mind, we selected a resource that is designed to provide teachers and students with an immersive experience of working scientifically (Simpson. & Billingsley, 2021). In particular, the 'Why do spinners spin?' resource offers children the opportunity to experience practical scientific enquiry, encourages children to express their curiosity through asking questions, and introduces/consolidates the use of scientific 'enquiry' vocabulary. The resource is also associated with promoting student agency and opportunities for creativity. Science is a creative process – or can be understood to be creative, depending on how it is taught. If learning about science is restricted to emphasising facts and concepts, creative thinking is less accessible according to Bill Wallace (a high school teacher in the US). Wallace emphasises "if instead, you teach science as a process of learning, of observing and of gathering information about the way that nature works, then there's more room for incorporating creativity" (Cutraro, 2012).



The resource has three key elements:

1. Two 'spinner' templates that will be cut out and folded for the hands-on practical experiment (which is outlined on the Essential Experiences in Science activity card)

2. The Essential Experiences in Science activity card (front)
   This front side of the card brings into focus observation as a key method of elements in scientific processes.
   Using their observations as they work with the activities on the front of this card, their sense of agency is developed as they 'think like a scientist' when working scientifically by measuring, recording, changing variables.
3. The Essential Experiences in Science activity card (back)
   The second side of the card explores simple scientific concepts (gravity, air resistance), and encourages students to conceptualise these different forces coming together and helping to explain their observations.

The Essential Experiences in Science resource 'Why do spinners spin?' was initially developed as an activity to teach science to children aged between 8 and 12 years old during post-lockdown recovery phase (Billingsley et al., 2020). The resource is accompanied by teachers' notes and CPD in a form of the teacher resource pack. A colourful activity card and simple equipment (spinner template) helps to teach scientific enquiry and develop scientific vocabulary. The card explores simple scientific concepts such as friction, air resistance, gravity and how they help us explain scientific concepts and phenomena.

The resource enables practical learning of the scientific enquiry process through hands-on activities and develops students' inquiry skills such as: asking questions, making predictions, setting up tests, observing over time, making measurements, recording observations, interpreting, communicating and evaluating. The key vocabulary such as 'observation', 'predict' and 'record' is also introduced and explored.

There are many possible variables that can be investigated with spinners activity: for example, the length of the wings, two opposite ways the spinner 'wings' are folded, time it takes for the spinner to fall/spin down at given height, the number and placement of additional weights (paper clips), and the height of the spinner itself could be varied/changed.

What is key to this activity is the use of language: participants are encouraged to record what they observed.

Participants

Around 100 trainees in two institutions providing initial teacher training in England took part in sessions using the 'why do spinners spin?' activity. The activity was delivered across multiple sessions to trainee teachers with a variety of specialisations; some were specialists in science, but majority had A Levels or degrees in humanities and other disciplines. The trainees were enrolled in a variety of courses leading to a teaching qualification (QTS). Some were postgraduate teacher trainees studying on the Postgraduate Certificate of Education (PGCE) course, some were studying for their BA in Education, some were postgraduate students training through a school placement.

Findings and Discussion

Trainee teachers were encouraged to trial and test the activity. Working together and individually they were quick to identify questions, hypotheses, observations and conclusions

Throughout the activity an emphasis was placed on using scientific terminology and in particular 'observe' and 'observation'. At one point in a session a discussion ensued as to what was significantly different about **'observing'**, in comparison to 'seeing', or 'noticing', or 'looking'. Observing as a methodological process is distinct to 'seeing' as a biological process.

We noted that what was also key in this activity was that it supported each participant's agency in 'thinking like a scientist' and 'working scientifically'. It was apparent that the activity made it 'safe' to experiment, have things 'go wrong', and try different approaches without a sense of judgement of 'success' or 'failure'. We also noted that the activity encouraged creative thinking, with students electing to drop spinners from different heights – floor, chair, table and finally the staircase banister. (This investigation inspired discussion about health and safety considerations if performed in the classroom.) The variations mentioned above were recorded and discussed. When testing on the stair banister, the group of students performed the spinner race and observed that the place the spinner lands depended on the height from which it was dropped. The trainees asked, 'does it matter how I drop the spinner?' then compared and observed how the spinner dropped differently when dropped down or thrown up. There was also a competition whose spinner would spin faster when thrown from the high banister, measuring time for the spinner to travel to the bottom of the stairs.

After formulating hypothesis 'if we fold the spinner other way, it will spin clockwise', the trainees tested spinners with wings folded two ways, observing that folding the wings opposite way will change the direction of spin, clockwise and anticlockwise. They also observed that folding and then unfolding back the wings changed the way the spinner spins and that 'folding wings stop the spinner spinning'. The trainees formulated questions such as: 'does it matter if a person is left- or right-handed?' for the way the spinner spins. Through working scientifically, non-science specialist trainee teachers were asking questions that were good for science to investigate.

Another creative development in the enquiry was to test how adding weight to the spinner influences the way it spins and drops. Two types of weight were used: paperclips and pieces of plasticine, separately and together. The trainees tested and observed that 'the more paperclips added, the faster spinner spins'. They also noted that too much weight makes wings fold, and the spinner drops down. This led to informed analysis; the observation that 'some mass is good, too much is not good' prompted discussion on how to test to find out the optimal point. 'The weight needs to be added gradually and slowly to find out how much, but not too much' to put on the spinner. The question 'how to find out to establish how many spins a spinner does before it drops?' brought a suggestion of creating a slow-motion video, which then could be carefully observed. Here we have an example of creative application of technology (in this case, a smartphone with a timelapse setting) to develop and inform scientific enquiry.

Finally, the trainee teachers were discussing further ways to investigate and testing with ideas such as: 'can we add more arms?'. This experience helped the trainee teachers to think like a primary school student planning an investigation and collecting data. Another investigation suggested was to measure time of the drop without weight and with different weight added (more paperclips, more plasticine, both) requiring participants to record data and seek patterns. One trainee suggested comparing whether the spinner drops faster or slower if dropped upside down. The trainee teachers discussed the reasons for observed variability such as difficulties of keeping the launching process consistent and accurately identifying the point of landing. Within a morning's session, trainees (many of who had felt unconfident about teaching science, having struggled with some of the sciences and not having studied it beyond GCSE) were 'thinking like scientists' and working scientifically. They were:

- Making observations that stimulate questions about the natural world that we can investigate
- Using observations to collect data (with the awareness that not all outcomes are measurements/ measurable)
- Drawing conclusions
- Reporting, reflecting upon and applying data.

(Harlen and Qualter, 2014;98)

The sessions concluded with trainee teachers' questions, observations, and reflections. Using the resource enabled the trainee teachers to develop the confidence to model science enquiry skills in their classrooms, such as observing carefully, asking questions, planning investigations, taking measurements, and collecting data. The trainee teachers concluded that children, using this activity, could be encouraged to make a reasoned prediction based on existing knowledge and prior experience. The role of the teacher in the classroom is to model and facilitate this process. Several key elements were identified as key in understanding the nature of science and working scientifically:

1. sometimes a pattern can only emerge after an extended period of time. When observing over time, the observations need to be gathered and noted several times - this is an action of phenomena being investigated
2. it is important to practice and learn how to critically analyse data - for example, accuracy of tools and the way the measurements are made (for example, squeezing a practical into a short time can make it difficult to distinguish differences and potential inaccuracies)
3. children may need help to consider variations that might be due to their actions as investigators - for example, lack of accuracy in dropping (at not exactly the same height)

Conclusions and considerations

The sessions were well received. The cards encouraged trainees to express curiosity and explore nature of science through working scientifically and learning scientific concepts. The primary teacher trainees especially appreciated having an opportunity to test and obtain free hands-on resources and accompanying pedagogy through this CPD in preparation for their upcoming placements. They commented that the resources and activities were fun and informative. The session gave them a chance to explore basic concepts in physics and biology, using scientific vocabulary confidently, and testing how it is to 'think like a scholar'. The activities made them inquisitive, exploring natural world in a way child would but applying principles of working like a scientist – making observations, identifying, and classifying, pattern seeking and fair testing. It was particularly valuable as most of the trainees did not have scientific background. The feedback was that after participating in activities they felt more confident to deliver science activities related to the explored topics and concepts. Trainees' comments included "I enjoyed the practical activities and discussion; it prompted lots of questions."

The trainee teacher students were surprised by how using simple hands-on activities could creatively teach pupils the nature of science and develop their scientific enquiry through engaging and encouraging exploration, constructing questions, and making observations. During the session the students also learnt the power and limitations of science such as appreciation that some questions can be answered only at given time with available knowledge, some cannot be answered fully by science, and some answers that at one point were deemed 'right' might be proved wrong as more knowledge is being acquired. The session also showed that science is enjoyable and accessible to anyone, regardless of the science capital. One student exclaimed (during activities) 'this is amazing'. Most of the trainees declared they would use the pedagogy and resources at their placement.

It is clear that through scientific enquiry children (and their teachers) develop abilities to question their observations in a critical way. As they learn the concepts and the scientific processes, they will also learn how to work and think like a real scientist, solving problems, investigating ways to respond and seek answers to questions, and exploring new and often big ideas. Scientific enquiry will also help children (and their teachers) to deepen their understanding of key concepts, address gaps and

misconceptions, learn to exercise their sense of agency, develop their resilience and determination, as well as build appropriate vocabulary. Enabling young people to be able to adeptly select and work in multidisciplinary ways will be increasingly important as the role of STEM becomes more embedded across different areas of our lives. Developing these competencies (transferable skills) will contribute to equipping students with attitudes, skills and expertise important for a future-ready citizen of an inclusive and sustainable society [OECD, 2018].

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WHY CAN'T WE BREATHE UNDERWATER?' - PROVIDING CHILDREN WITH OPPORTUNITIES TO EXPLORE BIG QUESTIONS ABOUT HUMAN PERSONHOOD AND THE NATURE OF REALITY

Laura Hackett

Abstract

Many children are interested in 'Big Questions' – those to do with human personhood and the nature of reality, such as 'can a robot be like a human'. Yet, there does not exist an appropriate educational setting for children to have the opportunity to think about and discuss these questions – at home or at school. One barrier from research seems to be adult confidence to engage with these topics. Epistemic Insight resources were created for use among children and an appropriate adult (parent, carer, teacher) to facilitate discussions about questions that bridge science and humanities. The resources were tested in two phases – first, with 9 families in the home, and second with 29 upper primary school children at an after-school club. Findings show that the resources were effective at stimulating discussion about Big Questions, but particularly in the school setting over the home. This was mainly attributed to a lack of time to use the resources in the home, although other benefits to using the resources among family were noted. Recommendations are given, such as the need for a dedicated epistemic insight lesson in the school timetable, or for epistemic insight to be brought into aspects of existing lessons in the school day.

1. Introduction and rationale

Why can't we live more than 100 years? Can we create new animals? What made earth? Does someone control the weather? Why can't we breathe underwater? Children's minds are full of Big Questions about human personhood and the nature of reality. However, the current curriculum framework in England leaves little to no opportunity for these to be explored. Many children perceive science to have the answers to all our questions. Yet even in science lessons, children do not ask these Big Questions as they are deemed to be 'off topic'.

If not at school, then where can children discuss these Big Questions? At home, where children can talk with a member of the family? Our findings indicate that this is not the case. The majority of children we survey state that while they enjoy thinking about Big Questions (like whether a robot can be like a person), they do not talk about them at home. Findings from the 'Faith in the Nexus' report by the NICER centre at Canterbury Christ Church University suggest that this may be due to parents/carers lacking the confidence, knowledge and opportunity to discuss these topics, particularly where science bridges religion and faith. Some were also fearful of 'indoctrinating' their children when discussing religion. Adults then avoid engaging in discussion, and children learn not to ask these types of questions. The NICER report also found that providing space and time for reflection encouraged more interactions in the home relating to religion and faith, and that parents' confidence to discuss these topics increased when schools encouraged talk about 'spiritual matters' (Casson, Hulbert, Woolley and Bowie, 2020).

Talking with friends and family about science has been shown to have a significant influence on the strength of children's science identity and the career choice they make - whether or not the family have science qualification/professions (Dou et al., 2019.) Discovering ways to motivate and stimulate scientific and science-related conversations at home and in informal learning settings continues to be widely discussed and debated (Romeo, 2019).

2. Methodology

To combat the problem of a lack of opportunity for this talk, and in response to these findings, we developed a set of resources for use at school or in the home, among children and their parents, carers, wider family members, or teachers. In our project we are looking for ways to develop children's appreciation of how science relates to and informs Big Questions. This aim is combined with the aim of finding hands-on activities that students can take with them out of the classroom and carry out at home, if and when conditions at school are affected by Covid.

The activity resources we created provide an opportunity to explore Big Questions about human personhood and the nature of reality. We call these resources 'Discovery Bags', and each discovery bag focuses on a question such as: 'Why is the sky blue?', 'How do we make sense of the weather?' and 'Why do we need water?'. Children and their helpers can then investigate through an investigation card that contains prompts for discussion, using both scientific and religious viewpoints. The bag also contains a piece of science equipment and instructions on how to conduct a simple investigation, such as an anemometer (wind-measuring device) for exploring how we make sense of the weather.

Our hope was that the piece of scientific equipment was sufficiently interesting that it would stimulate exploration of the Discovery Bag and thus exploration of the accompanying Big Question. For instance, after investigating the strength of the wind using the anemometer, the Investigation Card goes on to ask: 'Could there be a God who controls the weather?'. The card draws on examples and stories from religious texts such as the bible, in which God uses the elements (such as wind) to speak to a man named Elijah. These examples aim to encourage deeper thinking about whether God (if there is a God) still uses the weather to communicate today.

We piloted these bags in two settings to test their effectiveness. First in the home, and then in a school. Ethical approval was granted by Canterbury Christ Church University prior to commencement of the project. All families and schoolchildren were given a participant information sheet and consent form. Participants were assured that any data would be anonymised and they could withdraw from the project at any time without having to give a reason. Consent was also gained from the Headteacher of the primary school setting.

2.i Discovery Bags in the Home

A total of nine families had access to Discovery Bags resources between November 2020 and April 2021. Each family received between 1-3 bags depending on their desired level of involvement with the project. Below is a breakdown of the families involved (all names have been replaced by pseudonyms):

Family A: Anita (mum), Aaron (son, 9) and Alice (daughter, 7).	Recruited through a connection with local church. Received 3 discovery bags.
Family B: Barbara (mum), Bethany (daughter, 9).	Recruited through the project's connection to a local church. Received 3 discovery bags.
Family C: Carol (mum), Caleb (son, 9).	Recruited through connection with local school. Received 3 discovery bags.
Family D: Deborah (mum), Danny (son, 8).	Recruited through connection with local school. Received 3 discovery bags.
Family E: Edgar (dad), Ethan (son, 7).	Recruited through a connection with local church. Received 3 discovery bags.

Family F: Fiona (mum), Francesca (daughter, 8).	Recruited through a connection with local church. Received 1 discovery bag but never used – withdrew from the project.
Family G: Ghafur (dad), Gabir (son, 7)	Recruited through local mosque. Withdrew from the project before discovery bags were delivered.
Family H: Hannah (mum), Henry (son, 6)	Recruited through the project's connection to a local church. Received 1 discovery bag.
Family I: Ingrid (mum), Ivan (son, 6)	Recruited through the project's connection to a local church. Received 1 discovery bag.

Bags were delivered to different families over the course of several months – some just before periods of national lockdown, others when lockdown was lifted. We aimed to provide practical science and opportunities to discuss Big Questions in light of school closures during the December-February period. We reasoned that as children were spending more time at home, sending the bags directly to the families' homes would provide a 'space' and 'place' for Big Questions to be discussed. After the bags were collected back, 4 families consented to be interviewed about their experiences. Both the parent and child(ren) of families A, B, C and D all took part in an interview lasting between 14 and 23 minutes (mean: 18 minutes).

2.ii Discovery Bags in a School Setting

A local primary school was approached through opportunity sampling to pilot the next phase of the project with Key Stage 2 students. They were enthusiastic and signed up to participate, agreeing to run the after-school club for 8 weeks over the Autumn Term (September to December 2021). This proved to be one of their most popular clubs, with 31 children across Year 4, 5 and 6 signing up. As this exceeded the maximum number allowed in one club, it was agreed that we would run the club twice – first for a period of 4 weeks with 16 children and then repeated for a period of another 4 weeks with 15 children, to ensure all who signed up could take part. Two children withdrew from the project, so the club began with 29 children and ended with 23 children. This was due to a Covid-outbreak in one of the school year group 'bubbles', meaning that 6 children were unable to continue attending the club. The club sessions ran for one hour over a period of four weeks for each group of children. The sessions were led by a member of the LASAR team (a qualified primary school teacher) and supported by the school's Science Coordinator. Each session began with a science investigation and concluded with discussion about a 'Big Question' from a multidisciplinary perspective using the Discipline Wheel tool (figure 1).

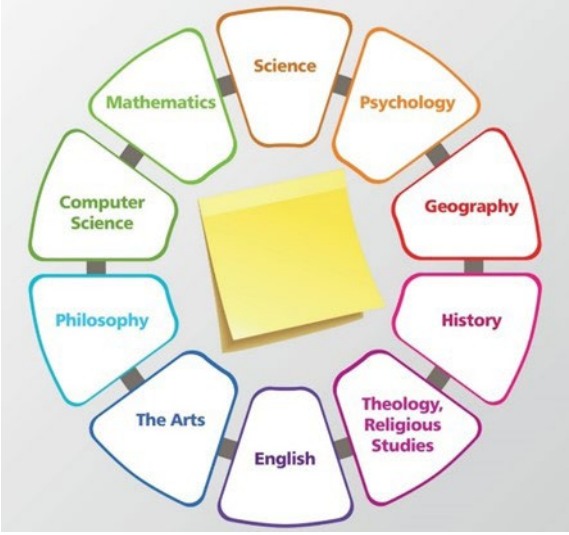

Figure 1: The Discipline Wheel – a Big Question is put into the centre and is explored through a range of disciplinary perspectives.

Findings and Discussion

3.i Findings from the home

Despite spending more time at home during lockdowns, parents and children appeared to be just as busy as when they were out of lockdown. As a result, recruitment and engagement with the project was acutely impacted by a lack of time. One family withdrew before they received their first discovery bag citing lack of time as a main factor. Another family sent back the resources un-used a few months after receiving them, due to being too busy to use them. Two more families dropped out of the project after using the first set of resources, and a further three families reported struggling to find the time to use the bags (although they did remain in the project and used all three sets of resources). Two of the families were very enthusiastic about the resources and were fully engaged in the project. Yet, out of the nine families this does cause us to wonder if the bags were more of a burden than a support for parents/carers.

As one mum said in an interview:

> *'Interviewer: Was there any factor that impacted the time that you had available to use the bags?*
>
> *Barbara: Erm... just normal busyness isn't it, it's actually carving out that much time where we can get some peace and quiet to do it'*

Other parents felt similarly:

> *'I feel like the first [discovery bag] – did we have it in lockdown?... if we were trying to fit it in now with our current lifestyle of busyness and after school club and work and everything, I think we'd struggle to fit them in a bit more. Whereas when we did fit them in, life was a little bit calmer.' (Anita)*
>
> *'The timing with personal stuff, I think it was just not getting the chance. I mean you gave us ample time, but it was still that window that had so much that was going on that I just didn't have the time to. But in future I think we will definitely endeavour to prioritise and get into it.' (Deborah)*

Nevertheless, positive feedback regarding the bags was received by all families that used the bags:

> *'We both enjoy sharing our opinions about the world... When we are not too busy we talk about big questions a lot' (Barbara)*
>
> *'We like to be open and talk about feelings and life and discuss why things happen' (Ingrid)*
>
> *'We probably both learned new things together didn't we?' (Carol)*
>
> *'It was interesting. I was curious to find out more, because what my knowledge covers is actually minute, so that was quite interesting to explore, to get to know more…' (Deborah)*

The bags did seem to be effective at prompting deeper conversations about Big Questions with their child(ren):

> *'We both discussed the topic and asked equal amounts of questions... Caleb enjoyed the experiment and looking at the big questions around it' (Carol)*
>
> *'The boys enjoyed using anemometer. They thought about what was being asked.' (Hannah)*
>
> *'It's not something that you talk about every day but it is in your mind... you don't talk about the world and things around you and how things change, so yeah that was good.' (Deborah)*

For some families, it was the first time they had thought about science and religion as working together:

Anita (mum): We've not really ever put the two together explicitly like that. Have we ever really talked to you about science and religion together, or Christianity and science in the same way together, linking them?

Aaron (son): Not really... sometimes, maybe.

Parents needed support and information about the topic to feel confident in discussing the Big Question, and this support was contained in the form of a parent discussion guide provided in the bags. These proved helpful for those who used them, as outlined by this parent:

Interviewer: If you used them, how useful were the parent discussion guides?

Carol: We did look at them them, yeah, they were really detailed - nice and easy to follow as well. We literally looked through every sheet didn't we, and we went through everything

Interviewer: Were there any particular aspects of the discussion guide that helped you?

Carol: Yeah, I think as well it's good to show how it relates to different subjects, so you could see the geographical side or the scientific side, the religious side as well. It was a nice breakdown to learn how water was used in religious education and then how it was used in science.

Other parents did not use the guides, and this was mainly attributed to time pressures:

Interviewer: did you get a chance to use the parent discussion guide, if yes how did you find it and if no was there a particular reason why?

Anita: I think with, it's one of those things, if I had been doing it with a planned group like a Sunday school group or a school group, I would have read that, but because we were getting it out in front of the kids, we just read it as we went through and read what they read

Children seemed particularly interested in the piece of science equipment:

'I think they enjoyed working out how, as a piece of equipment, how it worked – the engineering style of the piece of equipment itself was quite, erm, yeah they found that interesting.' (Anita)

'The glasses one was my favourite, I really liked how it looked and they were really fun' (Bethany)

When asked about their experience of using the bags, this was the main element that they remembered:

Carol (mum): What did you find interesting?

Caleb (son): Erm, syringe.

Carol: Not just the syringe but I mean in the science and the religious education, I mean you loved doing the science experiment didn't you?

The positive comments from families indicated that the resources were valuable and enjoyable. Yet, it is clear that some changes would need to be made to the current format to make it more successful in future. Our hope for the Discovery Bags was to support engagement with Big Questions about human personhood and the nature of reality, rather than the bags being just 'another thing' to cram into an already busy family lifestyle.

Nevertheless, one benefit of the home environment was the freedom to ask questions that children may not feel comfortable to ask at school:

Anita (mum): What do you think it would be like at school if you did [the activities]?

Alice (daughter): We'd have to take turns

Anita: You'd have to take turns, yeah

Aaron (son): Because it's kind of tricky at school, like loads more people, but at home there's just a few of us...

Anita: ...How do you think, if you were doing those activities at school would you ask the same questions and said the same things do you think?

Alice and Aaron: No...

These findings from the home aspect of the project led us to think about opportunities for children to engage in the activities where time was less of an issue.

3.ii Findings from a school setting

We hypothesised that an after-school club had the potential to be the ideal space for these resources – children are already at school and parents can benefit from additional childcare. Most primary schools offer extra-curricular after-school clubs such as sports, cooking, and crafts. These are often more relaxed in their content than lesson time, as there is freedom from the limitations of the curriculum. However, sometimes these can come with an additional charge. A free after-school club is particularly beneficial, since schools can offer a wider range of extra-curricular engagement for students at no extra cost to school, parents or carers. We reasoned that this would facilitate our recruitment to the Discovery Bags project.

The club proved to be a great success and high levels of enjoyment and engagement with the activities could be seen from all students. It was also clear that the key messages of the Epistemic Insight resources were being absorbed – even after the first hour's session, children were beginning to use the scientific vocabulary 'observe' and 'observation'. Findings from pre- and post-survey data show that before participation in the club, approximately 68% of students would choose the word 'experiments' to explain the nature of science. By the end of the club, this had fallen to approximately 23% and the word 'observations' was the most popular choice (approximately 64% of responses).

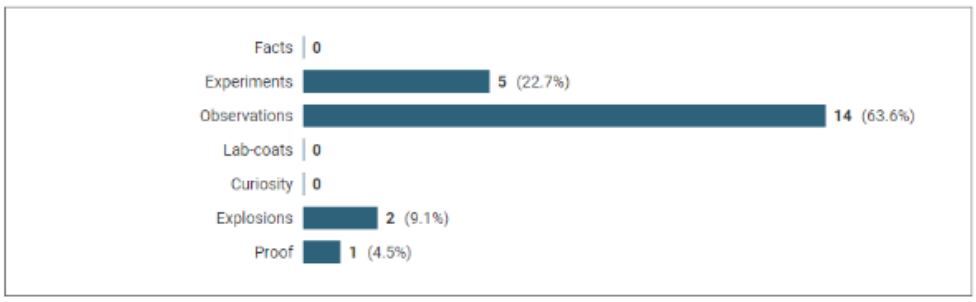

Figure 2: Pre-survey responses describing the nature of science in one word

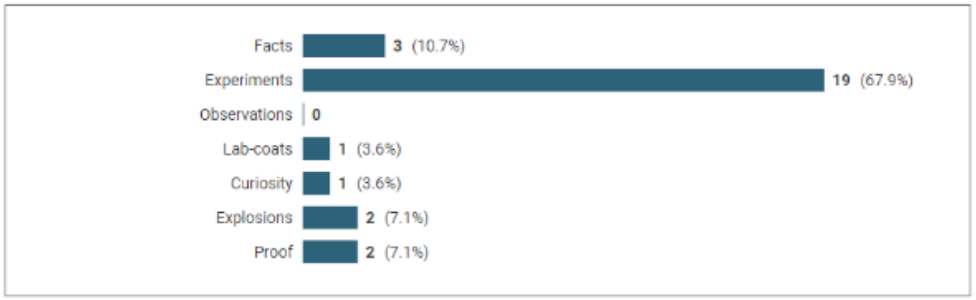

Figure 3: Post-survey responses describing the nature of science in one word

Students demonstrated high levels of interest in thinking and talking about Big Questions to do with human personhood and the nature of reality. For instance, the first session ('Why do spinners spin?') had students questioning not only from a scientific perspective ('How can I change my paper spinner

so that it falls quicker?') but from a multidisciplinary perspective as they looked at the Big Question: 'What makes a good parachute?'. Students generated their own questions from disciplines such as Art ('What is the best colour parachute?', 'Why do they make parachutes in different colours?'), History ('Who invented the first parachute?', 'How has parachute design changed over time?'), Maths ('What is the heaviest you can be to use a parachute?') and even Psychology ('Why are parachutes so scary/ fun?'). Prior to the start of the session, none of the students were able to explain what a discipline was.

Exposure to and interest in Big Questions also increased as a result of participation in the club. At pre-survey, approximately one third of children stated that they couldn't think of any Big Questions when asked. At post-survey, no student said they couldn't think of a Big Question, and several stated that they had 'a lot', such as 'why are people made', 'what created the world' and 'who are we'. Here are some more examples of children's thinking about the Big Questions – students were asked to produce a poster to explore: 'why do we have colours?':

Figure 4: Children's posters exploring 'Why do we have rainbow colours'.

These examples demonstrate that children with no prior exposure to the concept of disciplines have the capacity to think in a multidisciplinary way after only a few hours of teaching about epistemic insight.

4. Conclusion and recommendations

The role of the home environment plays an important part in a child's education. While the Discovery Bags did seem to stimulate discussions in the home, the families that we reach in future may benefit from more or different forms of support.

For instance, more direct time spent with a member of the research team with whom they could ask questions or discuss the use of the resources may be helpful, although would add to the time pressures already felt by families. Or, a set of short YouTube videos provided by the research team as an introduction to the topics could be another way to increase parents' knowledge and confidence to discuss Big Questions at home.

The role of clubs in this mix is also important and gives students hands-on experiences of science and Big Questions. One benefit of the clubs model is that they are led by a specialist member of the research team, who has practiced the learning and so is more confident and prepared to engage in these kinds of discussion. It seems that school can provide an ideal setting for teaching about multidisciplinary thinking if it is given a designated slot. However, the after-school club provided opportunities for just a few children in the school to access education about epistemic insight.

One idea to bring epistemic insight to all Key Stage 2 children is the introduction of an epistemic insight lesson – a dedicated portion of the timetable on a weekly or fortnightly basis, within which to explore the nature of science and other disciplines, what makes these disciplines distinctive, the similarities and differences between disciplines, and how these disciplines can work together to explore Big Questions about human personhood and the nature of reality. However, we understand that in reality, school timetables are already very full and we do not wish to add to teachers' workloads or burden them with what may seem like yet another 'new fad' in teaching.

Another option is to incorporate epistemic insight into the lessons that are already being taught. Most of the students we survey indicate that they have never had a lesson that involved two teachers from different subjects (such as an RE teacher in a Science lesson). Yet, by looking at a topic or question from more than one disciplinary perspective, children's learning can certainly be enriched. For instance, learning about the titanic in History can be coupled with discussion about floating and sinking. Children could make a model titanic out of plastic containers and see for themselves how the ship sunk, using water to investigate using their models. Or, learning about cloning in science could be accompanied with discussion from an RE perspective about the morality and ethics of cloning – whether we should do something just because we can.

There is much potential for the teaching of epistemic insight in education – it may just take some creativity to find the most appropriate 'space' and 'place' for it within the school curriculum.

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SECTION 2

This section focusses mainly on the HE sector. It examines the work that I have done, as researcher and lecturer in education to promote research engagement in secondary PGCE students. This is followed by the first-hand experiences and reflections of Buffy-Lucy Jennings and Anastasia Sofia Semaan who have started their journey as research engaged students.

WHAT INITIAL PROCESSES ARE NEEDED TO ENCOURAGE ITE STUDENTS TO BECOME COMPETENT, RESEARCH ENGAGED PRACTITIONERS?

Dr Dani Shalet

Introduction

An invitation to take part in a challenge went out to members in the faculty of education, that challenge was to find a way to produce research engaged students. As one who is always up for a challenge, I decided to take my team up on this offer and see if I could encourage ITE students to become competent, research engaged practitioners. This came with a bit of a problem however, and that was how do you convince student teachers that research is important to their professional success as a teacher? Especially when PGCE students have very little time to become qualified teachers, and their focus is getting to terms with pedagogical practices, learning the curriculum, and hitting their standards. When all of this is going on, who has time for research, and what is the point? This is especially challenging when research does not rank as highly on the PGCE course, as perhaps it should.

In the limited amount of research available on student teachers and teachers' opinions on research, the evidence suggests that research practice it is not rated highly among students and professional teachers (McCartney 2018). The research that has been done seems to suggest that student teachers have a very low opinion of learning research methods as the found that it did not "help them realise the importance of research in the field of education" (McCartney quoting Lombard and Kloppers, 2015). Exacerbating this is that professional teachers also seem to rate research of less importance. A study done by Hemsley-Brown and Sharp in (2004) found that teachers found the volume of research daunting, did not subscribe to academic journals, and rarely had access to academic libraries". Research is put to the bottom of the already unsurmountable tower of work, that teachers must navigate through just to perform to standard, it is no wonder that time is better spent on other things.

What this paper hopes to illustrate is that becoming a 'research engaged practitioner' comes with bonusses, especially in terms of creating beneficial 'habits of mind' for future work (teaching and/or otherwise) and building ITE students' confidence in their abilities. As a 'research engaged practitioner' myself, I will share with the reader a simple intervention that I used (whilst undertaking the invitation to the challenge above) to encourage my students to become more research engaged, to enjoy the process, and to prove to them that research engagement is beneficial for their future careers.

To approach the question at hand one must first examine the importance of being a 'research engaged student' in education; as well as to know the approaches used to encourage ITE students to adopt the said, 'habits of mind' (Costa and Kallick, 2000) that will benefit them in terms of their education and future as professional teachers. One is not born with these 'habits of mind' and adding to the difficulty of acquiring the correct habits, students are hindered by entrenched compartmentalisation in their early years of schooling; the understanding that assessment tends to focus only on student progression in any given subject (http://www.epistemicinsight.com/wp-content/uploads/2019/06/EI-ITE-brochure-8May19-1.pdf) These habits must therefore be nurtured, taught, and adopted from an early age, and reinforced through research engagement.

Research engagement

The first thing to address is the connection between ITE and research led training, this has been a topic of much debate over the last three decades, and one that has fallen in at out of fashion. As a result, there are quite large gaps in the scholarship that examines this engagement.

Furthermore, much of the work that has been done in this area over the years has been primarily focused on helping the 'school student' to become more research engaged and as a result there is a limited emphasis on ITE (Initial Teacher Education) student. An early example of this 'pupil' based focus is in the writing of Kincheloe, J., Steinbery, S. (1998) a monograph that focuses directly on student empowerment through meaningful research. At the time it 'filled a specific gap in education literature by making explicit the relationship between teaching methods, classroom practice, and the production of knowledge' and how these factors can influence students' 'self-esteem' and participation. Though it filled an educational gap at the time, the research is quite outdated, and it is very theoretical, with no practical elements to guide the tutor/educator through the process of forging research engagement into something tangible and assessable.

The understanding of what it was to be research engaged, was limited at this time, to something more akin to teaching students how to research (i.e., through primarily textual based analysis) rather than engaging in critical thinking and deeper and more varied analytical approaches that would have produced a more rigorous researcher. There was also no indication of the 'habits of mind' so to speak, that students must form to become research engaged students. 'Habits of mind' emerged from the field of brain research and education and is described as a "…concept that entails the habits as the behaviours that would be used appropriately without painstaking attention or requiring some brain activity that was not initially adopted" (Alhamlan et al. 2018). There is no indication of this in the work of Kincheloe and Steinbery (1998) where the focus is (albeit rather simplified) the importance of cultural thinking and critical literacy. Cultural literacy being what would be assumed an average member of a particular culture would know (Hirsch 1983 https://www.westernsydney.edu.au/studysmart/home/cultural_literacy/what_is_cultural_literacy assessed by author 28 of April 2022) in terms of knowledge. Though this is important in certain respects, as such literacy should theoretically enable a student to become knowledgeable in specific areas related to cultural norms, and practices as emphasised by (Ochoa, 2016), it does very little on its own, to help the student acquire the explicit methods and knowledge needed to succeed in a specific scholastic field.

Though Johns' (2012) states that her use of the term 'research' is too loosely defined—what she refers to as the—'investigation of problems and/or questions on interest' there is the implication that research is purely based around the idea that in order to encourage students to become researchers it is a matter of encouraging them to ask questions of "texts, of contexts, [and] of experts" as well as to discuss their points. This is merely a piece of the multifaceted process needed to forge the research engaged student.

Following on from the articles above and completing this picture is a work by Emad A. Ismail and James E Groccia (2018) *Students Engaged in Learning*. This article emphasizes the importance of students' active engagement in their learning, leading on from the work of Chickering and Gamson's (1987), Bonwell and Eison (1991) and Prince (2004). Prince defined active learning as "Any instructional method that engages students in the learning process. In short active learning requires students to participate in meaningful learning activities and think about what they are doing…the core elements' of active learning are students' activity and engagement in the learning process" (Ibid 223 as quoted in Ismail and Groccia 2018). Though Ismail and Groccia's article does not specifically address the benefits of active learning in terms of research engagement, I will illustrate how active learning, combined with critical and cultural literacy, creation, and assessment, were imperative in forming the research student's 'habits of mind' needed for their success. Furthermore, this paper seeks to illustrate that to encourage research engagement among students, the educator must actively involve themselves in this learning experience and give the student a 'set goal' to work towards.

Methodology

The purpose of this short article is to demonstrate the tutor/student research relationship more closely and to provide procedural based guideline for one to follow to produce the 'habits of mind' needed for success in becoming a 'research engaged' student. These habits of mind are "distinctive behaviours" and/or a "set of dispositions" that provide the agent with the mental space needed for problem solving and the "effortlessness" to complete specific tasks (Alhamlan et al., 2018; Costa and Kallick, 2000). 16 were identified by Costa and Kallick (2000):

In the case of becoming research engaged it is a matter of 'thinking like a scholar' (Billingsley et al. 2018) and knowing the tools and approaches one's said discipline uses to answer questions and solve difficult problems. In the case of this intervention, these scholarly habits take the form of a mixed method approaches as is common in education research. The 'habits of mind' are taken from the work of Costa and Kallick (2000). 'Habits of mind' means having a disposition toward behaving intelligently when confronted with a problem. In the case of research engagement this problem is the research process, and the intent complete this process through the mindful employment of tools, and skills, old and new. Billingsley's work, although not explicitly stating these 'habits of mind' closely link to many of them: **Thinking flexibly; Persisting; Thinking about thinking; Creating, Imagery and Innovating; remaining open to continuous learning; thinking interdependently;** gathering data through all the sense, and the Epistemic Insight framework creates a solid, well researched, and proven system to work with. This is used in combination with Costa and Kallick's work to form the base for this intervention.

The students were part of an REE (Research Enquiry and Education) module, set up to provide secondary PGCE students with an opportunity to create a research project for assessment. Due to the content of the module, it was thought by the researcher that it would be the perfect testing ground for creating research engaged students. This intervention ran over two terms, with an intro class running before the 2021-2022 half term and subsequent classes running after, from Jan 2022-to Feb 2022. The inconsistency of the class resulted in several difficulties in terms of student applications and progress, this was made more challenging by the fact that the students' intro session, to the course, was on the 29th of September 2022 approximately 3 months before the follow-up sessions. Subsequently, the schedule after half term was also rather disruptive to the students' learning objectives, because there was over a month's gap between their re-introduction to the 'research' content, and the final intervention which was held remotely on the 25th of February 2022.

There were 10 sessions in total, most session running from 9:00 to 16:00 with an hour break, for lunch. In total this equated to 52 hours of contact time (and an additional two-hour tutorial set up by the class tutor). During these sessions the students were introduced to different course content, all associated with an aspect of Education technology—which for the sake of simplicity will be referred to from this point forward as—EdTech. 20 of the 52 course hours were spent covering Epistemic Insight—related content—with the purpose of preparing the students for their work and upload to the Epistemic Insight Zenodo community, an open-source repository[1]. The students were in a class of 13 initially, but due to uncontrollable and unforeseen circumstances the core group who participated in the intervention were n=9. These students were made up of a multidisciplinary group of PGCE secondary students, whose specialties were:

—n=3 Science (Chem, Phys, Biology)

—n=2 Computer Science

—n=2 Mathematics

—n=1 History

—n=1 Art

To gain a better insight into the research question, the researchers implemented several qualitative techniques for data collection. These included: observations, evaluation forms, textual analysis, and short interviews (thought it must be noted that due to time constraints and pressures interviews were not held). The observations were done by the tutor/researcher during the interventions, with notes recording student behaviour as well as engagement throughout the 52-hour interventions. It must be noted that the sessions have been recorded for accessibility purposes—as per the University's accessibility guidelines—so the researcher had access to the content to check verification of observational responses and behaviours. Furthermore, the students were provided with an evaluation form after each session to evaluate session feedback. However, the evaluation forms were also strategically implemented to help the tutor to create relevant course content—whilst simultaneously providing an organic way for the students to facilitate their own learning, and the course tutor to gauge their level or learning.

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1 Built and developed by researchers, to ensure that everyone can join in Open Science. The OpenAIRE project, in the vanguard of the open access and open data movements in Europe was commissioned by the EC to support their nascent Open Data policy by providing a catch-all repository for EC funded research. CERN, an OpenAIRE partner and pioneer in open source, open access and open data, provided this capability and Zenodo was launched in May 2013.

In support of its research programme CERN has developed tools for Big Data management and extended Digital Library capabilities for Open Data. Through Zenodo these Big Science tools could be effectively shared with the long-tail of research.

https://about.zenodo.org/

A comparison was done between the work that students produced at the beginning of their intervention in the form of their research proposals, which included a methodology; and students' writing/methodologies post interventions, those that were uploaded to Zenodo. This formed an assessment of the students understanding of the content given and informed the tutor/researcher of the strengths and limitations of the intervention.

Short one-to-one interviews were planned on being held when the students' project work was completed. The intention was for the interviews to be semi-structured so the students' journey from ITE student to—research engaged and published ITE student—will be tracked. These interviews were going to be held either via Teams or Blackboard and would have been recorded by the interviewer with the students' consent. If the student did not consent to the recordings, the interviewer would have provided other options like: voice recordings, transcriptions, 'notes and quotes'. To reach participants an initial email will be sent out to the EdTech group, with the instructions to contact the tutor/researcher if interested. It is estimated that .20 to .30 will be amenable to an interview. It has been considered that scheduling may be difficult due to students' limited time, and the disjointedness of how the course was run this year. For example, the course started in October then the others were run in February and then March. The suspected lack of interviewees led to the interviews as an afterthought and purely to bolster and support the other qualitative methods mentioned above.

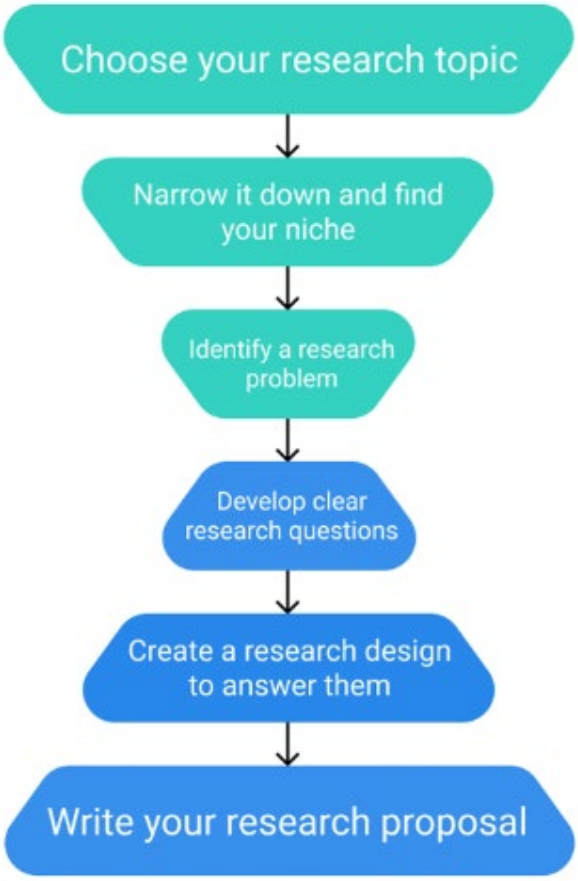
Content provided for students

Step 1—EI and multidisciplinary learning

Building from the observation by Prof Billingsley, rather than assuming they had, or requiring them to have prior knowledge of academic research, it was decided to assess their prior knowledge. This was done in class simply by asking the students to share their previous research experience with the class. The results were unexpected (especially in a class where 50% of the students had and MA or MSc) with around 70% of the class having no or very limited knowledge and experience of writing a research paper. It was also interesting to note, though not unexpected (given the research done by Billingsley and her team 2015-2022) the students were uncertain about engaging in a research activity that would require them to utilise tools and methods that they did not perceive as part of their expertise, arsenal. To aid them in this, and to build their confidence a key element in research engagement as indicated by the American Psychological Association (2015), they were introduced to the EI framework during session 2 that ran in Jan 2022. The focus of this session was to introduce them to the importance of multidisciplinary engagement, Big Question, and bridging questions, to help them overcome any barriers that stood in their way of producing a research project that was multidisciplinary, given its very nature of being computer based.

Step 2—How to structure a research project

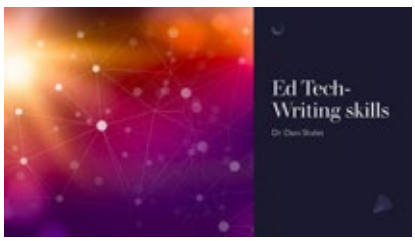
After it become apparent that the students' lacked prior knowledge in terms of academic writing and project creation, it was deemed necessary to take them through a process that specifically focussed on how to structure a research project (See A2) and the lecture took them step-by-step through the process:



They were then introduced to how to create a SMART plan for their projects; how to choose and use relevant source material, and how to fill out an ethics form and write a research proposal. Once this section was completed, they were taught the different types of methods they could use to gather their data. It is interesting to note: though most of the students came from a science or mathematics background they had very little knowledge of the importance of statistics in quantitative research and had little to no knowledge of how to gather specific data. This observation enabled the tutor/researcher to go on to create a session that would define these types of analytical methods and provide the students with practical examples they could use in their own data gathering.

Step 3—Academic Writing

Another issue that was made apparent during lesson discussion was the lack of knowledge that the students had regarding academic writing. The only student that had any real knowledge of this was the history student, the other students who were primarily science based, had no real experience of this form of writing. Two students showed a great deal of anxiety when the subject of writing academically was broached in class, one specifically stating they didn't believe they were "smart enough" to do it and they weren't sure if they could do the assignment, they were being asked to do with the other asking "do I actually belong here?". This performance anxiety was felt by students even though they were expected, by the university, to be working at assessment level 7 (see https://www.canterbury.ac.uk/quality-and-standards-office/assessment-criteria.aspx for marking criteria). To address this issue a separate session had to be written up ad hoc to make certain that all students were at the appropriate level they needed to be at, to undertake this writing task. The topics that were covered were: how to write critically; how to choose your source material; how to appropriately reference; and how to format an essay. Examples of writing were given, and the students were tasked with writing an annotated bibliography to practice using source material in their writing.



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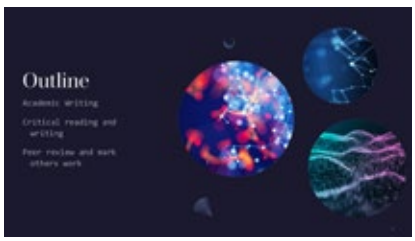

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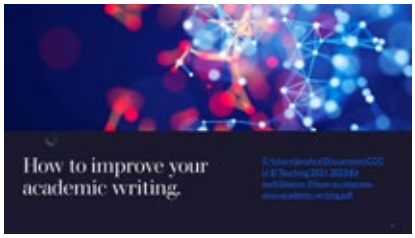

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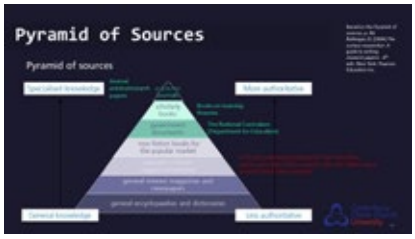

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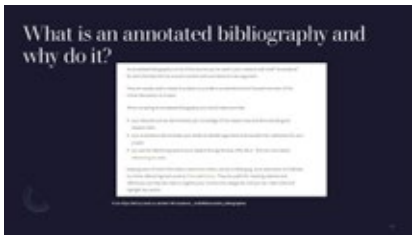

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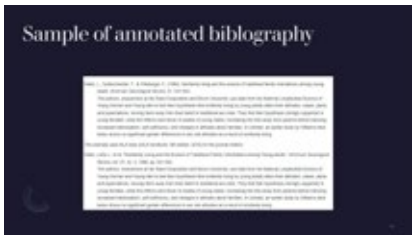

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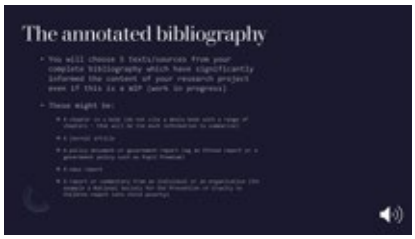

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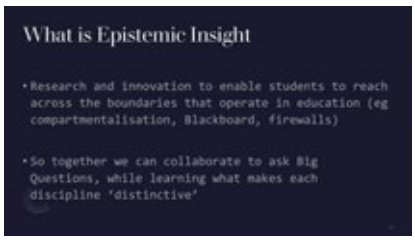

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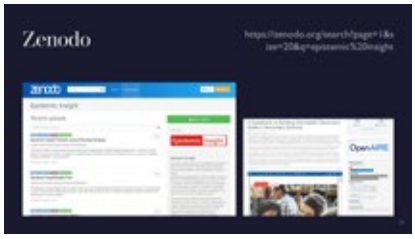

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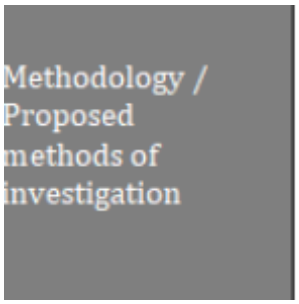
Step 4--Writing a methodology

The students were required to produce a research proposal earlier on in the module before they had any experience in writing one. Here is one such example:



1. Use of Plickers in classroom – Questions to be done by all students and record answers and marks obtained used for analysis of student learning.
2. Analysis of benefits of use of Plickers or any other Edtech for formative assessment
3. Survey via questionnaire to be done by students for their personal reflection on gamification as an assessment tool.

Before

Methodology

In order to investigate my research hypothesis, different evaluation methods were conducted to determine whether gamification is effective for formative assessment on student engagement and learning. The methodology for this study shadows Brookfield's four lenses as it takes an all-inclusive perspective which addresses teaching from different standpoints. It draws from personal experience and reflection, students' experience, colleagues' experience and findings from theoretical literature.

Qualitative data was also obtained from personal observations and reflection. Plickers was implemented for formative assessment and simulations (PhET, online virtual labs) in different classes to teach different topics.

Qualitative data was obtained from two teachers who have previously implemented gamification in their classroom, via Google forms for their opinion on the effectiveness for student learning. This was a relevant method as the teachers provided feedback based on their experience of its use in the classroom and also evaluated whether it was effective for students learning.

Quantitative data was collected through an objective lens via questionnaire surveys completed by students. Student feedback was obtained during class using the Plickers app at the end of a lesson that utilized the same method for formative assessment of the topic.

Scores obtained by students taught using simulations and those that were taught without the use of simulations were also used to compare the effectiveness of technology in education. The control group (no use of gamification) had a sample size of n=26 and the experimental group had a sample size of n=27.

After

The students were then tasked with writing a methodology for their research paper. Though this was originally something that had been planned for earlier in the module it was clear from their lack of knowledge of academic writing that some scaffolding was needed before they could be moved on to the larger task of writing a methodology for Zenodo, that would form part of their overall research assignment. Therefore, an interactive session was created that focussed on writing a methodology. During this 6-hour session the students were also tasked with peer reviewing old papers, and then writing their own methodologies, they were then asked to peer review each other's methodologies, and provided with instructions on how to upload them onto Zenodo for publication. The lesson took the form below:

When students were asked *What did you feel went well* with the above session, four students out of five responded with the following:

- *Engagement*
- *The session with examples of previous students' work was very useful to give us the opportunity to peer mark and should help with evaluating our own work before we submit our assignments,*
- *Engaging; open dialogue with tutors; Looking at previous papers to peer mark*
- *More in-depth discussion of methodology.*

Further illustrating that it was the engagement as well as the active participation in the task, that students found most beneficial.

Results and Discussion

Though this intervention is imperative in teaching the students the tools needed to navigate a social science discipline, the tutor went into this task presuming that PG students would have prior knowledge of how to write academically. Further illustrating that specific disciplinary tools were needed to be taught, not assumed. A suggestion for future interventions would be to give the students a small survey that assesses their prior knowledge of academic writing, before embarking on this journey. This would ease prep and enabling the sessions to run more chronologically and organically.

Once the students arrived at the level of confidence in their writing, they were able to produce work that was of a publishable standard. Moreover, giving the students something to work towards, not only incentivised them but galvanised them; and their sense of pride was apparent in their writing. A pride that was lacking in the work of two students that did not engage. One could also see the forging of particular 'habits of mind' as well as adopting, discipline specific language. For instance, students started asking questions and using vocabulary like: samples, participants, analysis, methodology, approaches, quantitative, qualitative, peer review (as is illustrated in the question answers above); and their thought process shifted from thinking of this as mere assignment to a process of 'creation'.

Habits of mind that were identified

Students showed **"persistence"**: even though a number, as stated above, believed they were incapable of the challenge, achieving grades between 60-75% and work that will be published in the CCCU upcoming EI digest publication. **"Questioning and problem posing"** was also evidenced; strongly linking to **"creating, imaging and innovating"**. For example, students joined the class uncertain about EdTech and with more uncertainty about what they would produce for their final project. Through their **persistence** as well as **flexible thinking** and **openness to continuous learning**, students were able to come up with their own research questions; and were able to think around problems they faced with data gathering, caused by an uncertain year (due to Covid). **The flexibility in their thinking** was demonstrated in their abilities to see problems that they may have encounter in their current projects, and their **persistence** was further shown in their ability to meet the challenges and succeed in their successful project delivery. Furthermore, all students demonstrated their ability to think interdependently, responding positively to peer feedback and tutor feedback, with one student stating that: "I wanted to thank you…the feedback is very useful, and I will certainly take it into consideration with future work".

Conclusion and Future Considerations

Though this paper is rather limited in terms of looking at the long-term benefits of research engagement in ITE students, it provides a small window into the possibilities that this entails

and supports the need for a larger study. It has been concluded that through a well-structured intervention, with the end goal being publication, the lecturer can become more focussed on the module objectives and outcomes, and the students have something assessable to work towards; whilst also producing something tangible and lasting. The interventions are also easily repeatable and could be used by any tutor in ITE.

Furthermore, as stated by Anderson et al (2015) the "publication process refines writing skills" and gives the student "the opportunity to learn from constructive feedback provided" (Anderson et all quoting Lawson and Smith 1996; Peden 1991). The evidence produced by publication: writing skills, ability to receive constructive feedback; methodology, data collection, and analysis (Brownlow, 1997) will also benefit the student in their future careers. This was evidenced by the work that the students produced (it will be showcased in a future digest issue) and the fact that all the students, who took part, received respectable grades.

It must be noted that more research could be done on the changes of the students' "habits of mind" through a deeper analysis (including the documentation of changes in these habits from the start of the intervention); as it was not entirely clear whether these habits of mind were already instilled in students, and/ or the interventions and prospect of publication merely reinforced those 'habits' that were already present. It would also be beneficial to get students' opinions on research as part of their teacher training, and ideas on whether they may implement it in the future, and if so, how might they do this. Furthermore, a future study would benefit from student interviews on their experiences of the interventions and on their publications.

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CO-CREATION DURING A LASAR WORK PLACEMENT

Buffy-Lucy Jennings

While on placement with the LASAR (Learning about Science and Religion) Research Centre I worked with experienced researchers on a project to test one of the tools that are in the Epistemic Insight toolbox. Epistemic insight means knowledge about knowledge – and this project tested the value of the Epistemic Insight Discipline Wheel as a tool to help us to address the question of 'what is the nature of friendship?.' Other areas of work where I contributed to during the placement included inputting and discussing data gathered via surveys in schools.

Monday 11th April 2022
This was the first day of when the placement began.

After introductions and discussing project outlines, we focused on a new area of work for LASAR – testing the value of the Discipline Wheel as a tool for use in Higher Education. The aim of the study was to explore its potential to help HE students to build their understanding of their own and other disciplines and how disciplines can work together. As such, it is an example of what is called a 'co-creation research project' where the students and course designers collaborate to develop and evaluate a teaching resource.

The Epistemic Insight Discipline wheel was important in the researching because it showed each of the disciplines that we could examine and work on individually. The Epistemic Insight wheel that we used for the question of 'what is the nature of friendship?' contained ten subjects and each one linked to friendship. However, this was not as simple as I first thought it would be because myself and the person I worked with struggled to find scholarly information about friendship for our set disciplines. For example, I worked on finding about the nature of friendship in the discipline English. As a student doing an English degree, I figured the best place to start would be there, but it was a struggle to find anything about friendship related to English. I had this trouble with the other disciplines I worked on too, but I decided to consider famous friendships within novels, stories, and other literature. This became a useful skill for me because it was an easier way to find out relevant information about friendship.

The project team and I co-created what was the best way to approach it and chose to divide it up so that we were each working on different subjects. The ten subjects included, English, The Arts, Philosophy, Computer Science, Mathematics, Science, Psychology (originally Economics), Geography, History, and Theology, Religious Studies. I worked on English, The Arts, Science and Psychology. We then discussed how we wished to present our work and decided it would be in the form of a poster. The project team and I each researched scholarly sources that were related to friendship in each discipline. The discipline wheel is useful for answering a question such as 'what is the nature of friendship' because people can think and consider how other disciplines can answer the question. For example, a student with a degree in English may answer that friendship can be based on who you trust. Shakespeare shows this with the friendship between Hamlet and Horatio, not on class status or interests, whereas, a mathematics student may view friendship in the form of one person inviting n amount of friends to a party and within that party, each person will know another person. (Longyear, Parsons, 1972)

In deciding how we would split up the disciplines on the EI discipline wheel, the project team agreed that I would take on English, The Arts, Science and Psychology and the other person would do Philosophy, Computer Science, History, and Theology, Religious Studies. Mathematics was given to one of the team members from LASAR and both of us did some research for Geography.

After discussing the project outlines, and co-creating the disciplines, for the rest of the day we worked on a spreadsheet containing survey data and helped organise it. Using the data, I was given, I had to match up the data that was on one spreadsheet to another spreadsheet. To maximise workload we switched it around, so that one of us was doing the spreadsheet and the other was working on and conducting research for the friendship project.

Student Name: Buffy Lucy Jennings
Period of Placement (start and end date): 11.04.22-17.04.22

Organisation (placement provider): LASAR

Pre-Placement Section

Post-Placement Section: Partner Debrief

To be completed at end of the placement

Proposed Activities on Placement	**Outcomes**	**Comments from Placement Provider**
1. Research and develop a profile of friendship using an EI discipline wheel	completed	A well-researched profile of friendship was created.
2. Work with EI survey/research data and help collate an Excel spreadsheet	completed	Valuable input on organising an excel spreadsheet of survey data.
3. Help propose ways an ERD profile of loneliness can be created.	completed	Discussed and preliminary research conducted.
Student Signature: Buffy-Lucy Jennings	**Student Signature: Buffy-Lucy Jennings**	
Provider Signature: Aryn Litchfield	**Provider Signature: Aryn Litchfield**	
Date: 11.04.22	**Date: 17.04.22**	

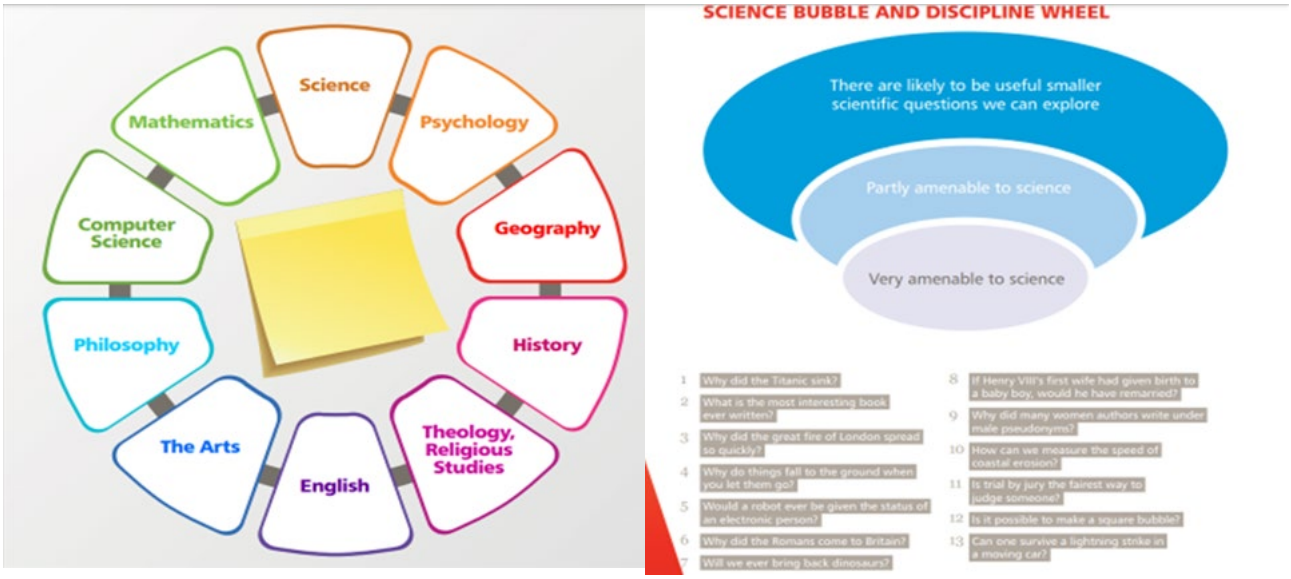
Fig 1: Proposed activities that were discussed during the LASAR work placement.

Tuesday 12th April 2022

The project team and I worked on the survey spreadsheets before switching over to our main project. The spreadsheet was a challenge at first but the more familiar I become with the data the more expedient I became at organising it.

After a break, we turned our attention to working on the friendship discipline wheel. Firstly, we started to research information about loneliness for the bubble tool project, but we mostly came up with the same ideas and information we found. With the discipline wheel, we had to decide how we wanted to present it. It was decided by the project team that it would be in poster form.

I worked on trying to find scholarly information about the disciplines I was tasked with. I began with English because I thought it would be the best place to start. However, this was not as easy as I thought it would be because I struggled to find information relating friendship and English together. This posed a dilemma for me, and I had to think of another way to get my research. I decided to consider famous friendship within literatures of English. I started with a friendship from a well-known Shakespeare play, Hamlet. Doing this allowed me to get quotes about friendship and consider the friendships of the playwright. I did this with other forms of literature, and it proved to be effective because it opened up more ways for me to research how English and friendship can be linked.



Wednesday 13th April 2022

Today, the project team and I finished the survey spreadsheets and continued the discipline wheel.

Spreadsheet done, I continued working on the friendship discipline wheel. For the rest of the day I tried to find out scholarly information for the other disciplines. Firstly, I added some more information to the English discipline before moving onto the next discipline, The Arts. As I was researching about friendship within The Arts, I realised that the term was too broad which made this more difficult for me. Like with English, I had to find a way to work around the term.

In order to find information on The Arts as a whole, I decided to consider what The Arts are. For example, I thought about the various sub-genres that The Arts contained such as music, songs, plays, and a few others. This proved to be effective because it allowed me to expand on my research of scholarly quotes about friendship. For example, friendship can be shown within musical interests, 'Art can be shared between friends influencing styles and facilitating exposure to new forms of creativity. In times of struggle "art approaches, as a saving and healing enchantress."' (Selfhout, et al. 2009).

Once I had managed to find some scholarly quotes and research on The Arts, I moved onto the next discipline I was tasked with, Science. As I was researching about friendship within Science, I realised I had the same issue with finding information. I tried searching up scientists and seeing how their friendships impacted them. For example, I found out about friendships between Einstein and Besso and Locke and Newton. Using this, I found information about the relationship between each of these friends such as 'in 1897 Anna, the oldest of the Winteler daughters, visited Zurich, and Einstein made a major contribution to Besso's life by introducing her to him' (Medicus, 1994).This is showing that friendship within chemistry has the ability or inability to affect personal relations which can be influential to someone in science.

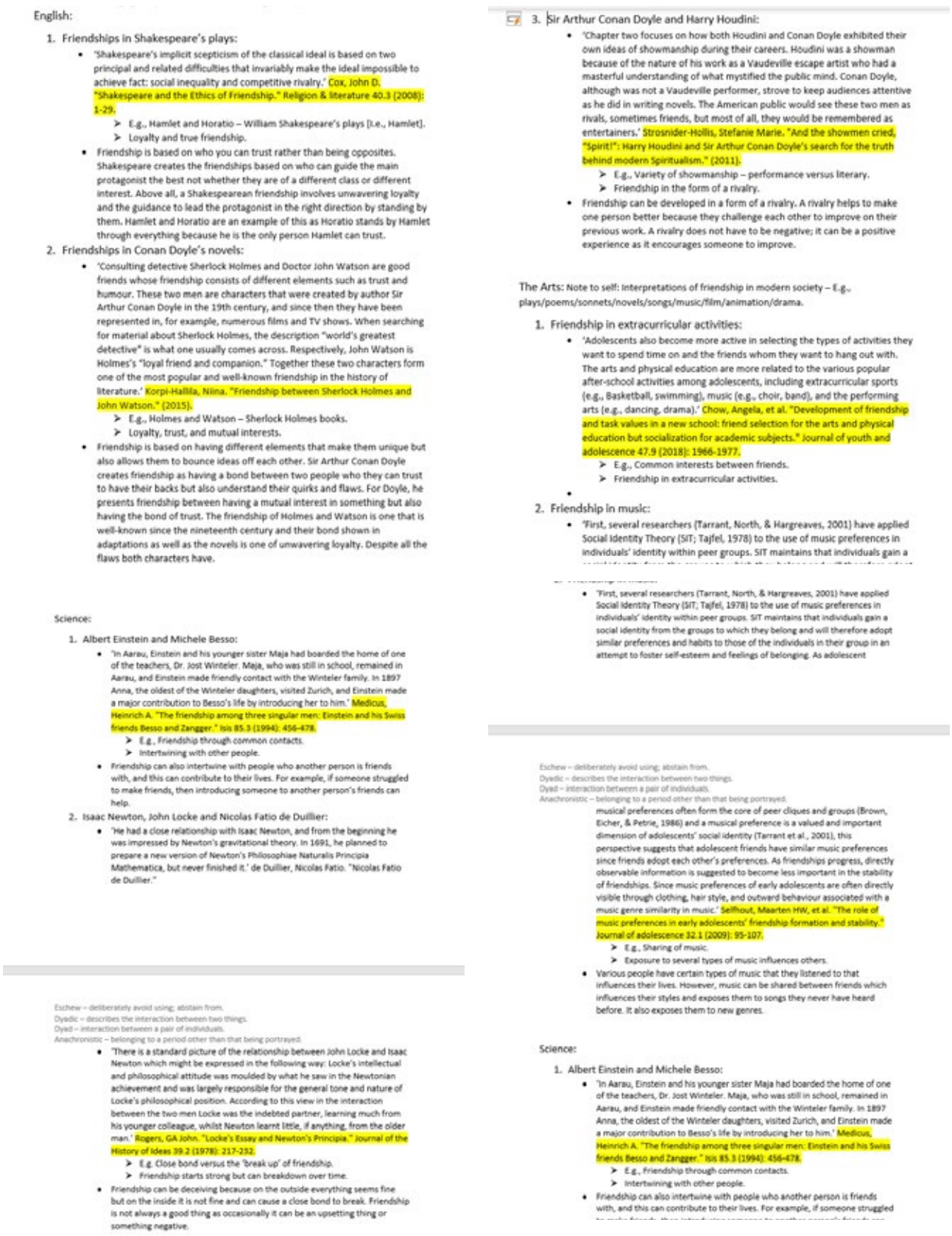
Thursday 14th April 2022

Our aim was to get the research for the discipline wheel completed today.

Although today was slightly different because we were working remotely and therefore communicated through Teams. On Teams we discussed with one of the team members from LASAR about how the project was going and whether the project team would be able to finish it by the deadline. The deadline given for the friendship discipline wheel was by the end of today (14th April).

I continued to work on finishing the research that I was doing, however, I had to redo some of the research because I was unable to access my work. This made it more challenging to get the research

done by the deadline. Fortunately, I was able to find most of the research I had previously gotten and added some other scholarly research to it.



English:

1. Friendships in Shakespeare's plays:
   - 'Shakespeare's implicit scepticism of the classical ideal is based on two principal and related difficulties that invariably make the ideal impossible to achieve fact: social inequality and competitive rivalry.' Cox, John D. "Shakespeare and the Ethics of Friendship." Religion & literature 40.3 (2008): 1-29.
     - E.g., Hamlet and Horatio – William Shakespeare's plays [i.e., Hamlet].
     - Loyalty and true friendship.
   - Friendship is based on who you can trust rather than being opposites. Shakespeare creates the friendships based on who can guide the main protagonist the best not whether they are of a different class or different interest. Above all, a Shakespearean friendship involves unwavering loyalty and the guidance to lead the protagonist in the right direction by standing by them. Hamlet and Horatio are an example of this as Horatio stands by Hamlet through everything because he is the only person Hamlet can trust.
2. Friendships in Conan Doyle's novels:
   - 'Consulting detective Sherlock Holmes and Doctor John Watson are good friends whose friendship consists of different elements such as trust and humour. These two men are characters that were created by author Sir Arthur Conan Doyle in the 19th century, and since then they have been represented in, for example, numerous films and TV shows. When searching for material about Sherlock Holmes, the description "world's greatest detective" is what one usually comes across. Respectively, John Watson is Holmes's "loyal friend and companion." Together these two characters form one of the most popular and well-known friendship in the history of literature.' Korpi-Hallila, Niina. "Friendship between Sherlock Holmes and John Watson." (2015).
     - E.g., Holmes and Watson – Sherlock Holmes books.
     - Loyalty, trust, and mutual interests.
   - Friendship is based on having different elements that make them unique but also allows them to bounce ideas off each other. Sir Arthur Conan Doyle creates friendship as having a bond between two people who they can trust to have their backs but also understand their quirks and flaws. For Doyle, he presents friendship between having a mutual interest in something but also having the bond of trust. The friendship of Holmes and Watson is one that is well-known since the nineteenth century and their bond shown in adaptations as well as the novels is one of unwavering loyalty. Despite all the flaws both characters have.

Science:

1. Albert Einstein and Michele Besso:
   - 'In Aarau, Einstein and his younger sister Maja had boarded the home of one of the teachers, Dr. Jost Winteler. Maja, who was still in school, remained in Aarau, and Einstein made friendly contact with the Winteler family. In 1897 Anna, the oldest of the Winteler daughters, visited Zurich, and Einstein made a major contribution to Besso's life by introducing her to him.' Medicus, Heinrich A. "The friendship among three singular men: Einstein and his Swiss friends Besso and Zangger." Isis 85.3 (1994): 456-478.
     - E.g., Friendship through common contacts.
     - Intertwining with other people.
   - Friendship can also intertwine with people who another person is friends with, and this can contribute to their lives. For example, if someone struggled to make friends, then introducing someone to another person's friends can help.
2. Isaac Newton, John Locke and Nicolas Fatio de Duillier:
   - 'He had a close relationship with Isaac Newton, and from the beginning he was impressed by Newton's gravitational theory. In 1691, he planned to prepare a new version of Newton's Philosophiae Naturalis Principia Mathematica, but never finished it.' de Duillier, Nicolas Fatio. "Nicolas Fatio de Duillier."

Eschew – deliberately avoid using; abstain from.
Dyadic – describes the interaction between two things.
Dyad – interaction between a pair of individuals.
Anachronistic – belonging to a period other than that being portrayed.

- 'There is a standard picture of the relationship between John Locke and Isaac Newton which might be expressed in the following way: Locke's intellectual and philosophical attitude was moulded by what he saw in the Newtonian achievement and was largely responsible for the general tone and nature of Locke's philosophical position. According to this view in the interaction between the two men Locke was the indebted partner, learning much from his younger colleague, whilst Newton learnt little, if anything, from the older man.' Rogers, GA John. "Locke's Essay and Newton's Principia." Journal of the History of Ideas 39.2 (1978): 217-232.
  - E.g. Close bond versus the 'break up' of friendship.
  - Friendship starts strong but can breakdown over time.
- Friendship can be deceiving because on the outside everything seems fine but on the inside it is not fine and can cause a close bond to break. Friendship is not always a good thing as occasionally it can be an upsetting thing or something negative.

3. Sir Arthur Conan Doyle and Harry Houdini:
   - 'Chapter two focuses on how both Houdini and Conan Doyle exhibited their own ideas of showmanship during their careers. Houdini was a showman because of the nature of his work as a Vaudeville escape artist who had a masterful understanding of what mystified the public mind. Conan Doyle, although was not a Vaudeville performer, strove to keep audiences attentive as he did in writing novels. The American public would see these two men as rivals, sometimes friends, but most of all, they would be remembered as entertainers.' Strosnider-Hollis, Stefanie Marie. "And the showmen cried, "Spirit!": Harry Houdini and Sir Arthur Conan Doyle's search for the truth behind modern Spiritualism." (2011).
     - E.g., Variety of showmanship – performance versus literary.
     - Friendship in the form of a rivalry.
   - Friendship can be developed in a form of a rivalry. A rivalry helps to make one person better because they challenge each other to improve on their previous work. A rivalry does not have to be negative; it can be a positive experience as it encourages someone to improve.

The Arts: Note to self: Interpretations of friendship in modern society – E.g., plays/poems/sonnets/novels/songs/music/film/animation/drama.

1. Friendship in extracurricular activities:
   - 'Adolescents also become more active in selecting the types of activities they want to spend time on and the friends whom they want to hang out with. The arts and physical education are more related to the various popular after-school activities among adolescents, including extracurricular sports (e.g., Basketball, swimming), music (e.g., choir, band), and the performing arts (e.g., dancing, drama).' Chow, Angela, et al. "Development of friendship and task values in a new school: friend selection for the arts and physical education but socialization for academic subjects." Journal of youth and adolescence 47.9 (2018): 1966-1977.
     - E.g., Common interests between friends.
     - Friendship in extracurricular activities.
2. Friendship in music:
   - 'First, several researchers (Tarrant, North, & Hargreaves, 2001) have applied Social Identity Theory (SIT; Tajfel, 1978) to the use of music preferences in individuals' identity within peer groups. SIT maintains that individuals gain a social identity from the groups to which they belong and will therefore adopt similar preferences and habits to those of the individuals in their group in an attempt to foster self-esteem and feelings of belonging. As adolescent

- 'First, several researchers (Tarrant, North, & Hargreaves, 2001) have applied Social Identity Theory (SIT; Tajfel, 1978) to the use of music preferences in individuals' identity within peer groups. SIT maintains that individuals gain a social identity from the groups to which they belong and will therefore adopt similar preferences and habits to those of the individuals in their group in an attempt to foster self-esteem and feelings of belonging. As adolescent

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musical preferences often form the core of peer cliques and groups (Brown, Eicher, & Petrie, 1986) and a musical preference is a valued and important dimension of adolescents' social identity (Tarrant et al., 2001), this perspective suggests that adolescent friends have similar music preferences since friends adopt each other's preferences. As friendships progress, directly observable information is suggested to become less important in the stability of friendships. Since music preferences of early adolescents are often directly visible through clothing, hair style, and outward behaviour associated with a music genre similarity in music.' Selfhout, Maarten HW, et al. "The role of music preferences in early adolescents' friendship formation and stability." Journal of adolescence 32.1 (2009): 95-107.
- E.g., Sharing of music.
- Exposure to several types of music influences others.
- Various people have certain types of music that they listened to that influences their lives. However, music can be shared between friends which influences their styles and exposes them to songs they never have heard before. It also exposes them to new genres.

Science:

1. Albert Einstein and Michele Besso:
   - 'In Aarau, Einstein and his younger sister Maja had boarded the home of one of the teachers, Dr. Jost Winteler. Maja, who was still in school, remained in Aarau, and Einstein made friendly contact with the Winteler family. In 1897 Anna, the oldest of the Winteler daughters, visited Zurich, and Einstein made a major contribution to Besso's life by introducing her to him.' Medicus, Heinrich A. "The friendship among three singular men: Einstein and his Swiss friends Besso and Zangger." Isis 85.3 (1994): 456-478.
     - E.g., Friendship through common contacts.
     - Intertwining with other people.
   - Friendship can also intertwine with people who another person is friends

Fig 3: My research notes on friendship.

Tuesday 19th April 2022

This was the final day of the placement. On this day, the project team and I finished off our friendship discipline project and discussed about how we were going to have our work presented.

We chose to stick with the poster idea deciding to have small bits of information along the side explaining in more detail and what the research means. There would also be an interactive discipline wheel where you click on one of the disciplines and after reading it, you can move onto the next one (as shown in fig 4).

The project team also did consider linking each of the disciplines to another discipline because some overlapped. However, as we had a deadline, we instead chose not to do this and just focused on getting completing the poster.

Asking ourselves the question of 'what is the nature of friendship,' lead towards us having multiple definitions of what friendship is defined as. This meant that we needed to find and research information for each discipline that could explain the nature of friendship. Using the EI discipline wheel, the project team split up each of the discipline and conducted research into the set disciplines. Using this process allowed me to understand that different disciplines have something valuable to offer. For example, it showed me that some people in the discipline of English may see friendship as a form of entertainment and trust. On the other hand, people in the discipline of philosophy such as Aristotle see friendship in "three ways – formed for pleasure and satisfaction, formed for utility on usefulness and formed for virtuous on appreciation of morals" (Aristotle, 1984) This showed me that anything can be put in the middle of the discipline wheel, and everyone will have their own view on the term.

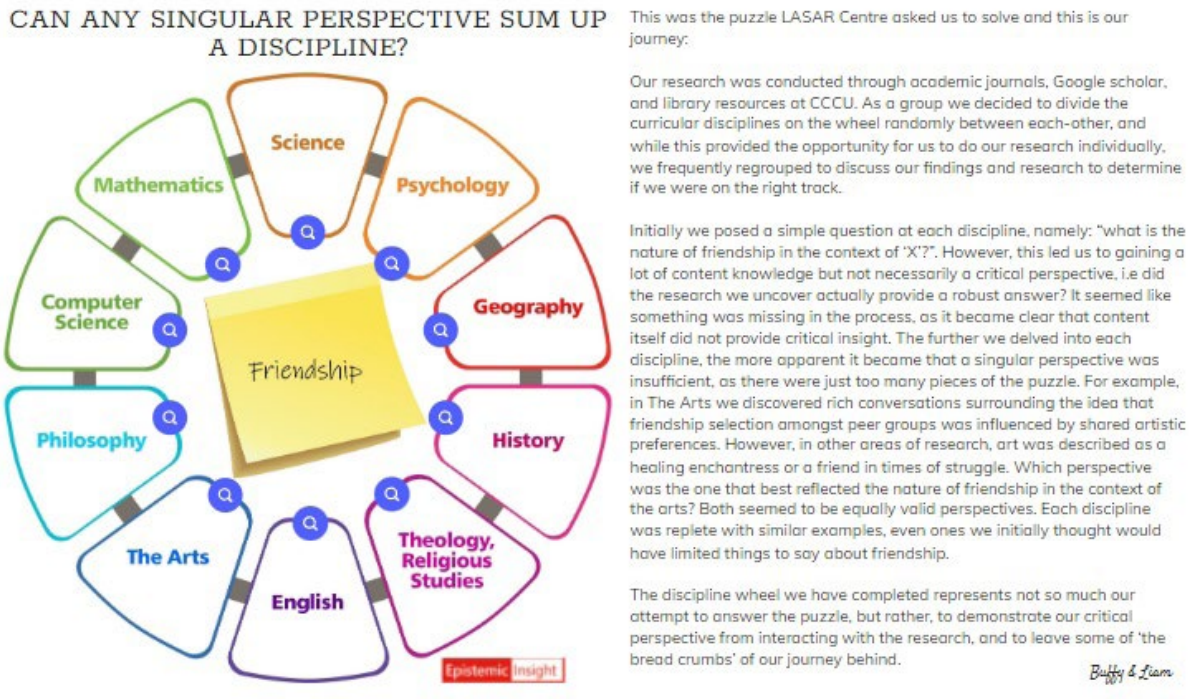

Fig 4: project output - Interactive discipline wheel and reflection. Available at: https://www.epistemicinsight.com/can-any-singular-perspective-sum-up-a-discipline/

The question of 'what is the nature of friendship' can be answered by a single discipline because each one has their own opinion of friendship. However, despite the question being possible to answer with a single discipline, it works better when every person researching about friendship has their own

opinions. When considering friendship as a topic, people will have their own ideas and each person's idea is a valid one because each person researching a discipline can understand where another is coming from. All the disciplines interact with another in one or more ways. The EI discipline wheel process was helpful in recognising the importance of interdisciplinary perspectives because it gave me an insight into how friendship can be seen different depending on a person's perspective.

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EPISTEMIC INSIGHT AND VALUES, JUSTICE AND PARTICIPATION REFLECTING SOCIETY'S INEQUALITIES

By Anastasia Sofia Semaan

The current Global Pandemic of Covid-19 has brought to the surface many of the inequalities that we are facing globally in society today. The conversation about such inequalities has become even more important. In the education system, unfortunately there is a lack of discussion of these inequalities, and the importance of the action that we have and can take on as society and individually.

Through the implementation of the *Epistemic Insight* and epistemo- logical methods throughout all levels of Higher Education we can say that we are taking action to making changes to the problems and inequalities in society. In a third- year core module titled *Values, Justice and Participation* we discussed various inequalities and how Covid-19 has brought them more apparent globally. We found it incredibly important to draw attention to not only the vulnerable groups that were "well known" prior to Covid-19, but also recognize how these groups' vulnerability and challenges have increased through the pandemic and throughout the year of 2020 and currently in 2021. The area that I chose to focus on was how the lack of knowledge of our human rights makes us a vulnerable group in society. I wholeheartedly believe that it is often the unknown or ignorance behind anything that can cause further issues, challenges and can lead to individuals or groups discriminating against others or being discriminated against. In my essay and through a development plan, I "brought to attention the claim that we may all become vulnerable members of society if we do not know our human rights. This vulnerability creates barriers that prevent us from fully participating in society, including preventing us from being able to teach others about their human rights and the inability to use our voice in society against human right violations. Through implementing Human Rights Education fully into the curriculum and implementing approaches that give children a voice in their daily school environment could be used strategically to support children and adolescents prior to adulthood."

This module and through interacting with Epistemic Insight approaches and discussion throughout my combined academic programs have allowed me as a student to not only learn about the issues, but take ownership of ways that I believe differences can be made. The efforts and "progresses" that society have gone through to develop, and in some ways damage society, require just as much (if not more) creativity, efforts and progress from everyone today to undo the damages. Through this and the questioning of any inequalities today, can this contribute to the moulding of a new world that we want to live in, one that that is also more inclusive, both in values and in practice.

SECTION 3

This final section looks closely at research that was done by the LASAR team during the pandemic, that draws on Teacher Tapp data to determine how teachers are equipped to introduce cross-discplinary questions. Closing this section is an article written by partner and collaborator Dr Martin Pickett on his research in MFL.

TO WHAT EXTENT ARE TEACHERS EQUIPPED TO DISCUSS SCIENCE IN AN EPISTEMICALLY INSIGHTFUL WAY WHEN AND IF THEY INTRODUCE CROSS-DISCIPLINARY QUESTIONS?

The LASAR team

This article was produced as part of the Epistemic Insight Initiative by the LASAR Research Centre at Canterbury Christ Church University, contact ***LASAR@Canterbury.ac.uk***

Introduction – elements of teacher preparedness

This study reports on findings drawn from two short surveys conducted with more than 8000 teachers in schools in England. The study was motivated by an interest in teachers' preparedness to teach about the relationships between disciplines in epistemically insightful ways together with the opportunity to access a large sample of teachers. The issues explored in this report address the following themes.

Teachers' experiences of team teaching between science and other subjects in their own formative experiences

To teach with epistemic insight, teachers need the ability and capacity to talk about the relationships between science and other disciplines when discussing questions that bridge two or more disciplines. Whether or not teachers had experience in secondary school of a team-teaching approach between science and other disciplines could be decisive in determining whether they have a 'roadmap' of a cross-curricular approach and its educational acceptability.

Familiarity with Ofsted's terminology of 'disciplinary knowledge' and 'substantive knowledge'.

The new Ofsted inspection framework marks a shift from focusing on exam results to a more holistic assessment of a school's approach to the curriculum. This includes examining how schools manage the teaching of both 'substantive knowledge', i.e. knowledge of content and 'disciplinary knowledge', i.e. knowledge about the preferred questions, methods and values of the disciplines involved in each distinctive subject. We identified this language as a potential marker of preparedness to teach with epistemic insight. The extent to which teachers are aware of current efforts at reforming towards a more integrated approach to schooling

Importance attributed to teaching about similarities and differences between disciplines

An important precursor to engaging with and using epistemically insightful approaches is an awareness of the importance of teaching about similarities and differences between disciplines. Teaching about disciplinary differences is important when engaging with Big Questions that cut across disciplinary boundaries.

Research Questions

Having identified these elements of teachers' preparedness to teach in an epistemically insightful way, this paper reports on the findings of three research questions:

1. Have teachers had experience in their own school background of a science teacher teaching a lesson with a teacher from another subject area?
2. To what extent are school teachers familiar with Ofsted's language of 'disciplinary knowledge' and 'substantive knowledge'?
3. What importance do school teachers attribute to teaching about the similarities and differences between disciplines?

The survey questions we report here were sent to teachers via two surveys at different times. For this reason we are not making comparisons across the answers to the three research questions. The surveys included a question for a fourth theme – designed to discover teachers' perceptions of the barriers and opportunities to teaching in a more epistemically insightful way. We report on the findings to this theme in our other publications.

Methodology

The study required a methodology that enabled rapid access to a large sample of teachers in England during a global pandemic, in which recruitment of teachers to research studies was extremely difficult. Having considered these significant methodological challenges, we decided to work with Teacher Tapp, an organization that runs daily polls with over 6000 teachers in England using an app. In the introduction we noted that Teacher Tapp, although a useful tool for our purposes, placed significant methodological limitations on the scope of this study. These include:

- Teacher Tapp limits use of its data to descriptive statistics, meaning that we were unable to run statistical tests to explore the data in more depth. We were limited in our analysis therefore, to straightforward observations of the data.
- Teacher Tapp promise access to between 5000-7000 teacher respondents. However, in studies using multiple Teacher Tapp surveys across multiple days such as this one, there is no guaranteed continuity of respondents, making it impossible to draw inferences.
- Because Teacher Tapp surveys teachers with a range of questions drawn from its own and other research agendas, this means that data are affected by unknown survey effects – they may have been asked a different set of questions immediately before or after.

However, having considered these limitations, we decided to ask Teacher Tapp to gather data for this study on the basis that the significant sample size of Teacher Tapp surveys make findings interesting purely on the observational and descriptive level, despite the lack of possibility of statistical analysis. Having considered this, we concluded that the opportunity to access a large sample of teachers in a time in which it was extremely difficult to recruit teachers for research participation was a worthy trade-off for the limitations of the dataset. We decided therefore to proceed with the study whilst also setting some strong boundaries and caveats to the scope of the findings and the conclusions that could be drawn. We will now give a brief description of details of the study.

Teacher Tapp works by sending teachers a notification at 3.30pm each day with 3 questions to answer. Teachers are incentivised with a range of rewards including classroom resources, relevant articles, and access to training opportunities. This helps reduce the influence of prior interests that may skew results and participation. Teachers are also permitted to view the data the following day. Teacher Tapp conducts their own internal research with teachers but also allows external researchers to pay for access to their large samples. Teachers are recruited through CPD events, social media, and word of mouth.

The teachers who participate are in primary and secondary – which gave us an opportunity to compare attitudes and barriers in each of these phases.

Teacher Tapp weight their samples following several demographic categories: School phase; Funding; Ofsted rating; Free school meals (FSM) quartile; School performance quartile; School governance; School region; Age; Gender; Experience; Seniority; Teacher subject/class.

Teacher Tapp describe their method for weighting as follows:

1. We drop the results of all teachers for whom we do not have a valid school identifier (Unique Reference Number).
2. We only retain teachers if they provide us with valid information on their gender, age and job post, the characteristics used for matching against the School Workforce Census.

3. We calculate population share in census data for 48 groupings of teachers who are allocated according to their phase, funding, region, gender, age and job post.
4. We calculate sample shares in the Teacher Tapp responses for the question, which yields weights as a ratio of population to sample share .

They describe their method for organizing demographic categories as follows:

1. For school phase: Primary and secondary phase (teachers in all-through and middle schools are allocated according to year groups they teach).
2. For seniority: Classroom teacher; Middle leader (with a significant responsibility such as Head of Department); SLT (senior leadership team) excluding head; Head teacher.
3. For Teacher subject/class: Secondary teachers select the main subject they teach. (The arts including design/technology includes all creative and performing arts.) Primary teachers are grouped into Years reception (R), 1 & 2 (EYFS/KS1) and Years 3-6 (KS2).

Survey 1 questions

When I was a child: In secondary school, I had some lessons where the science teacher and a teacher of another subject taught lessons together (5 point Likert scale response)

When I was a child: In secondary school I never had a lesson where teachers from two subjects taught a lesson together.

Survey 2 questions

How familiar are you with Ofsted's terms 'disciplinary knowledge' and 'substantive knowledge'?' (5-point scale: Extremely familiar/moderately familiar/somewhat familiar/slightly familiar/not at all familiar)

'It's important for students to know about the similarities and differences between (curriculum) disciplines?' (5-point Likert scale)

Visual Snapshot and Analysis of Findings from Survey 1

Survey 1 questions

When I was a child: In secondary school, I had some lessons where the science teacher and a teacher of another subject taught lessons together (5 point Likert scale response)

When I was a child: In secondary school I never had a lesson where teachers from two subjects taught a lesson together.

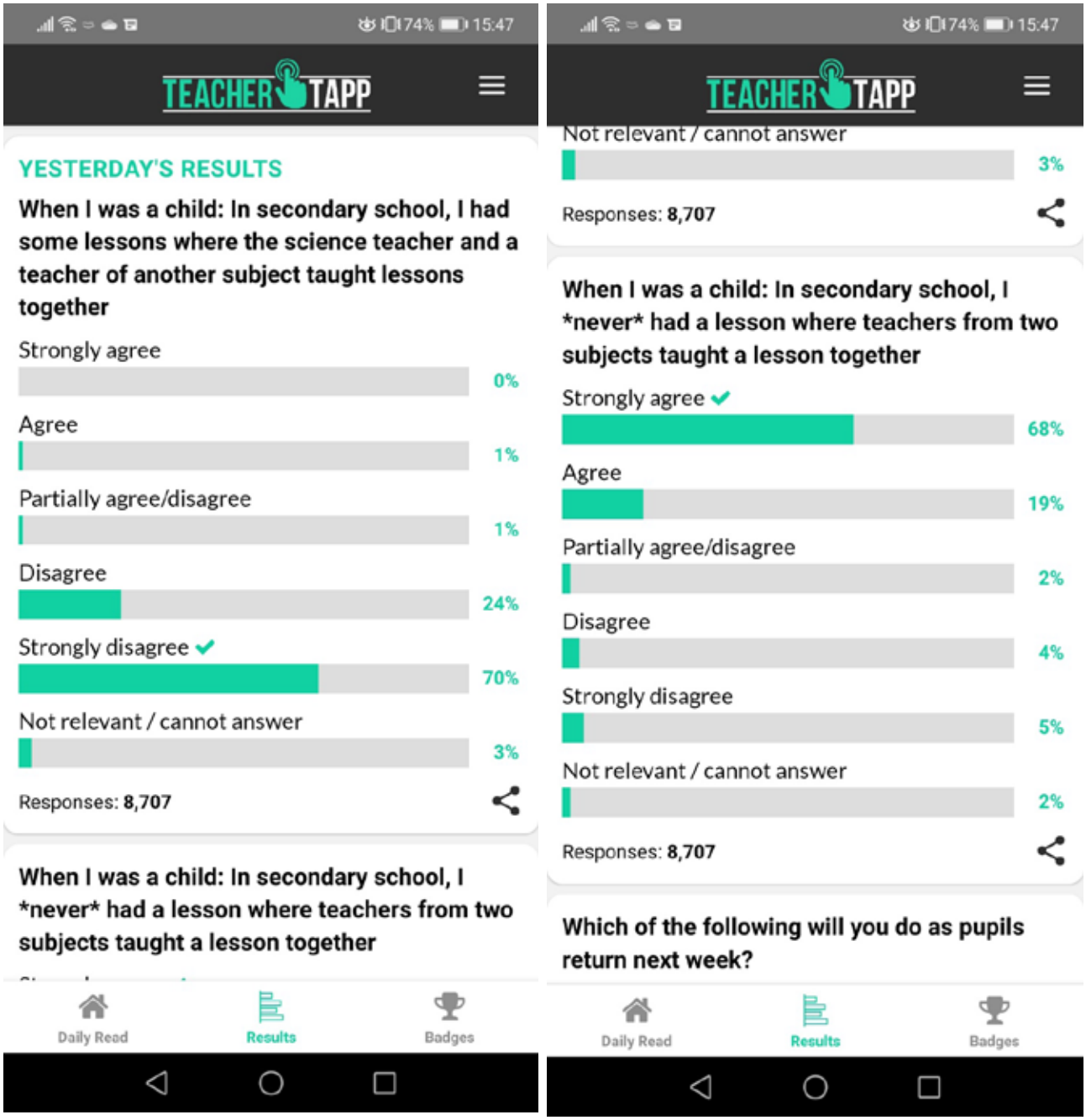
Findings

Research question 1 - Have teachers had experience in their own school background of cross-disciplinary teaching?

A very high proportion of teachers – 94% of teachers - disagree or strongly disagree that in their own secondary school experience they experienced a science teacher co-delivering a lesson with a teacher of another subject. Within this cohort, 93% of Primary teachers surveyed had never had a lesson at secondary school where a science teacher taught with another subject teacher

These findings indicate that few teachers will have had the opportunity for engaging in their own educational experience with issues in which science interacts with other disciplinary perspectives.

The 'looser' subject boundaries in English primary education gives teachers have the opportunity to design learning bringing together science with other subjects. We can expect however, that few will have had this approach modelled to them at a secondary level. This demonstrates clearly the value and



importance of, for example, our 'Essential Experiences in Science' work, supporting teacher to explore links between science and other subject areas.

A similar picture is presented for a similar question asked in reverse format – 87% of participants agree or strongly agree that in secondary school they never had a lesson where teachers from two subjects taught a lesson together.

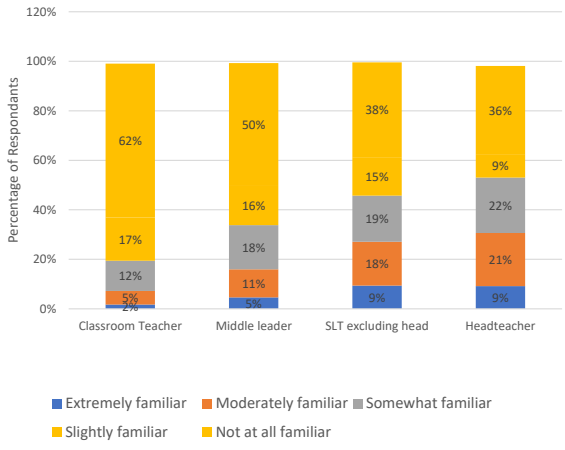
Analysis of Teacher Tapp Responses to Survey 2

Findings from the first question (ID1003472): 'How familiar are you with Ofsted's terms 'disciplinary knowledge' and 'substantive knowledge'?' demonstrate overwhelmingly an unfamiliarity with these terms, with the most common response from all schools being 'not at all familiar' (53%). This is

problematic for developing epistemic insight in children, since teachers who are unfamiliar with the differences between these types of knowledge are likely to focus more heavily on the teaching of subject-specific concepts rather than understanding the subject itself. As a result, children may miss out on learning about that subject (as a discipline), how it relates to other disciplines, and how each provide different perspectives when answering big questions.

An interesting distinction can also be seen in the data between the level of seniority and the amount of familiarity with the definitions of knowledge (fig. 1). Classroom teachers indicated the lowest levels of familiarity (62% were 'not at all familiar'), with levels of familiarity increasing as seniority increased. Headteachers were the most familiar with the terms, which may be due to their major role in curriculum design and implementation. However, this indicates that understanding of these concepts are not being communicated down through the school, resulting in the classroom teachers who plan and deliver the lessons to the children being the least familiar with these distinctions in types of knowledge.

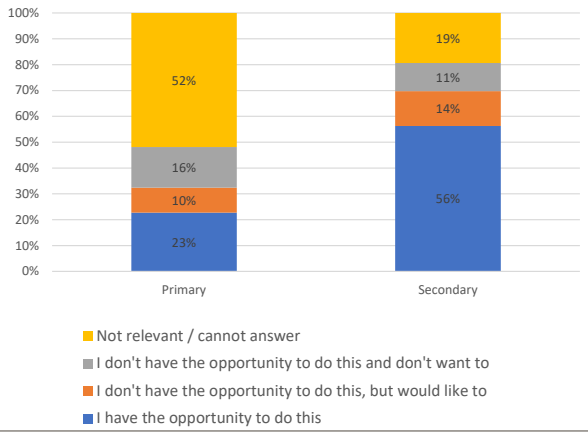
Fig. 1 'How familiar are you with Ofsted's terms 'disciplinary knowledge' and 'substantive knowledge'?



Regarding the second question (ID1003473): 'It's important for students to know about the similarities and differences between (curriculum) disciplines?', just over a third (36%) agreed with the statement, while just under a third (31%) partly agreed/disagreed. Secondary school teachers were more likely to agree (41%) than primary teachers (32%). Secondary schools were also more familiar with Ofsted's terms 'disciplinary' and 'substantive' knowledge, with 19% of respondents indicating they were either extremely or moderately familiar, compared with just 10% of primaries. This may be due to the more fragmented nature of the subjects taught in a secondary context, in which each teacher has their own specific discipline to be taught, compared with primary teachers who deliver a much wider variety of subjects. The implications of these findings are that primary school children are at a potential disadvantage compared to their secondary peers since they are less likely to receive teaching that develops their epistemic insight and more likely to receive teaching that focuses on subject-specific (or 'substantive') knowledge and concepts.

A third distinction between secondary and primary schools was evident from responses to questions ID1003474 and ID1003484. Secondary school teachers reported having more than double the opportunities that primary teachers have for teaching disciplinary knowledge to students (fig. 2) with 56% of secondary teachers indicating that they have the opportunity for some form of interdisciplinary discussion within their classroom. However, judging by the fact that most teachers were unable to distinguish between disciplinary and substantive knowledge (ID1003472), it is unknown to what extent or quality that these opportunities occur. It is vital to clarify what teachers mean when they refer to disciplinary distinctiveness, to determine if their understanding

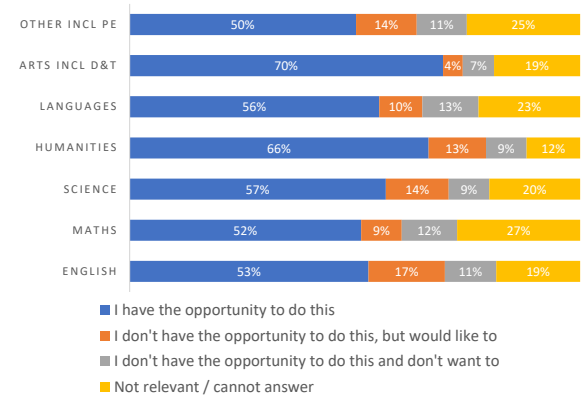
Fig. 2 'I have the opportunity to teach students what makes my discipline(s) distinctive compared to other disciplines.'



is the same as that of the Epistemic Insight Initiative or if the same terms are used to talk about different ideas.

Lastly, a link was evident between curriculum subject and opportunities for interdisciplinary teaching at secondary level. Arts and Humanities teachers reported having the most opportunities to teach students of the distinctiveness of their discipline compared to others (ID1003474) and to compare the similarities and differences in methods between disciplines (ID1003484). The breakdown of ID1003474 can be seen in fig. 3. While over half (56%) of secondary teachers reported having opportunities for interdisciplinarity, the opposite was true for primary schools, with the majority (52%) responding 'not relevant/cannot answer' (fig. 2).

Fig. 3 'I have the opportunity to teach students what makes my discipline(s) distinctive compared to other disciplines.'



More positively, over a quarter (26%) of secondary schools responded to ID1003484 that, while they currently do not have the opportunity for interdisciplinary teaching, they would like to. This was higher than for primary schools (15%), indicating that secondary schools may be a more appropriate target for future interventions than primary schools since they are more willing to change their practice. The findings also suggest that there are barriers to primary schools which prevent them from either understanding the importance and potential for epistemic insight to be taught in their classrooms or prohibit them from answering for other unknown reasons.

Recommendations for future research

Moving forward, several directions for further research have emerged from the findings and analysis. Firstly, in relation to schools' understanding of Ofsted's definitions of knowledge it is important to determine:

- How do headteachers understand Ofsted's definition of disciplinary/substantive knowledge and how is this communicated to staff within schools?
- Can a training resource support classroom teacher in their understanding of disciplinary/substantive knowledge?

Secondly, regarding secondary teachers' increased opportunities for interdisciplinary than primary teachers it would be beneficial to explore:

- What lessons can be learned and shared from secondary schools' opportunities for interdisciplinary knowledge?
- How do Arts and Humanities teachers promote interdisciplinary discussion within the secondary classroom?

Lastly, since 26% of secondary schools report wanting more opportunities for interdisciplinarity but are currently unable to do so, future studies could determine:

- Can epistemic insight webinars (or other training resource) increase secondary teachers' opportunities for interdisciplinary discussion?
- What support do secondary teachers require to promote opportunities for understanding similarities and differences between different disciplines and their methods?

MFL MEETS EI IN THE DESIGN OF DRIVERLESS CARS AROUND THE WORLD, HOW AI AND ENGINEERS CAN BENEFIT FROM MFL SPECIALISTS AND MFL DISCIPLINES IN CREATING CARS OF THE FUTURE.

Dr Martin Pickett—St Olave's Grammar School.

Introduction – the link between MFL and other disciplines

If one discipline or subject has been regularly isolated in a metaphorical silo within the school curriculum, then Modern Foreign Languages (MFL) is arguably placed in that silo. MFL is a discipline which recognizes that people are currently speaking other languages than our own around the world. So, how can MFL benefit Science and vice-versa? The current global market for new driverless mobility may, in fact, provide a useful world stage to set the scene of how engineers will create machines that are as safe and functional as possible.

Our hypothesis is that students have not before considered the way that two different disciplines can shine different lights onto the same question – a key tenet in Epistemic Insight (EI). Scientists and engineers will create the technology, the software, coding and data needed to work in the physical world. Nevertheless, are we going to give all instructions to the car in English? Imagine the US user - on a UK holiday - commanding their car to "go on the pavement". How unsafe could this be for those unlucky pedestrians on the sidewalk (UK pavement)!

A linguist would instantly inform the engineer that words can have different and contradictory meanings, even in the same language. Are not the British and Americans divided by the same language?

Furthermore, what should we anticipate in a different language where colours are not as translatable as one might imagine. Would the engineer commanding the car to go at a green light in Japan be shocked to find out later that the Japanese do not refer to red, amber or green traffic lights on their roads but rather to red, amber and blue.

Indeed, is it reasonable to expect that all the world must understand and command their new cars in English? MFL specialists, by learning a foreign language from scratch, already demonstrate humility – we do not assume that everyone speaks or should speak English and there is no need to question someone's intellectual ability or intelligence on the basis of being an anglophone or not. Indeed, just because one speaks English well does not make one superior to those who do not.

For some learning a language is considered a talent, a gift, an inherited skill, even a luxury to speak. At first glance, scientists and engineers may not see the link or the advantage of having a multilingual communicator on their team. Nevertheless, they will avoid elementary mistakes by listening to an MFL communicator. In fact, business investors may save money by employing the linguist to anticipate communication problems in different cultures.

At the same time in the school context, parents as well as children have to be convinced that they need instruction and investment of time learning a foreign language. One needs to see the links between MFL and other job-related disciplines. Pupils should feel confident and motivated enough to continue language learning as their efforts will be recognized and remunerated in due course.

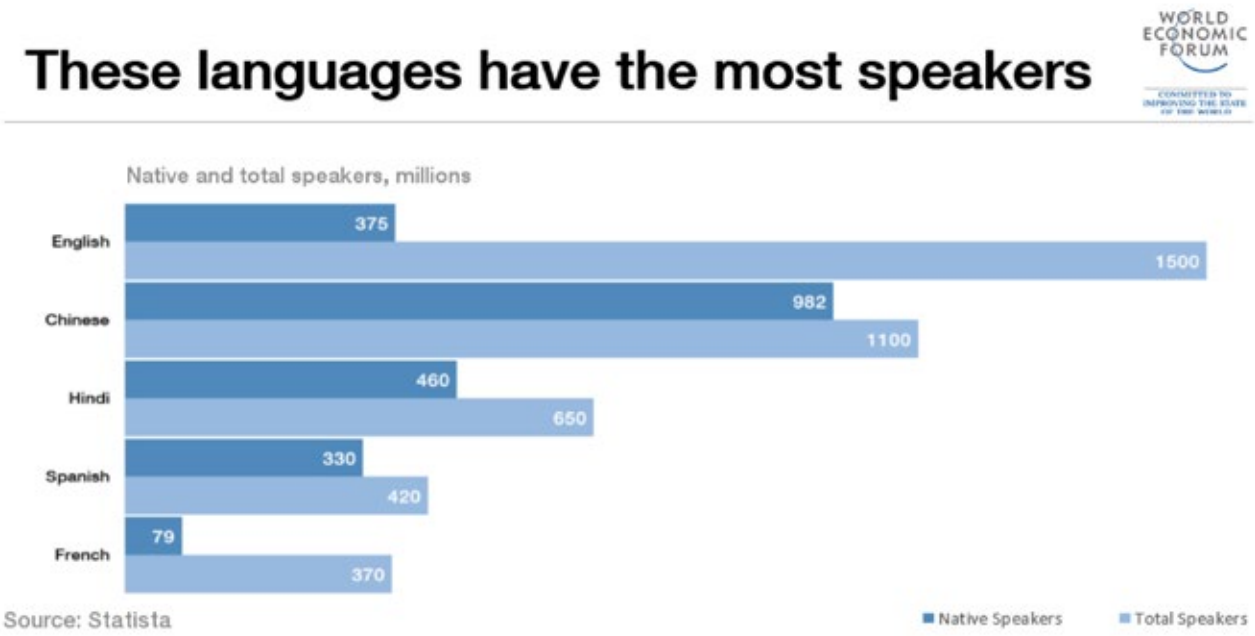


Figure 1: Top 5 languages in terms of speakers (from native to non-native speakers with varying fluency)

Social sciences should gather and show the data regarding languages as they are. The data set above shows that all the world's population do not speak English, let alone as a second language where the high numbers of English speakers counted include those individuals with minimal linguistic competence. Thus it is important to avoid repeating urban myths that "everyone speaks English". In reality, the world is more multicultural and multilingual. For instance, the data given does not even show the truth that there are billions of non-accounted speakers of other foreign languages. These individuals live, interact, buy goods and services all in a non-English-speaking world. Therefore, the social sciences are able to give MFL concrete evidence of its practicality through data gathering, making constant observations on the natural and social world. Consequently, Epistemic Insight (EI) provides a path for MFL to exit the silo and benefit from other disciplines like the social sciences, economics and engineering.

Literature Review – the crossover between motivation to learn a language and Epistemic Insight

Within the EI framework for developing informed research, MFL subject leaders need to critically appraise existing research and identify a question, or a field for research, while examining MFL's own research-informed practice. The research findings must ultimately have practical benefits for both pupils in class as well as society as a whole. For example, do UK students understand why MFL experts are needed in the future? If they could understand their role, then this would be a motivating factor to learn languages at school.

As a linguist with an academic background in both linguistics and the social sciences, I have studied motivation to learn a foreign language at micro, meso and macro levels (Pickett 2009) i.e. from the classroom, to school to the wider world. Now, I will be exploring the reason why there is still a need for school-educated MFL specialists.

In spite of the inevitable rise of Artificial Intelligence (AI) and instant digital translations, teachers today have to understand, show and discuss why MFL specialists exist, should take their language acquisition further and join more science-related teams. MFL informs us that the target language people spoken

- in their own communities and/or geographical areas - contains words and phrases that reflect their lives, cultures, preferences and aspirations. Knowing this information is extremely useful to commercial markets and governments as well as academia.

The theoretical underpinning of this research will come from studies of motivation in industry, educational research and other psychological investigations (Pickett 2009). Thus motivation is defined as the impetus to create and sustain intentions and goal-seeking acts (Ames & Ames, 1989). In this literature, motivation is important because it determines the extent of the learner's active involvement and attitude toward learning.

Understanding the motivating factors allows educators and policymakers to predict whether and how the foreign language learning being offered will respond to future demand and needs. For example, Julkunen in Finland focused on task specific motivation and context. He stated that there was a variety of different levels to scrutinize, e.g., physiological (the need to receive/respond to impulses, explore environment, master performance). Learning tasks needed to be "meaningful" in the mind of the learner and this personal measure would affect the amount of effort produced. One example of this could be the meaningful task of creating driverless machines for world markets.

Ever since the first general curriculum for the Finnish comprehensive school (1970, 95) motivation has been conceived as one of the didactic principles directing the organisation of the instructional processes and the teaching/learning situation. Learning requires energy that stimulates/creates and directs it. The factors that stimulate and maintain goal directed behaviour

are called motivational factors and the resulting state motivation (1989, p.23). He advanced the notion of epistemic curiosity i.e., the need-to-know factor; in other words, learning through novelty and surprise, then through interests and activities.

This idea of epistemic curiosity chimes with EI. The need to ask pupils big questions that science disciplines have never asked or are unable to answer is a novel way to motivate the linguist. Billingsley (2017) has questioned the assumption that science knows best or that there is only one valid way to answer the question. Questioning is to be encouraged. And then, by looking for solutions to these "problems" of language and culture, one overcomes major communication barriers.

Moreover, Barnes (2015) supports the idea of cross-curricular learning and students need to recognize multiple viewpoints –i.e. key principles to the MFL discipline. A multilingual and multicultural arena will always produce multiple viewpoints. Sometimes, individuals may wish to listen passively, other times interaction is necessary for the purposes of negotiation and persuasion. The MFL Communicator will be in their element to deal with real-life experiences.

The Pearson Report (2014) highlighted the skills gap of UK students and argued that schools need to equip them with "broad cognitive skills". In short, EI accentuates the importance of how these different disciplines interact (Billingsley and Nassaji, 2020) and, by pursing this crossover, we (teachers, students, business, policymakers) can all benefit.

The context - can we afford valuable curriculum time, effort and resources to deliver MFL?

The language curriculum at school should be designed to nurture curiosity (Bellingbury, Julkunen), enhance motivation (Dornyei, Pickett) helping students become independent learners. Nevertheless, looking at the official literature on the National Curriculum and UK examining bodies, the instructions to teachers are vague and more akin to guidance rather than direction. In KS3, there is a focus on creating a strong scaffolding of linguistic skills, i.e. the building blocks, on which pupils can build and develop over time.

In terms of the National Curriculum, MFL affirms the importance of the four language skills (speaking,

listening, reading and writing in the target language). To ensure that pupils are confident in using a foreign language, they must be able to express themselves accurately using the correct vocabulary, syntax and grammar etc. Furthermore, MFL exists as a discipline to equip students with the skills and cultural linguistic knowledge with the aim of communicating, opening doors to other cultures and understanding the world outside of the UK.

From Key Stage 3, pupils should know that they are learning a foreign language for the following reasons:

1. Language is for communication
2. Language is for identity
3. There is intrinsic value in knowing/speaking a foreign language
4. There are cross-curricular benefits and links to other subjects like Economics/Business, the English language, literacy and computer coding
5. One should even ask the big question: Is it advantageous or disadvantageous to be monolingual?

School MFL schemes of work build on what students may have already learned or not at KS2 but cannot take it for granted that students have a reason or a history of language learning prior to secondary school. It is up to the teachers and the schools to address key questions of motivation and the choice of target language to study. Of course, there should be progression to KS 4 and GCSE but teaching staff may need to be more explicit on reasons why it is worthwhile to learn a foreign language when everyone supposes that "all people in the world speak English".

Methodology – A quantitative survey to start the research on the big question

So what does it mean to think scientifically using the MFL discipline? In other words, what can linguists bring to science?

The aim of this research is to stimulate curiosity amongst secondary school students to gain epistemic insight on why learning a modern foreign language at school is useful and how this discipline's knowledge is shaped by them and, in due course, will benefit other disciplines like engineering, science and economics.

The learning framework developed by the Epistemic Insight Initiative at Canterbury Christ Church University considers disciplines as having different (and/or preferred) questions, methods and norms of thought (Billingsley et al, 2018). Therefore, by using this framework and its toolbox (from discipline wheels to pre-survey and post-survey questionnaires) students will come to know what it means to "think like a scholar" of MFL, understanding the questions and solutions to answers which cover a multilingual and multicultural world. The methodology in the pilot covered important areas of research and statements:

- Write down what are the ten most important words a driverless car should learn.
- Who decides what a word means?
- What instructions would you use most for a driverless car?
- How would an engineer solve the problem?
- How would the MFL communicator contribute?
- How would you advertise for the services of a linguist in an engineering team looking to design a driverless car?
- Why can't every human being speak the same language (well)?

As gaining epistemic insight is about developing an appreciation of the strengths and limitations of individual disciplines. One way to do this is to explore how two disciplines like MFL and engineering each investigate a cross-disciplinary question like creating driverless cars for world-wide practical use.

Therefore, let us focus on how do engineers (present and future) make safe and effective driverless

cars. Is this not an opportune moment to draw out the distinction between the language of science (as a way to think about the world in objective, generic terms) with the modern languages and culture of people in their current contexts?

The new team of students should think about how the experiences will differ. For example, do we explicitly make the distinction between "sidewalk" and "pavement" in the cars ready-to-use lexicon? How do we solve the issue of blue traffic lights in Japan? Can we see how cameras and sensors work efficiently in a controlled driving environment? Physical obstacles can be overcome but how about linguistic and cultural idiosyncrasies? Who or what is going to inform science and the engineer working on the driverless machine?

To give our student workshop structure, we treat 'MFL' as a discipline - which begins with the recognition that people are speaking languages which are other than our own around the world. The session will start with bare facts that not everyone speaks English. The figures should speak for themselves and demonstrate how many hours we think it takes to learn English to an intermediate working proficiency. We reinforce the idea of humility inherent in MFL and EI. Put diferently, is it reasonable nowadays to expect everyone in the world wanting to use a driverless machine to have a certain proficiency and understanding of English before starting?

In terms of the science discipline, which begins with the recognition that we can make observations of a natural world around us - and look for patterns of behaviour in how nature works that are useful and consistent. Is it scientific, or even realistic, to expect the whole world population to speak only one language, namely English, when history (one more discipline) shows us that this has never happened in human history?

Hence, midway through the student discourse, we want to know what can science and what can MFL tell us about how engineers design driverless cars that are as safe and useful as possible. We already understand that MFL tells us that in the language people speak in their part of the world or their community, there are words and phrases that reflect their lives and cultures. Crucially, the target language is not just 'different' - it's different for a socio-cultural linguistic reasons (among others like history, politics or geography).

Undeniably, language is more complicated than coding, one word in one language is not an automatic substitute for a different word with the same meaning in another language. There are likely to be multiple possible terms and nuance is important. To illustrate this point, in English there are numerous words for rain from "downpour" to "drizzle". Likewise, in Nordic languages and Russian, there are many more names for snow than in English. Even simple verbs like "come" and "go" can prove to be curiously ambiguous. In English, "come" is usually linked to here (as in "come here!" while "go" is connected with there. However in Russian, you can instruct the driverless car to "come there" and "go here". Therefore, how can the engineer, producing machine instructions for the target consumer, do so - without an MFL specialist?

Thus the 'safe' driverless car will need to be a 'good' road user in each country - behaving and talking the way the locals speak. In other words, using "go" and "come" in isolation could prove just as catastrophic in the Russian context as employing "sidewalk" and "pavement" in the US or British English case. Words and instructions between human and machine will matter.

In addition, the car is an example of engineering - which means the latest technology will be designed to solve one of life's problems. Technology is an appliance of science which needs to 'work' in the hands of the people using it. That means Engineers will need to work with specialists in science *and* specialists in MFL to succeed.

That is to say, once engineers have worked with scientists to invent a 'gadget' that works out the distance, acceleration and speed to other machines and pedestrians - that gadget will be measuring distances in metres - the universal language of science - because science has a universal language. To

illustrate this point further, let us consider the plane (a semi-automatic driving machine already created by engineers). In this case, English is used as the *lingua franca* of airline pilots and yet a common human error in the aviation industry is the misunderstanding of a number or digit (another universal language of mathematics) when giving the plane's altitude or distance. Confusion arises because the speaker meant to say feet rather than metres, miles rather than kilometres, or vice-versa. Set protocols need to be established and adhered to.

Nevertheless, when the engineers consider how their car will now work in a particular country, they will either need everyone there (and all the maps etc) to work with metres - or to convert the local terms into the terms used by their car. They will also need to align the car's journey position to the left or the right of the highway depending on the norms of that country.

And we have a choice as engineers - do we start by saying we want our car to 'fit right in'? And so be thoroughly "tuned into" the language and culture where it is being driven - or do we want a more generic device? Next, do we expect people to work with it and 'learn its language and ways'? The latter would mean a high degree of training similar to the airline pilot who needs beforehand so many hours "flying time" with an instructor and a comprehensive study of physics to be a competent user.

What are the benefits and disadvantages to each strategy? How do other disciplines like economics then come in to help us weigh up those options. The last strategy mentioned involving intense instruction and training has to be economically viable to work as a marketable consumer product. Why, indeed, would a consumer want to buy a driverless machine which involves added expense and training time to use it properly?

Also, once the students have overcome the obstacles, how are they going to sell the machine to the non-English speaking market? Will they use simple English or more sophisticated target language? Commercial enterprises will need to assess the advantages and disadvantages to adopting different marketing strategies?

Once more, our research would like to see how students approach the "problem" and find their own solutions. Will they rely on Artificial Intelligence and instant computer translation? Are there unintended consequences of being over reliant on Internet and broadband technologies? Do they (students) and we (teachers, policymakers and businesses) make too many assumptions? Can the students in the workshop anticipate problems?

Conclusion – the next step to gathering quantitative data and engaging students

Having explained why and how building students' epistemic insight provides a tangible reason to pursue MFL, the next step is to carry out the full quantitative research in schools using 1-2 lesson workshops and see how receptive, insightful and engaged the target student audience become. One school setting is not enough. Therefore, it would be optimum to have a wide-range of schools with different ranges of students and backgrounds (i.e. not restricted to grammar or single-sex schools). Consequently, if you are an interested teacher, willing to participate in this timely research, then we would very much welcome your contact (details below) and cooperation.

Could your school's MFL department benefit from this research and workshop as well as the link up to other disciplines like the social sciences, economics and engineering?

EI emphasizes the importance of how these different school disciplines interact (Billingsley and Nassaji, 2020) and, we (as researchers, teachers, students and policy makers) can - and will - all benefit from a multidisciplinary crossover.

As educationalists, our intention is to show students wanting to pursue science that there is no reason to ignore or drop an MFL subject. Indeed, their academic portfolio preparing them for the world of work could include at least one MFL subject. Moreover, one can imagine strong economic and

engineering reasons why business and governments will want - or need - multilingual workers with such an appealing portfolio in order to solve real multilingual problems in the global economy.

Equally, students should feel confident and liberated enough to pursue the MFL option, knowing that they are improving their career prospects, rather than hindering them. Ultimately, it should never be a false choice between MFL and the sciences. Both disciplines need each other. Students benefit from their different approaches to solve complicated communication, engineering and cultural challenges in a more diverse multicultural business context. The green (or blue) light is on, all systems are go!

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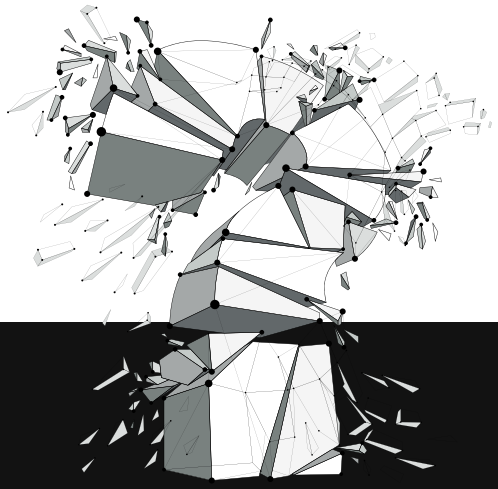
Epistemic Insight



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