"Just Google it?": Pupils' perceptions and experience of research in the secondary classroom

Kay Yeoman, Elena Nardi*, Laura Bowater, Huyen Nguyen
University of East Anglia, Norwich, UK

Abstract
While numerous studies examine perceptions of research held by university researchers, studies examining perceptions held by school pupils are rare. To address this gap and following analysis of questionnaire data (N=2634, KS3/4/5 pupils), we conducted eleven group interviews with one hundred pupils in England to investigate their experiences of research during schooling and their perceptions of how research is conceived, conducted, and where its utility and significance lie. Thematic analysis of the interview data – informed by Brew's (2011) 4-tier descriptor of perceptions of research (*domino*, *trading*, *layer*, *journey*), Stubb et al.'s (2014) elaboration of this descriptor, Meyer et al.'s (2007) *conceptions of research inventory* (CoRI) and Bills' (2004) distinction between *Research* and *research* – led to seven themes. Here we elaborate the most significant of these themes: fact finding as research; who formulates and owns a research question; and, the friction between uninformed opinion and informed view. We conclude that secondary pupils' experiences and perceptions of research, while overall relatively rich, vary across different disciplines. We also conclude that pupils would benefit substantially from more comprehensive engagement with research processes – and we observe the role that qualifications such as the *Extended Project Qualification* (EPQ) can play in fostering said engagement.

Key Words
Perceptions of research; secondary education; Kolb's *learning cycle*; *conceptions of research inventory* (CoRI); *domino*, *trading*, *layer*, *journey* 4-tier descriptor of research.

1. Introduction

Research that generates knowledge and innovation is a key component of the future prosperity of the UK. Of particular importance is the Science, Technology, Engineering, Mathematics and Medicine (STEMM) pipeline, which encourages young people into related careers that make a direct contribution to the knowledge economy. It is crucial, therefore, that pupils gain understanding of the importance of research and the research process during their secondary school education. There is a notable number of studies that investigate experiences and perceptions of research by early career or experienced researchers, or examine pupil perceptions of specific disciplines such as mathematics (Nardi and Steward, 2003) or history (Grever, Haydn & Ribbens, 2008). However, there are very few studies – such as the Moss *et al.* (1998) study of 'student scientist partnerships' – that do so for pupils' perceptions and experiences of research *generally* and across disciplines. The study we report in this paper aims to make a contribution in our understanding of these perceptions and experiences – and to make related pedagogical and curricular recommendations. We note that research on school pupils' perceptions of research is timely, given recent changes to both the GCSE and A level curricula which emphasise problem solving and exploratory, open-ended activity more than before. We also note that this study was carried out in England and that it focusses on pupils' perceptions

*Corresponding author.
University of East Anglia, School of Education, Norwich, NR4 7TJ, UK.
Email: e.nardi@uea.ac.uk

of research partly shaped by their engagement with the National curriculum (NC) for England, Wales and Northern Ireland (Department of Education, 2014) and its interpretation through the pedagogy of individual schools.

In what follows: we present the theoretical underpinnings of our study; we outline its aims and methods; we elaborate the main themes that emerged from our analysis; and, we present results in relation to several of these themes. We conclude with a synthesis of results and implications for policy and practice.

2. Theoretical underpinnings: Experiential learning

The Oxford English Dictionary (2015) defines research as "systematic investigation or inquiry aimed at contributing to knowledge of a theory, topic, etc., by careful consideration, observation, or study of a subject". The *Research Excellence Framework* (Higher Education Funding Council for England, 2011) – in resonance with Lawrence Stenhouse's succinct "research is systematic inquiry made public" (Skilbeck, 1983, p.11) – describes research as "a process of investigation leading to new insights, effectively shared" (p.22). Most of the definitions we identified seem to capture three key characteristics of research: it is *systematic* and it leads to *new insight* that becomes *effectively shared*. While "research" is not explicitly defined in the NC (ibid., 2014), there are explicit references to research related activities – particularly in the context of science – with wording such as "working scientifically" used to describe "the key features of science enquiry, so that pupils learn to answer relevant scientific questions" (p.169). We have explored the research-related wording in the NC in Yeoman et al. (2016) and we return to the insights that emerged out of this exploration later in the paper.

Our study endorses the definition of learning by experience (experiential learning) as defined by Kolb (2014). Kolb's *learning cycle* (Figure 1) draws together experience, perception, cognition and behaviour and is predicated upon the assumption that learners will approach new learning with a certain preference, denoted by Kolb as one or more of the following "styles" (p.100): *pragmatist* (learning by testing ideas to see if they work in practice), *activist* (learning by doing, using concrete experiences and active experimentation), *reflector* (looking back over past experiences often with imagination and a tendency to consider different perspectives) and *theorist* (analysing observations and creating theoretical models). All four "styles" are reflected in Kolb's learning cycle and recent neuroscientific research (Zull, 2011) has associated each with activity in regions of the cerebral cortex (concrete experience: sensory cortex; reflective observation: back integrative cortex; abstract conceptualisation: front integrative cortex; active experimentation: motor cortex).

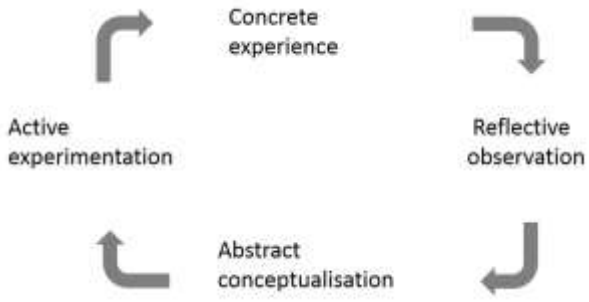

Figure 1. Adapted from Kolb's (2014) *learning cycle*, p.51.

We emphasise that we are not using Kolb's learning cycle in order to label individual pupil learning preferences but as a lens through which to examine the range of activities related to

research that pupils may engage with during schooling. In adopting the cycle for the purposes of our data analysis, we agree with Kolb's (2014) observation, particularly in the first chapter, that leading educationalists and psychologists such as Dewey, Lewin and Piaget take mainstream modes of conducting research (such as those deployed largely, if not exclusively, within science and history: see, the *scientific method*, Figure 2a and the *historical method*, Figure 2b) as examples of experiential learning and have often built their models of the learning process to these examples.

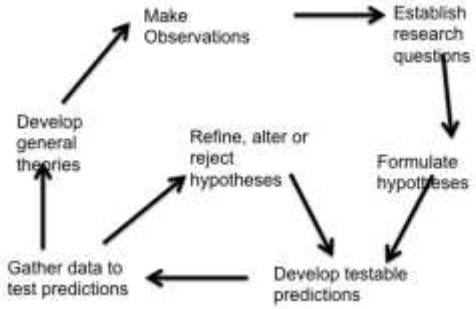

Figure 2a. The *scientific method*

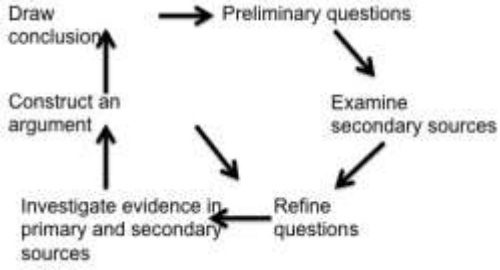

Figure 2b. The *historical method*

Our study sets out to explore whether pupils in school experience each and every part of the experiential learning cycle (Figure 1). Our conjecture, arising from our previous research (e.g. Yeoman et al., 2016) and experience, is that pupils are more experienced, and confident, in some aspects (e.g. research as fact finding, gathering information from primary and secondary sources) than others (e.g. establishing research questions) of this learning cycle.

Our investigation is a mixed methods one. We first surveyed a large number of secondary pupils (N=2634). Analysis of the survey data led to a list of issues that called for more elaborate investigation. To this aim, we interviewed groups of pupils, across three Key Stages and from a range of schools in our region. This paper focuses on the analyses of the group interviews.

In what follows, we first outline the study – thereafter the *SUPI* (School and University Partnership Initiative) *Project*, summarise the analysis of the survey data and highlight those findings that led to the list of focal points for the pupil group interviews. An account of the thematic analysis of the interviews follows.

3. SUPI (an RCUK-funded study) and relevant literature

In 2012, the Research Councils UK announced a funding scheme, *SUPI*, as part of its Public Engagement with Research Catalyst Scheme. One of the main *SUPI* objectives was "to bring contemporary research into formal and informal learning contexts to enhance the curriculum and raise ambition" and "encourage more young people from a diversity of backgrounds to pursue relevant studies beyond 16, follow research careers and enable more to act as informed citizens." (Research Councils UK, 2012, p.3). Twelve projects across the UK were funded, with UEA's (University of East Anglia) being one of the twelve.

The primary aims of the UEA *SUPI* are developmental and with a focus on public engagement. The rationale for the research elements of the project – which is what we focus on in this paper – is that working with schools and policy makers towards embedding research more firmly into pupils' experience needs to start from an understanding of what this experience currently is. We stress that there a notable body of work which examines the role of "children as researchers" (Rudduck and Flutter, 2000; Flutter and Rudduck, 2005) where pupils are engaged in systematic

enquiry and reflection upon their school experiences and they are active participants in change. Within these studies, the focus is on issues related to the pupils' experiences of schooling, rather than research embedded within disciplines present in the curriculum (sciences, humanities and social sciences). Our study is of pupils' perceptions of discipline-specific research linked to their experiences of said disciplines in school. We recognise that the perceptions of pupils who may have been engaged as researchers into their own experiences of schooling are likely to differ from the perceptions of those who have not. However, and to the best of our knowledge – and as evidenced in the pupils' responses to the related question in the interviews – the pupils participating in our study did not have any such prior experience.

In this investigation, we were particularly influenced by the following four frameworks. Two of these emerged from phenomenographic (interview-based) studies conducted by Brew (2001) and Stubb, Pyhältö and Lonka (2014), one is ethnographic (Bills, 2004) and one is a mixed methods study which uses a questionnaire and interview based approach (Meyer, Shanahan and Laugksch, 2005, 2007).

In her phenomenographic study, Brew (2001) conducted interviews with senior academics from three broad discipline areas: science and technology; social sciences; and, arts and humanities. Brew found that participants experienced research in different ways. She categorised these experiences in terms of the following four *variations*: *Domino* (research as process comprising tasks, events, things, activities, problems, techniques, experiments, issues, ideas and questions); *Trading* (research as product generation, e.g. in terms of publications, grants, networking and social recognition); *Layer* (research as bringing to light ideas, explanations and truths); and, *Journey* (research as engagement with activities which enable researcher growth or transformation).

Stubb et al. (2014) built on Brew's work with a study of Finish doctoral students from three different science disciplines – medicine, natural sciences and behavioural sciences – who were interviewed about their conceptions of research. Four categories emerged from the analysis of the interviews corresponding largely to the four *variations* by Brew: *research as a job to do*; *gaining qualifications and achieving accomplishments*; *making a difference*; and, *personal journey*.

Bills (2004) conducted semi-structured focus group interviews with supervisors of postgraduate students across a range of disciplines and, proposed a distinction between university (*big 'R'*) and non-university (*little 'r'*) research. The former is rigorous, methodical and situated within a theoretical or conceptual tradition; moves knowledge further; and, involves explaining, arguing, conceptualizing, theorising, thinking deeply and developing insights. In contrast, the latter consists largely of fact-finding (namely the collection and reporting of information) which is not necessarily new or emerging out of systematic investigation.

Meyer et al. (2005; 2007), the fourth framework that has influenced our study, sets out from the observation that research can be conducted in different ways in different disciplines: for example, as experimentation in the sciences, formal proof in mathematics, documentary analysis in history and naturalistic inquiry in the social sciences. The study examined perceptions held by groups of researchers, varying from early, middle to late career, with a range of disciplinary backgrounds (including social sciences, physical sciences, and development studies). The *Conceptions of Research Inventory* (CoRI) which emerged from the analysis consists of the following eight, often overlapping and complementary, categories: *research as information gathering*; *research as discovering the truth*; *research as exploration*

and discovery; *research as analytical and systematic enquiry*; *research as incomplete or inconclusive*; *research as re-examination of prior knowledge*; *research as problem-based* (we identify, study and solve problems); '*misconceptions of research*'.

We acknowledge that these frameworks have been constructed through research perception studies conducted with researchers in higher education who are far more experienced than the secondary pupils who are the focus of our investigation. Therefore, these frameworks may not be perfectly fit for purpose as a conceptual framework through which our data – of secondary pupil perceptions and experiences – can be analysed. Our analysis investigates this fit for purpose and we see this as a potential theoretical contribution of our study. What we do see as valuable in these four frameworks is that they highlight significant aspects of each part of Kolb's (2014) *learning cycle* (concrete experience, reflective observation, abstract conceptualisation, active experimentation) about research that pupils may experience during schooling – even if they do so in ways that may be far more sophisticated than anything expected from school-level engagement with research.

SUPI's first research phase (collection of quantitative data, through questionnaire) aimed at a broad description of pupil experiences and perspectives and was accompanied by a scrutiny of the NC for curricular evidence of what the intended experience of research is for secondary pupils. We summarise this phase of our study in what follows. We note that, while this paper focuses on *SUPI*'s second research phase, we see this brief summary of the first phase as necessary for two reasons: it provides the bare minimum contextual information of the study; and, it also demonstrates how the focal points of the interviews in the second phase emerged out of the analyses in the first phase. We also note that Ethical approval for both phases of data collection was granted by our institution's Research Ethics Committee.

4. *SUPI's* first research phase: questionnaire data and NC analysis

Details on this phase of *SUPI* are in (Yeoman et al, 2016). Here we summarise its key steps before proceeding to the second phase, which is the focus of this paper. The questionnaire – see Appendix 3 – was a 25-item Likert Scale (1-5) distributed to seven *SUPI* schools. We received 2634 returns from pupils across KS 3, 4 and 5 – see Appendices 1 and 2, excerpted from (Yeoman et al, 2016). We also asked teachers to complete the questionnaire in order to explore how they thought their pupils would respond. We received fifty-four teacher responses. Statistically significant differences in the responses were identified through a chi-square test on SPSS (version 22). We also considered how the term *research* appears in the NC and the three main English exam boards. Our analysis highlighted and discussed certain pupil views that emerged from the questionnaire data and which indicate areas where curriculum and pedagogy intervention may be necessary. These areas, which became focal points in the interviews conducted in the second phase, include the following. Pupils seem less confident in their understanding of research as involving the identification of a research question; and, they often see research as a means to confirm one's own opinion. They do however understand research as involving the generation of new knowledge and the collection of new data, such as interviews and questionnaires as well as laboratory work, field trips and library searches. They also appear relatively confident in their statements about their ability to do research, their school experiences of research and the importance of research in their future career choice. Their main perception of research was linked to fact finding. This was not surprising as our perusal of examination board specifications revealed the dominant reference to research as finding out information, rather than investigation. In Brew's (2001) terms, our scrutiny of the NC showed that it was dominated by examples of the *domino* variation, with some linked to the *journey*

variation. The semi-structured group interviews that form *SUPI's* second phase of data collection were designed to elaborate these key findings from the first phase. We now turn to an account of *SUPI*'s second research phase, the interviews.

5. *SUPI*'s second research phase: the interviews

We conducted the semi-structured, group interviews with pupils from four of the *SUPI* schools which had participated in the first phase of data collection (Table 1). These schools were located in the East of England. Each interview lasted between 50 and 60 minutes. Pupils were interviewed in groups, with size that ranged from four to five. We also interviewed two whole classes of pupils, one of size twenty four and another of size thirty. A total of one hundred pupils were interviewed. In total. there were 11 interviews: three at KS3, four at KS4 and four at KS5. The schools were responsible for the make-up of the pupil group for each interview and we were flexible about the number of pupils in each group. The KS5 pupil groups had a mix of students in the humanities, social sciences and natural sciences. The interviews were conducted mainly by the first author (with occasional assistance from a doctoral student intern – see Acknowledgements – who had been inducted in the aims of this phase of the project and had received appropriate research training). We include the interview schedule as Appendix 4. Interviews were audio-recorded and subsequently transcribed. This resulted in a set of transcripts about 75,000 words long.

School	Type	Description	Key Stages Taught	Current Ofsted rating
A	State (Academy status)	Large, mixed, city location	KS3, 4 and 5	Requires Improvement
B	State	Large, mixed, coast location	KS5	Good
C	Independent	Small, mixed, city location	KS3, 4 and 5	Outstanding
D	State (Academy status)	Large mixed, rural location	KS3, 4 and 5	Special Measures

Table 1. School type and Ofsted rating of schools taking part in the second phase of the study.

Thematic analysis of the transcripts followed. A key step of the analysis process was the production of narrative accounts by the first three authors. These were texts that condensed the contents of each group interview with attention to key points (as defined by the findings of the first phase of data collection, the four sets of studies that influenced the design of the study and relevant literature on perceptions of research) and with the aim to highlight key excerpts that encapsulate the group's response to each question. Analytical triangulation about how each narrative account met these criteria was carried out within the team.

Scrutiny of the post-triangulation version of the narrative accounts led to the identification of the following seven themes:

1. *Research as synonymous to scientific research, as a worthwhile endeavour and as a means for skill acquisition and improving career prospect*;
2. *Research as fact finding and research as being new to all or new to self*;
3. *Nature and ownership of a research question*;

4. *The nature of data and its generation*
5. *Research as challenge and as an incomplete and inconclusive process;*
6. *Compartmentalisation of research (as linked to coursework);*
7. *Friction between uninformed opinion and informed view*.

We note that how these themes reflected the frequency and intensity of utterances by the interviewees was corroborated through returning to the raw data and pulling out illustrative excerpts. We also note that these themes resonate directly with components of the four frameworks we outlined earlier as influences on the design and focus of both phases of our study as well as each part of Kolb's (2014) *learning cycle*. For example: several of Meyer *et al.* (2007)'s CoRI themes are reflected in the second, fifth and seventh themes above; Bills' distinction between *Research* and *research* is present in the second theme; and, Brew's (2011) *trading* and *journey* underpin the first and fifth themes. We also note that some of these themes – particularly the first – comprise components each of which could be seen as a theme itself, while others – for example the fifth – can be seen more easily as stand-alone themes. We acknowledge this imbalance but we also note that this spread of themes allowed us to maintain the narrative cohesion of the excerpts we sample in the Analysis section that follows.

6. Analysis of interview data and discussion

In what follows, we present results having differentiated between themes for which we only *summarise* the evidence and themes that we view as significant – affording stronger capacity for novel insight – and for which we *elaborate* the evidence.

6.1. Research as synonymous to scientific research, as a worthwhile endeavour and as a means for skill acquisition and improving career prospect

Pupils perceive the importance and value of research as evidenced firmly across our quantitative and qualitative data. Our questionnaire data analysis indicated that 70% of pupils considered research to be a worthwhile activity. Asking 'why do we do research?' elicited responses which map onto two of Stubb et al.'s (2014) categories: 'research as making a difference' (mentioned sixteen times across the eleven interviews and across KS) and research as 'gaining accomplishments'. Research is seen as progression, not only for humanity ('discover more about the world and society' (KS5)) but also for the individual ('satisfies my curiosity […] the benefit you have to the world, but there is a lot of benefit to you as an individual. You are increasing your mental capacity' (KS5)). The development of skills is mentioned thirty-three times across the eleven interviews ('I researched it off of my own back […] it makes you feel a lot more independent' and 'accomplished'). *Layer* and *journey* (Brew 2001) perceptions of research appear to be present from the start of secondary school education as evident in these responses: 'So we can get an understanding of things', 'Extend our knowledge', 'To find out answers to questions that we haven't answered yet' (which we also see as evidence of the *domino* perception in Brew's terms). 'So that you can get a good job and you can go through your GCSEs easier' and 'you might find something that's not been discovered and that can make you famous and stuff' (KS3) are also examples of *trade* perceptions. Research is seen as important for the future: 'if people stop doing research, actually doing the research jobs then there wouldn't be any innovative ideas or output at the end, so it won't just carry on' (KS4). At KS5 the building up of ideas over time was mentioned too: 'It is your contribution to the thousands of papers and research going into this world and knowing that you are making a contribution or at least a small one, is nice to know'.

Unsurprisingly, as pupils progress through the Key Stages, their accounts become more articulate and their example space richer, even if dominated largely by instances of research in the natural sciences, and far fewer in the social sciences and the humanities (see Table 2). While this bias may reflect (at KS5 at least) the A-level subjects of the interviewees, this is not the case for KS3 and KS4 when students have not specialised yet. The dominance of science in these examples is hardly disputable – as is the alarming absence of any example in mathematics and the humanities – and can be attributed *inter alia* to a bias in favour of science reporting in the media (as explained, for example, by the Agenda Setting Theory (Shaw, 1979), the key tenet of which is that the media, by covering certain topics influence what people think and talk about). We note that our finding resonates with Brew's (2001) observation that 'science is frequently used as a synonym for research' (p.273) and indicates a tendency of the pupils to place more emphasis on what Kolb (2014) labels *active experimentation*, often associated with conducting research in the natural sciences, rather than any of the other three components of the *learning cycle*.

Discipline	Frequency	Examples
Biomedicine	30	'Cancer' 'Stem cells' 'Ebola'
Biology	16	'Conservation' 'Climate change'
Chemistry	3	'substitutes for oil' 'carbon nanotubes'
Engineering	6	'Robotics' 'hybrid cars'
Physics	11	'asteroids' 'new planets' 'particle physics'
Arts	1	'graphic design'
Mathematics	0	None
Humanities	0	None

Table 2. The frequency of occurrence of particular disciplines and associated examples of responses when pupils were asked to give examples of research they considered worthwhile.

6.2. Research as fact finding and research as being new to all or new to self

As we note in Yeoman *et al.* (2016), and in resonance with Bills (2004), research in schools is often of the 'r' type (non-systemised fact-finding, new to self, also noted in Meyer *et al.'s CoRI* as 'research as information gathering'). Our interview data tends to corroborate this view. Pupils at all Key Stages often describe fact finding when asked in the interviews 'to give an example of research they have done in school' (sixty seven references). Examples include: 'In physics we sometimes do research on certain people that have made or done stuff to impact our way or living' and 'We are given some of it in class, but then we have to go home and do it as part of homework, and would just Google it'. ('Google it' comes up often as a method of doing research). The majority of interviewees (83.4%) consider that they do research and this transpires to be largely of the fact-finding type. KS5 interviewees take a different stance though and refer to fact-finding as an inferior, 'low scale' form of research:

> 'there are lots of different tiers of research. You can do basic research or there is more advanced research. If you are doing basic research it could be reading from a textbook or just reading something on the internet. While more higher [sic] research will require you to get more primary sources and look deeper into what other people have written in more advanced papers, and things like that. So maybe it is more of a sliding scale rather than a quantised scale of research'.

> 'I think the difference is though with all our research, we're always getting secondary data so we're always looking for things that other people have already researched and

already come to conclusions and then we're just collecting all of that data as opposed to getting any of our own.'

In Kolb's (2014) terms, while the vast majority of non-KS5 pupils place far more emphasis on the *concrete experience* of research as fact finding, KS5 pupils' distinctions between higher and "lower" forms of research and "deeper" ways of engaging with evidence and other people's findings echo more what Kolb labels *reflective observation* and *abstract conceptualisation*.

We note that there were clear statements across all Key Stages on the distinction between primary and secondary research (seven explicit statements). For example: in science, 'Primary research is research that you gather yourself, it is data that you gather from experiments that you set up. While secondary data is data you have got from somebody else's experiments' (KS5); in history, 'A primary source is going to be something that was recorded at the event, or just after the event, by an eye witness or someone who was there, whereas a secondary is going to be someone who heard about it, or from a later date' (KS4).

Fact gathering and formulation of a research question go hand in hand. The data we elaborate in 6.3 suggest that secondary pupil experience of this quintessential link is somewhat limited.

6.3 Nature and ownership of a research question

While in our survey data (Yeoman et al., 2016) only 38.8% of pupils strongly agreed or agreed that research starts with a question, in our interview data different understandings of what we mean by 'research question' were evident nine times across all Key Stages. Here is a KS3 example: while research question and topic are seen as synonymous by one participant, another participant then describes 'a question/your topic because wouldn't they be kind of similar, a question and a topic because they're pretty much synonyms to each other?' followed by 'I think a topic is more widespread though than just the question'. A KS4 example (which begins to suggest a clearer differentiation between topic and question) is: 'it could be the actual question you're researching, so the main topic'; 'the hypothesis, like the theory they want to test'. Finally, a KS5 example (which comes across as more sophisticated) is: 'hypothesis that you are trying to test by asking a question' and 'you had to create an experiment to collect data to prove the hypothesis. So you had to find a method of actually answering your question'. We note here too, as in 6.1 and 6.2, the proliferation of research in the sciences in the pupils' discourse and range of examples.

When asked if they have ever set their own research question, interviewees mention frequently putting together question items for 'surveys' in relation to mathematics, geography and psychology (in Yeoman et al (2016) we noted that 86.2% of pupils consider that research data can be collected through interviews and questionnaires). Surveys, often used in school, are widespread. The rare references in these interviews to mathematics are in connection to surveying and to presentation of data, rather than a research question in the discipline of mathematics per se. These are references largely to the 'tallying' aspect of surveys: ('In maths, we had to do a tally chart on different questions') and data is referred to as 'in lines [line graphs]' and 'pie charts'.

Research questions included 'favourite things' and 'how many people have visited a certain place'. In this instance the students designed the questions themselves ('we got to do them ourselves') but they did not find this particularly challenging ('quite easy').

Again unsurprisingly, at KS5 there were more sophisticated responses, which highlighted parts of the research process: for example, identifying a study sample ('in human biology we have looked at the effects of DNA ageing and how scientifically, how it will affect you, but also psychologically, and how it affects the people around you.') or searching for associations between variables ('in language we look at how and where people diverge or converge their language based on their surroundings. So we look at how the Beckhams are talking more posh and stuff like that because they come from very working class family and how language progresses over time').

Overall, however, the students' experience of identifying a focus for research and formulating a research question was limited. This finding resonates with those in the evaluation by Moss et al (1998) of 'student scientist partnerships' designed to immerse students in an authentic research experience. In this investigation, students became involved with four different projects which required the collection of data. The students were interviewed about the perceptions of research across the year, and the results indicated that very little had altered around their perceptions of research: they were unclear about the *raison d'être* of the projects, and felt they were not fully involved with input in either establishing the research questions, or designing the methods for data collection. Moss et al.'s evaluation suggests that being involved in the data collection alone is far from sufficient for engendering a sense of ownership of research.

There are examples however where pupils at KS5 are experiencing setting their own research questions. In some A-level subjects and some examination boards, e.g. History, 20% of the mark is associated with a piece of research where pupils come up with their own research question which is then investigated researched and an argument constructed (AQA, 2012). Within the specification, pupils are given advice as to how to frame their research questions. There is also the expanding adoption of the Extended Project Qualification (EPQ). The EPQ is a dissertation or investigation/field study, which involves formulating and then addressing a research question through either a literature review and argued discussion or data collection and analysis. Two KS5 pupils outlined the EPQ experience as follows: '…if you are given an EPQ, you choose a title', 'essentially what you do is, you have a timescale of about a year to conduct your own project, which is research based, or experiment based or whatever. But you have to do research as a part to achieve that qualification. It can be artsy or it can be scientific', 'very research based', 'goes towards the scientific papers you would probably do at Uni research level, and it [demands] dedication because you are doing it outside of lessons'. We return to the importance of experiences such as the EPQ in our concluding remarks.

6.4 The nature of data and its generation

Both in the questionnaire data (Yeoman et al., 2016) and in their responses to the more open questions in the interviews, pupils considered that data could be collected in a variety of different ways that included field trips, library and archive searches as well as laboratory work. The terms 'quantitative' and 'qualitative' were mentioned without prompting by the interviewer six times (KS4 and KS5 only) and pupils sketched essential differences between the two in plain terms such as 'when data is quantitative it is made up of numbers and when it is qualitative it is made up of words' (KS4). As the interviewees' references to the nature of data are often made in tandem with observations we discuss under other themes, we return to these references there.

6.5 Research as challenge and as an incomplete and inconclusive process

Pupils across the Key Stages acknowledge that research poses substantial challenges and referred to several of these, ranging from practical / technical to more intellectual. The interviewees listed hardship with access to information, tedium of repetitive work (e.g. in laboratory work) and complexity of research terminology amongst these challenges. One of the most poignant observations put forward was on the challenge emerging out of contradictory or inconclusive results. These observations resonate with one item in Meyer et al's (2005) *CoRI* ('research as the re-examination of existing knowledge') and can also be seen in the terms of Kolb's (2014) *reflective observation*. This is evidenced in our data as 'repetition of work' and this theme was referred to eight times across the eleven interviews. Examples, all from KS5, include references to psychology ("in psychology we just look into memory. We do loads of experiments in that. Just normally backing up other people's research to see if we get the same findings"; "when we're trying to back up people's experiments they've already done, you've got to try and make sure that you do it pretty much the same so you cut out things that are going to affect it in a bad way, like your experiment, extraneous variables.") and history ("I think the subject where I've done the most research is history, because we have to read other people's work"). Asked if it mattered if an experiment was conducted in exactly the same way, the reply was "No, not as long as you note what's different, because then you can compare it and the way that that's affected it." and "you cannot always replicate everything exactly, but as long as you record what is different then it's valid". There is ample evidence here of Brew's (2001) *domino* variation, particularly in relation to experimental methods as well as the seeds of what appears in Kolb's (2014) *learning cycle* as *abstract conceptualisation.*

Furthermore, in the spirit of Kolb's (2014) *reflective observation* and *abstract conceptualisation*, while our interviewees often see the repetition at the heart of the research process in a negative light, there are also numerous demonstrations of understanding that this is often a necessary component of validation. In the light of such exchanges with our interviewees, we suggest that pupils have a more nuanced understanding of research than implied by Bill's (2004) firm segregation of research ('r') in school. We note, for example, the exchanges below (KS4) that evidence a debate about whether reproducing other people's work is stealing (suggesting awareness of research ethics) or a form of validation.

Interviewer:	Do you think it's valid to completely reproduce what somebody else has done?
Pupil:	No. That would be like stealing someone else's effort.
Interviewer:	Yes.
Pupil:	It's not your research. It's just someone else's results. There's no point in you conducting a research and just taking someone else's results.
Interviewer:	What if you didn't think that the results they had come up with were correct but you needed to repeat what they did?
Pupil:	If you were comparing that would be different, but I think if you just said you hadn't taken up any research and just got these results and said, "Oh, these are right" that would be wrong.

There were frequent references in the data to contradiction in research findings (often in a negative light):

> 'with psychology, when you actually look through there is so much contradiction in research that you don't necessarily get any findings out of it. As well, if you research on the internet, just literally typed in 'memory studies' there are so many that contradict each other it's like which one do you go with?'

> ‘the problem we have with our textbooks is that one textbook puts it one way, another textbook puts it another way, and then a third textbook completely contradicts it all.’
>
> ‘The contradiction side of it. The amount of ones that just contradict is just – there is no definite answer’.

Across our interviews there was a tendency to feel that a research question must have a ‘right’ answer and that its potential inconclusiveness, while acknowledged as a frequent occurrence by the interviewed pupils, was treated more as a problem, and less as a salient, inevitable and potentially creative feature of research.

6.6 Compartmentalisation of research

By compartmentalisation of research we refer to two subthemes, one pragmatic (pupils associate research with course work) and one suggestive of a potentially problematic perception of research (pupils perceive engagement with research as moving on from certain research skills as they progress from GCSE to A level, leaving those – perceived as mastered – skills behind).

With regard to the first subtheme, the association between research and coursework was made fifteen times across the eleven interviews and is typified by this KS4 response ‘We do a lot of coursework so we do a lot of research’. This is not surprising as the exam board specifications across different subject areas expect some aspect of investigative work to be part of the coursework for GCSE and A-level qualifications (Yeoman et al, 2016). For one school at KS4 ‘Suffragettes’ was the focus of their controlled history GCSE assessment. This was described as follows: ‘find out all the stuff about Suffragettes, Black Friday and stuff like that and then put them into note form so we can take that in and then write our assessment’.

A KS5 pupil described her experience with geography assessment as follows:

> ‘Geography you have to pick your own subjects, so you have about six questions and you pick which one you want to do. I chose tectonic houses. The paper is 70 marks and you have to do research. It is like a report whilst you are in the exam […]. So under tectonic houses you have four sub-headings as well. Then those sub-headings branch off into about 70 different sub-headings as well […]. You have to find, so how does research influence tectonic activity? Or is tectonic activity increasing but why is the economic cost decreasing?’

Within this account lies evidence of a systematic research process for gathering factual information – firstly splitting information into four major ‘subheadings’ and then each subheading branching into other subheadings. This response also illustrates how one may have one major question, which is then further split into smaller questions.

With regard to the second subtheme, pupils also compartmentalise their different experiences at different stages of their education. This is exemplified by the following KS5 conversation.

Pupil 1:	At GCSE level, we used to hypothesise all the time.
Pupil 2:	We’d all have the same ones though, pretty much.
Pupil 3:	Yes, but we still had to… Yes, they were the same.
Pupil 4:	It was all about, “How does this affect that?”

Pupil 5: And then we'd have to write our own hypothesis from that, but we don't do that sort of thing anymore, because that's GCSE.

The above excerpt ('because that's GCSE') illustrates a 'misconception' about research (in the terms of Meyer et al's, *CoRI*, 2005). Hypothesis / conjecturing is part of scientific investigation throughout and in a cyclic manner, not just a starting step, and certainly not a skill one practises, masters and then leaves behind.

6.7 The friction between uninformed opinion and informed view

A striking finding from the quantitative data analysis we reported in Yeoman et al (2016) is that many pupils (50%) consider that you do research to confirm your own opinion. This pupil perception contrasts with the common view, amongst researchers, that research is expected to be characterised by open-mindedness (Harding and Hare, 2000). It is also listed in Meyer et al's (2007) CoRI items as a research "misconception" (their questionnaire item was similar to ours: 'research is about collecting data which back your argument').

As we suspected that above finding may have been the result of the potentially ambiguous phrasing of this item in the questionnaire, we investigated pupil perspectives further in the interviews. The interviews revealed a more diverse perspective on this matter than the questionnaire data. Pupils at all Key Stages are clear about the difference between uninformed opinion and informed view. Opinion being described as 'what somebody personally thinks about a topic' (KS3); 'how a person feels towards a certain subject or object' and 'something that a person believes to be true whether backed up by evidence or not' (KS4). Informed view was described as 'an opinion that would generally be factually correct, that you have researched it' (KS3); 'an opinion on proved data and validated by more than one person' (KS4) and 'an opinion that has had the balanced information given to them, so not biased information' (KS5). In addition, the word 'evidence' was linked to 'informed opinion' eleven times across the eleven interviews.

The tensions between uninformed opinion and informed view is evident in the following conversation triggered by a statement by a KS5 pupil that 'sometimes people can have a strong opinion before they start doing research and they can often try to tailor their research to fit an opinion'. In the conversation this was countered with 'no, you should start the research with no opinion at all, really open-minded and then at the end form an opinion'. This exchange illustrates that these (A-level) students recognise the importance of remaining open-minded. Asked 'do you think we do research to inform our own opinions?' one reply was:

> 'Yes, for some people are trying to prove their own opinion, but you can get people who are looking into research to disprove their own opinion. That they believe it but they don't want to. They want to know the truth rather than what they believe, they want to know the facts, that is what some people use research for.'

Statements such as the above address the friction between personally held belief and proven fact as a potentially problematic, albeit to some extent inevitable, feature of the human endeavour that is research. We see such statements as evidence of welcome nuance from our interviewees and embrace of the more reflective parts of Kolb's (2014) learning cycle.

Analogous evidence is in the KS5 pupils' discussion of 'cherry picking' of results in the following:

Pupil 1: It depends how ambitious you are.
Pupil 2: It depends what the opinion is of.
Pupil 3: You might research but it might not affect your overall opinion, you only cherry pick what you want to hear and what you don't.
Pupil 2: I think in things like philosophy you have to be quite neutral and non-biased, like my dad would always be careful and say he's agnostic rather than into any of the religions because that can affect your viewpoint. I don't think it would be to confirm your opinion, I think it would mainly be giving an answer. You do research to answer a question and if you do it well then you'll probably get the correct answer in the end… so it would change from an opinion to a fact/answer.

We note here the strong preference for definite answers. For example, this preference is noted by a KS5 interviewee in relation to research in history as follows: 'Research in h istory is quite shady, because you never really know the definite answer. You can say that this happened on this day, but whether it happened as people explain it, it is really hard to judge'.

In sum, the evidence we sample from in the preceding sections, 6.1 – 6.7, suggests certain characteristics of pupils' perceptions and experiences of research that correspond to all parts of Kolb's (2014) cycle, albeit with very different emphasis and depth. Our findings confirm the proliferation of pupils' perception of research as research in the natural sciences and the *active experimentation* (Kolb 2014) often associated with conducting research in these disciplines. The bulk of research reported by our interviewees is of the fact-finding type (with KS5 interviewees differentiating between fact-finding and more *reflective* and *conceptual* components being highlighted as key to research). Our interviews also exhibit different understandings of what is meant by 'research question', with KS5 pupil responses highlighting key parts of the research process with considerable nuance. Overall, however, the pupils' experience of identifying a focus for research and formulating a research question was limited and being involved in the data collection alone proved far from sufficient for engendering a sense of ownership of research. The interviewees listed challenges of research (such as hardship with access to information, tedium of repetitive work and complexity of research terminology amongst these challenges) but put special emphasis on the challenge emerging out of contradictory or inconclusive results. Despite this endorsement of a more conservative perspective – less embracing of the openendedness and complexity of the research process – there was also substantial evidence of a reflective and solid perspective on approaches to establishing the validity of research results. We appreciated the numerous demonstrations of this understanding as we did the evidence of awareness of research ethics. All in all, however, we also felt that the pupils' insistence on research questions having to have a 'right' answer and their agitated concern about its (frequent) inconclusiveness were areas meriting more attention. Our findings concerning the pupils' perception of research as a compartmentalised acquisition of skills are also cause for some concern. We were however impressed by the nuance (not evident in the survey data but evident in the interview data) in the pupils' take on the differences between uninformed opinion and informed view.

Overall, we see the evidence in our interviews as suggesting that more elaborate experience of the research process during schooling generates more nuanced perceptions about research. We elaborate this view further in the closing sections of our paper, the first of which offers a glimpse into the shifts of pupil perception that *are* possible, as evident in the the brief, yet intense, experience of a UEA *SUPI* summer school focusing on research.

7. The public engagement aspect of SUPI: A Summer School vignette

SUPI aims to embed research into the secondary school environment and the UEA SUPI does so by introducing research clubs, mentoring A-level pupils on the EPQ and introducing a research summer school for Year 10 (KS4) pupils. Pupils apply to take part in the summer school, and they have to prepare a CV and attend an informal interview. Many of the summer school sessions are designed and run by doctoral students who design activities relating to their own research, often teaching the pupils quite complex techniques e.g. *in situ* hybridisation of frog embryos. Other sessions provide opportunities for pupils to establish their own research question, and then design the experiment to test their ideas, followed by appropriate analysis of their findings. For example, pupils investigate questions relating to the feeding behaviour of locusts, and followed this with presenting their research in the form of a scientific poster. The pupils in our study, who were interviewed at the end of the summer school, were able to articulate a more sophisticated view of research. When asked if 'research can be finding out factual information', responses included 'it's not original', 'it's known to us' and 'something isn't research if you know what the outcome is going to be'. When asked to give an example of the type of research they do in school and for what subject, the response was **'**we don't really do research' (in contrast to earlier statements in the questionnaire that they do). These responses suggest that a short, but intense intervention can change perceptions about what research is and how it is conducted. Pupils in the summer school were offered opportunities to develop research skills and confidence towards doing self-directed research (Moss et al., 1998, Christensen and James, 2008, Bucknall, 2012, Bradbury-Jones and Taylor, 2015). As these works suggest, there is value in engaging pupils as researchers, and doing so with their interests, concerns and level of development in mind. It is exactly this focus on pupils' experiences and perceptions that the research elements of SUPI (reported in this paper) aimed to gain insight into.

8. Concluding remarks

One of the aims of our study was to explore if the frameworks identified in the introduction (Bills, 2004; Brew, 2001; Meyer et al 2005; Stubb et al 2014), which describe research conducted with researchers in higher education who are at varying stages of their careers, are fit for purpose when investigating pupils' experiences and perceptions of research. Our analyses indicate that there was no one framework that enabled us to map all of the themes which emerged from our study and that a combined use of the constructs within each one of these four frameworks was necessary. Our analyses also demonstrate that pupil perceptions of research have their roots within formal schooling and that with age and experience comes more nuanced understanding.

Our study set out to explore whether pupils in school experience each and every part of Kolb's (2014) experiential learning cycle (Figures 1, 2a, 2b). Our findings indicate that pupils consider research to be worthwhile and valuable to their careers, as well as a route to accomplishment (per Stubb et al (2014)). They also experience research as a *journey* (per Brew 2011). Furthermore, we show that, while school pupils consider fact-finding to be research, they also realise, in resonance with Bills (2004), that there are different types of research. We note that the pupils' elaborate understandings suggest to us that perhaps the framework by Bills (2004) belittles 'r' within the school environment. We also note that a comprehensive experience of the research process, (as defined, for example, by the *scientific* or *historical* methods, Figure 2) includes the search and acquisition of known facts. Fact-finding therefore is an essential component of the research process and our interviewees seem to know this well. On a more

concerning note, it is clear from this study that pupils have little opportunity within their school environment to set their own research questions, and that there is a disconnection between 'research as information gathering' and the 'research question'. This disconnection leads to confusion over what a research question is. It is evident that secondary schools are teaching a substantial part of the process of research, and they do so in a systematic way that offers opportunities to experience, even fleetingly, all parts of Kolb's (2014) *learning cycle* – except the part about identifying and formulating a research question. We see this as an important part as it has the capacity to strengthen pupils' sense of ownership of a research project, enhance learner autonomy and foster intellectual curiosity. Our recommendations, emerging also from the school engagement parts of the SUPI project, aim to address exactly this concern. We note that these recommendations need to be read in awareness that the intensity and extent of pupil experience of research varies across UK regions and across different countries and that these recommendations have relevance that may vary across different educational contexts.

9. Recommendations

Our recommendations would be to encourage schools to offer the Extended Project Qualification (EPQ) at A-level and extended project at GCSE. We note that the adoption of the A-level EPQ has been expanding and we welcome this expansion. In the 2014-15 academic year 33,564 pupils completed the EPQ [http://www.jcq.org.uk/examination-results/a-levels/a-as-and-aea-results-summer-2015]. This allows pupils an opportunity to experience the whole of the research process, as the research question is a key part of the EPQ investigation. An added benefit is that many universities, our own included, are starting to offer incentives (e.g. lower fees and reduced grade for entry requirement) to EPQ-certified candidates.

Further to the above, we note that a recent initiative has been the establishment of the Institute for Research in Schools (http://www.researchinschools.org/). This institute gives opportunities for schools to take part in authentic research projects in physics and biology. These research projects allow pupils at KS4 and KS5 to experience the full research process and data collected through these projects can also be used for the EPQ.

To these welcome initiatives we would add two recommendations, also discussed briefly in Yeoman, Bowater & Nardi (2015): to train the teachers in charge of the EPQ towards a much needed, more comprehensive appreciation of the research process; and, to extend the scope of disciplines and topics – currently dominated by some STEM, humanities and social science subjects but with mathematics and wet laboratory research severely under-represented – that pupils have access to. With regard to the first recommendation, we note that if teachers do research themselves (for example at Masters level) their perspectives on research are likely to be richer. Some of our own work aims to support teachers to this aim. We have experienced this emergent richness through the supervision of action research or reflective practitioner Masters dissertations produced by the teachers enrolled in our institution's part-time postgraduate programmes. We have also observed this in other countries (e.g. Germany) where research experience, at least at Masters level, for teachers is mandatory.

Acknowledgements

We thank the secondary pupils, and their teachers, who participated in this study very warmly. The UEA SUPI (http://ueasupp.org/) is funded by the Research Councils UK (RCUK) 'School: university partnership initiative' (SUPI, http://www.rcuk.ac.uk/pe/PartnershipsInitiative/,

EP/K027980/1). The interviews were conducted by the first author, with valuable assistance from doctoral student, and intern to the project, Claire Bushell.

References

2015. *The Oxford English Dictionary*, [Online]. Oxford University Press. Available: http://www.oed.com/view/Entry/163432?rskey=RKm0Mc&result=1#eid [Accessed 6 September 2015].

AQA. 2012. *Teacher Resource Bank A-level History Coursework Guidance* [Online]. AQA. Available: http://filestore.aqa.org.uk/subjects/AQA-2040-W-TRB-CG.PDF [Accessed 6 September 2015].

Bills , D. 2004. Supervisors' conceptions of research and the implications for supervisor development. *International Journal for Academic Development,* 9**,** 85-97.

Bradbury-Jones, C. & Taylor, J. 2015. Engaging with children as co-researchers: challenges,counter-challenges and solutions. *International Journal of Social Research Methodology,* 18**,** 161-173.

Brew, A. 2001. Conceptions of research: A phenomenographic study. *Studies in higher education,* 26**,** 271-285.

Bucknall, S. 2012. *Children as researchers in primary schools. choice, voice, and participation*, London ; New York : Routledge, 2012.

Christensen, P. & James, A. 2008. *Research with children: Perspectives and practices*, Routledge.

Department of Education. 2014. *The national curriculum in England. Framework document* [Online]. Department of Education, . Available: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/335116/Master_final_national_curriculum_220714.pdf [Accessed 6 September 2015].

Flutter, J. & Rudduck, J. 2005. Pupil voice: purpose, power and the possibilities for democratic schooling. *British Educational Research Journal*, 31 (4), 533-540.

Grever, M., Haydn, T. & Ribbens, K. (2008). Identity and school history: the perspective of young people from the Netherlands and England. *British Journal of Educational Studies 56* (1), 76-94.

Higher Education Funding Council for England. 2011. *2014 Research Excellent Framework. Assessment framework and guidance on submissions* [Online]. Available: http://www.ref.ac.uk/pubs/2011-02/ [Accessed 6 September 2015 2015].

Kolb, D. A. 2014. *Experiential learning: Experience as the source of learning and development*, FT press.

Meyer, J. H., Shanahan, M. P. & Laugksch, R. C. 2005. Students' conceptions of research. I: A qualitative and quantitative analysis. *Scandinavian journal of educational research,* 49**,** 225-244.

Meyer, J. H., Shanahan, M. P. & Laugksch, R. C. 2007. Students' conceptions of research. 2: An exploration of contrasting patterns of variation. *Scandinavian Journal of Educational Research,* 51**,** 415-433.

Moss, D. M., Abrams, E. D. & Kull, J. A. 1998. Can we be scientists too? Secondary students' perceptions of scientific research from a project-based classroom. *Journal of Science Education and Technology,* 7**,** 149-161.

Nardi, E. & Steward, S. 2003. Is mathematics T.I.R.E.D? A profile of quiet disaffection in the secondary mathematics classroom. *British Educational Research Journal*, 29(3), 345–367.

Research Councils UK. 2012. *RCUK Public Engagement with Research Catalyst Scheme. RCUK School-University Partnerships Initiative* [Online]. Research Councils UK, .

Available:http://www.rcuk.ac.uk/documents/documents/rcukschool-universitypartnershipsinitiative-pdf/ [Accessed 6 September 2015].
Rudduck, J. & Flutter, J. 2000. Pupil Participation and Pupil Perspective: `carving a new order of experience'. *Cambridge Journal of Education,* 30(1), 75-89.

Shaw, E. F. 1979. Agenda-Setting and Mass Communication Theory. *International Communication Gazette,* 25**,** 96-105.
Skilbeck, M. 1983. Lawrence Stenhouse: research methodology "Research is systematic inquiry made public". *British Educational Research Journal,* 9**,** 11-20.
Stenhouse, L. 1981. What counts as research? *British journal of educational studies,* 29**,** 103-114.
Stubb, J., Pyhältö, K. & Lonka, K. 2014. Conceptions of research: the doctoral student experience in three domains. *Studies in Higher Education,* 39**,** 251-264.
Yeoman, K., Bowater, L. & Nardi, E. 2016. The representation of research in the national curriculum and secondary school pupils' perceptions of research, its function, usefulness and value to their lives. *F1000 Research*. http://f1000research.com/articles/4-1442/v2.
Yeoman, K., Bowater, L. & Nardi, E. (2015). Enquire within. *Teach Secondary, 381,* 50-51.
Zull, J. E. 2011. *From Brain to Mind: Using Neuroscience to Guide Change in Education*. Stylus Publishing, LLC.

Appendices

Appendix 1. The *SUPI schools:* From (Yeoman et al., 2016)

School	Type	Description	Key Stages Taught	Current Ofsted rating[1]
A	State	Small, mixed rural location	KS3 and 4	Good
B	State	Large, mixed, town location	KS3, 4 and 5	Requires Improvement
C	State (Academy status)	Large, mixed, city location	KS3, 4 and 5	Requires Improvement
D	State	Large, mixed, coast location	KS5	Good
E	Independent	Small, mixed, city location	KS3, 4 and 5	Outstanding
F	State (Academy status)	Large mixed, rural location	KS3, 4 and 5	Special Measures
G	State (Academy status)	Large, mixed town location	KS3, 4 and 5	Good

Appendix 2. Make up of questionnaire respondents (gender, KS): From (Yeoman et al., 2016).

	Gender		Key Stage			School Type	
	Male	Female	3 (aged 11-14) Years 7, 8 and 9	4 (aged 14-16) Years 10 and 11	5 (aged 16-18) Years 12 and 13	State	Independent
Sample (n=)	1134	1259	928	845	861	2200	434

Appendix 3. The questionnaire: The data can be downloaded from the results section of (Yeoman et al., 2016).

University of East Anglia School University Partnership Programme

Male ☐	Year 7 ☐	Year 10 ☐	Year 12 ☐
Female ☐	Year 8 ☐	Year 11 ☐	Year 13 ☐
	Year 9 ☐	State School ☐	Independent School ☐

We thank you very much for taking the time to help us with our research! Kay Yeoman, Project Director

This short questionnaire aims to explore your views on what is research, who uses it, how it is conducted, whether you see it as something useful and enjoyable, and as something that you are good at and interested in. We expect this to take no longer than 15 minutes to complete.

Please shade the box 1, 2, 3, 4 or 5, with **1** standing for **Strongly Agree** and 5 for **Strongly Disagree**. Shade 3 if you neither agree nor disagree, or if you are unsure.

	Statement	1	2	3	4	5
1.	Scientists do a lot of research.	☐	☐	☐	☐	☐
2.	Research is a worthwhile activity.	☐	☐	☐	☐	☐
3.	Knowing how to do research will help me in my future career.	☐	☐	☐	☐	☐
4.	People around me would not take me seriously if I said I was interested in a career in research.	☐	☐	☐	☐	☐
5.	Research will not be important in my life's work.	☐	☐	☐	☐	☐
6.	I am confident that I can do research.	☐	☐	☐	☐	☐
7.	Historians do a lot of research.	☐	☐	☐	☐	☐
8.	Doing research is challenging.	☐	☐	☐	☐	☐
9.	Research can be carried out through collecting data during a fieldtrip.	☐	☐	☐	☐	☐
10.	Artists do a lot of research.	☐	☐	☐	☐	☐
11.	You have to be a genius to do research.	☐	☐	☐	☐	☐
12.	Research involves coming up with new theories.	☐	☐	☐	☐	☐
13.	The main purpose of research is to generate new knowledge.	☐	☐	☐	☐	☐
14.	Research involves collecting new data.	☐	☐	☐	☐	☐
15.	Research always involves investigating a question.	☐	☐	☐	☐	☐
16.	Research involves searching through sources, such as libraries.	☐	☐	☐	☐	☐
17.	Philosophers do a lot of research.	☐	☐	☐	☐	☐
18.	Doing research is not useful.	☐	☐	☐	☐	☐
19.	Research can involve collecting data through interviews and questionnaires.	☐	☐	☐	☐	☐
20.	You do research to confirm your own opinion.	☐	☐	☐	☐	☐
21.	Lawyers do a lot of research.	☐	☐	☐	☐	☐
22.	Research is carried out solely through experiments in a laboratory.	☐	☐	☐	☐	☐
23.	Anybody can do research.	☐	☐	☐	☐	☐
24.	Mathematicians do a lot of research.	☐	☐	☐	☐	☐
25.	I think I do research in school.	☐	☐	☐	☐	☐

Appendix 4. Questions asked in the semi-structured group interviews were:

- Where do you think that scientists conduct their research?
- Could you give us an example of research which you consider to be worthwhile?
- What sort of career might you want in the future?
- Do you think it matters if other people don't take you seriously when you say you are interested in research?
- Could you give us an example of the type of research you do in school and for which subject?
- Could you give us an example of the type of research which a historian would do?
- Where do you think a historian will carry out their research?
- What is the most challenging piece of research you have done so far and what subject was it for?
- In conducting your research, what part do you find the most challenging?
- Could you give us an example of how research could be conducted on a field trip?
- Could you give us an example of a piece of research which an artist would do?
- What do you think research means for an artist?
- Do you think you have to be clever to do research? Why or why not?
- Could you give us an example of a scientific theory?
- Could you give us an example of what you consider data to be?
- What do we mean by a research question?
- Could you give us an example of a research question?
- Have you ever been asked to come up with your own research question?
- What type of profession would use a library or archive for their research?
- What do you think a philosopher might research?
- What type of data do you think a philosopher would collect?
- Could you give us an example of a useful piece of research?
- What type of profession might use a questionnaire to gather data?
- What do you think an opinion is?
- What do you think an informed opinion is?
- Why do we do research?
- Could you give us an example of the type of research which a lawyer would do?
- Where else can research be conducted?
- Could you give us an example of the type of research which a mathematician would do?
- Do you enjoy doing research? Followed by:
- What do you find enjoyable about research? OR: What do you find not so enjoyable about research?
- In which subject do you do the most research?