RCUK PUBLIC ENGAGEMENT WITH RESEARCH:
SCHOOL-UNIVERSITY PARTNERSHIPS INITIATIVE (SUPI)

FINAL REPORT -UNIVERSITY OF EAST ANGLIA

Engaging Secondary School Pupils with Research Experiences

SUPI PROJECT NAME: **UEA SCHOOL:UNIVERSITY PARTNERSHIP**
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1: THE 'STORY' OF YOUR SUPI PROJECT

a) Please provide a narrative summary that describes the journey your SUPI project has taken from beginning to end and covering all the key developments in between.

Development of the UEA SUPI

The development of our SUPI can be told around a number of key areas, the schools with whom we created a network; the external stakeholders with whom we worked; the governance of the partnership, the evaluation process as well as activities offered as part of the four year programme.

School Partnership Development

During the course of the project we established relationships with five other secondary schools (Tables 1.1a and b). These schools entered the SUPI through previous networks, e.g. from Reepham the Head of Physics was a previous student of the principle investigator (PI), as was the head of Science at Sir Isaac Newton. The network with schools has matured, evidenced by a high level of co-operation between the schools themselves, and the university facilitates this, by supporting projects e.g. helping to write grant applications and providing university facilities. We have moved from a group of individual schools and an HEI to a community of practice.

Table 1.1a Secondary Schools Comprising the original Consortium

School	Location	Type
Archbishop Sancroft High School	Norfolk	Rural secondary state school. Mixed ages 11-16
Attleborough High School	Norfolk	Rural secondary state school, 11-18
City of Norwich School-An Ormiston Academy (CNS) (lead school)	Norfolk	City secondary state school. Mixed ages 11-18

Kesgrave and Farlingaye teaching alliance (including Northgate High School)	Suffolk	City outskirts secondary state school. Mixed ages 11-18
Thetford Academy	Norfolk	Urban secondary academy. Mixed, ages 11-18
Wymondham High School	Norfolk	Urban secondary state school. Mixed ages 11-18

Table 1.1b Schools added to the consortium

School	Location	Type
Sir Isaac Newton 6th form	Norfolk	City specialised science 6th form. Mixed ages 16-18
Reepham High School	Norfolk	Rural secondary state school, 11-18
Flegg High School	Norfolk	Rural secondary state school, 11-18
Norwich School	Norfolk	City independent school. Mixed ages 11-18
East Norfolk 6th form	Norfolk	Urban 6th form. Mixed, ages 16-18

External Stakeholder Development

The UEA SUPI worked with a number of external education stakeholders from the start of the project (Table 1.2), others came into the SUPI as it developed (e.g. Yellobric and Youth STEMM C.I.C). As trust relationships developed we were able to get involved in further projects, e.g. the Engineering Development Trust (EDT) gave us access to a long-term raising aspirations project funded by the Dulverton Trust.

Table 1.2 External Education Stakeholders

Stakeholder	Role in project
The SAW Trust	Provide teacher training in SAW projects and develop bespoke activity for specific projects (e.g. ISS radio link and the Space Race weather balloon project)
Teacher:Scientist Network (TSN)	Linked scientists to all partner schools
Engineering Development Trust (EDT)	Running engineering events in our partner schools, including First Edition and Go4Set. Partner schools became involved in a longer term project with EDT funded by the Dulverton Trust (ongoing)
Norwich Castle Museum & Art Gallery	Manage the 6th form Biodiversity Conference and hosting the Humanities Matters conference.
Yellobric	External funds secured (from the Institute of Physics) to link Norfolk Schools with schools in South and East Africa for the 'Space Race Weather Balloon' competition-this was an example of authentic research
Youth STEMM Award C.I.C	Established the Youth STEMM award now operational in half of the secondary schools across Norfolk
Brilliant Club	Ran courses for pupils in target schools, e.g. Thetford Academy, teaching pupils on pupil premium. UEA SUPI championed the Brilliant Club and this enabled them to become embedded in UEA to deliver training to PGR students.

Governance

The governance initially was around keeping stakeholders informed and engaged, and ironing out difficulty, but as our SUPI developed it quickly became more about brainstorming new ideas instigated from the schools, rather than the university, ie a bottom up approach. This contributed hugely to the success of the UEA SUPI due to project buy-in from schools. The weekly bulletins have continued, but we will migrate this to the UEA outreach office.

Development of activity

Authentic research activity

A key part of the UEA SUPI was to offer authentic research opportunities. We started this by instigating a year-long project investigating the DNA barcoding of lichen species in Norfolk. Pupils were trained at UEA on the equipment and techniques, but the actual project was conducted within the schools. The pupils published a paper on their work for the British Lichenology Society Magazine. This was followed in Years 2 and 3 by pupil involvement in Antibiotics Unearthed, a citizen science project run through the Microbiology Society, and inspired by The Small World Initiative project that emerged from Yale University in the USA; pupils conducted their research in the school and university environment and presented their work as a poster at a Microbiology Society conference. Currently in Years 4 and 5 pupils are working on gathering atmospheric data by launching a weather balloon into space, pupils have design the balloon payload, and also programmed the Raspberry Pi to collect data as the balloon heads towards space. Embedding research was achieved in other ways, by developing a taught course for PGR students 'Taking your Research into Schools', as well as the Year 10 summer school, which focussed on research techniques which was also designed and delivered by the PGR students. We recognised that the Extended Project Qualification was an ideal way in which pupils could gain access to the research experience across both the sciences and the humanities, and we subsequently developed mentoring schemes and resources to help schools with this. As time progressed we made contact with the Institute for Research in School, and a 'TimPix' detector for radiation (https://principia.org.uk/activity/timpix/) is now in place at Norwich school, enabling all schools in the region to gather data, for e.g. EPQ projects. As our SUPI developed credibility we have been involved in writing impact statements on research grants, and this has resulted in us working with three different research groups.

Humanities Focussed Activity

The UEA SUPI established a Teacher: Humanities Network. In the first year of the project, scholars from across the Arts and Humanities Faculty at UEA were linked to the partner schools and activities were designed and delivery arranged. The first two years saw clear success, with most activity taking place in partnership with the independent school, Norwich School, but involving other participating partner schools. Activity was most successful where it directly linked to the school curriculum such as the GCSE English Literature and History workshops that were held in the spring terms of 2013 and 2014 which involved students from three of the participating schools. The most successful activity developed in an Arts and Humanities context is the Humanity Matters: Humanities Matter annual sixth form conference, which

brought together year 12 students with specialists across the Arts and Humanities disciplines to workshop around specific research themes (such as gender, race, war, art, rights, religion) in order to illuminate the role that the Arts and Humanities research has in addressing 'real-world' issues and to allow students to explore how the subjects they may be studying within the A Level curriculum might lead them in directions previously unconsidered. The success of the conference was the inspiration to involve the schools with an AHRC British Academy funded series of activities in Norwich which were part of the national *Being Human Festival of the Arts and Humanities*. This series of events was cross-curricula, involving creative writers, historians, literary critics, political scientists, and legal experts and a wide range of external partners.

Evaluation

The evaluation started as a joint initiative with the School of Education to conduct baseline study on research perception, but has ultimately led to a new research area in 'Research Perceptions', publications from which will be REF-returnable. The collaboration enabled applications for other funding (Wellcome Trust learning Plus)-and although not successful in that, we have worked together since on other projects. For example, two of the Co-PIs (Bowater and Nardi, unknown to each other before the UEA SUPI programme) applied successfully for funding to gain a PhD student working in the area of Citizen Science. The external evaluator, Dr Richard Watermeyer and myself (Yeoman-PI) are working on a joint publication examining the power of school:university relationships. We are also exploring other areas of collaboration, and Watermeyer is currently working on the evaluation of the Youth STEMM Award programme.

2: KEY FINDINGS, LEARNING POINTS AND ENGAGEMENT ACTIVITIES

a) Please list the key findings from your SUPI project

Research Perceptions Study

The project has gathered a massive amount of data relating to research perception. The following section provides a basic background and methodology for our research perceptions study and the key findings, we then show how these findings were influential in the design and delivery of our SUPI activity.

Background and methodology

One of the key objectives of SUPI was to embed research within the secondary school environment, but before this can happen, we must first discover secondary pupils' perceptions of research as being. We undertook a research Perceptions Baseline Study. Young people's views on research, how it is conducted and whether it is important influence the decisions they make about their further studies and career choices. We used questionnaire data to focus particularly on pupil perceptions of research in the sciences and the scientific method. Our questionnaire was a 25-item Likert Scale (1-5) distributed to seven collaborating schools (see appendix 1 for the questionnaire). We received 2634 returns from pupils across Key Stages (KS) 3, 4 and 5. In addition, we asked teachers to complete the questionnaire to reflect how they thought their pupils would respond. We received 54 teacher responses.

Results

The research question

A fundamental part of the research process as described by the scientific method is the establishment of the research question.

- Pupils were unclear that research should begin this way, only 38.8% strongly agreed or agreed with the statement. There was no significant difference in responses with regard to either gender or KS.
- The perception of the importance of posing research questions did not increase as students gained more investigative experience through their education.
- When teachers were asked how their pupils would respond to the statement there was no statistical difference in how the pupils responded and how the teachers thought they would respond.

Research as new knowledge

No clear learning outcome is provided by the National Curriculum for Science that asks pupils to understand that scientific inquiry or research is a systemised effort to gain new knowledge.

- 70% of pupils across all key stages strongly agree/agreed with the statement 'the main purpose of research is to generate new knowledge'. There was no significant difference is responses across Key Stage or gender.
- There was also no statistical difference in how the pupils responded and how the teachers thought they would respond.

Research is challenging

As pupils progress through their educational experience, it is assumed that the work they are asked to do which involves research becomes more and more challenging.

- When asked to rate the statement 'Doing research is challenging', there was a significant difference in the way in which pupils across KS responded. Pupils in KS5 were more likely to strongly agree/agree with this statement than those in either KS3 or 4.
- There was however a significant difference in how teachers and pupils responded to this statement with teachers thinking that pupils would find research challenging.

Pupils' perceptions and experience of research in the secondary classroom.

Background

Following analysis of questionnaire data 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.

Results

Research as a worthwhile endeavour and as a means for skill acquisition

- Pupils perceive the importance and value of research.
- Research is seen as progression, not only for humanity but there is a lot of benefit to you as an individual.

- The development of skills is mentioned thirty-three times across the eleven interviews
- Research is seen as important for the future.

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

- Research in schools is often non-systemised fact-finding and new to self. 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: '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'.

Nature and ownership of a research question

- Only 38.8% of pupils strongly agreed or agreed that research starts with a question but different understandings of what we mean by 'research question' were evident nine times across all Key Stages.
- 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.
- At KS5 there were more sophisticated responses, which highlighted parts of the research process.

Cohort Study with Sir Isaac Newton Specialised 6th form

Method

We conducted a separate cohort study with Sir Isaac Newton, Norfolk's first and only specialised science 6th form. Student who began at the school in the 2014 academic year were given the questionnaire to fill out (n=86). Pupils then interacted with 2 years of the UEA SUPI project and then completed the questionnaire again in June of 2016 (n=41). The aim of the cohort study was to investigate any difference in research perception after two years of SUPI activity by the school. As a control sample (KS5 baseline) the Key Stage 5 data from the original study was used, with these pupils taking a variety of different A-levels in different schools.

Statistical differences in the responses were observed and interestingly these were related to research in the humanities and social sciences.

1. Pupils in the specialised science 6th form were apt to become more sceptical about research conducted in the humanities. This is hinting at a cultural divide opening up, and one which is often seen in universities.
2. Evidence of scepticism emerging on how research is conducted, exemplified by the responses to the questions 'Research involves searching through sources, such as libraries' and 'Research can involve collecting data through interviews and questionnaires'.
3. Confidence in their ability to do research decreased. This could be seen as a negative outcome, but these students were exposed to authentic research opportunity through the Antibiotics Unearthed Initiative, the extended project qualification (EPQ) and numerous visits by research scientists talking about their research. It is a reflection on the realisation that research is about being 'new' and not necessarily about fact finding.

Project Activity Developed In Response to Pupils Perception of Research Study

The Extended Project Qualification (EPQ)

The UEA SUPI established an online mentoring scheme for the Extended Project Qualification (EPQ), which allows pupils an authentic research experience which complemented a training course initiative by the UEA outreach team. After evaluation we subsequently developed resources (an on-going project) which are now more widely available for schools to use. We hosted an EPQ training session for teachers as part of the UEA teacher conference, and the Pi led a session on how wet laboratory EPQ projects could be more widely adopted by schools. We are currently talking to Edexcel about how we can write resources for schools to encourage more to consider doing wet laboratory projects. Pupils applying to UEA now get benefit from studying an EPQ, there is a grade reduction and a bursary of £1,000 if they achieve an A or A* in their EPQ.

Research Based A-Level Lesson Plans

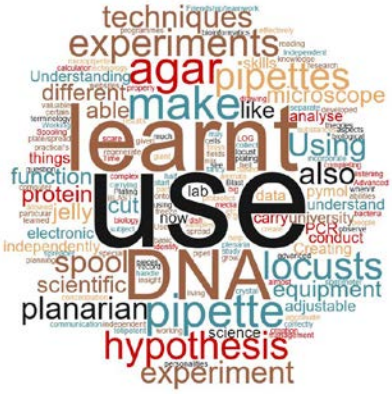
During the SUPI project we became involved with Pearson Education on the new linear science A-levels. They asked us to develop a set of lesson plans based around real research in action to provided contextual information for A-level students. Each lesson plan consisted of a real research case study, written by scientists, accompanied by a lesson plan on how the research could be embedded into a lesson (section 4) provides details of these case studies. They are available as a downloadable pack from Pearson and Amazon, as part of the package of extra resources for A-level teachers doing the OCR and Edexcel courses.

Summer School

The summer school was designed to give Year 10 pupils a taste of a real research environment, to try and overcome some of the research perception issues as part of our study. 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. Many of the doctoral students completed the training course ‘taking your research into schools’ (see section 8). Pupils were provided opportunity to establish their own research question, and then design the experiment to test their ideas, followed by appropriate analysis and presentation of their findings. Evaluation responses suggest that a short, but intense intervention can change perception about the nature of research as well as the steps of doing research.

In 2015 we asked the summer school students before they arrived what skills they wanted to develop, and what they thought research was. We then asked the same questions after the summer school was complete.

a)



b)

c)

d)

Figure 2.1 Word cloud of free text comments to the question a) 'what do you hope to gain by doing the summer school? b) what skills did you develop on the summer school? c) what do you consider research to be? (pre-summer school) d) what do you consider research to be? (post summer school).

The pupils are hoping to gain knowledge, skills and experience, and indeed they feel they have leant specific skills relating to use of instruments e.g. pipettes but also skills in terms of experiments and experimental design (hypothesis). In terms of understanding what research means, the vague 'something' has been replaced with a more specific words, such as 'hypothesis' and 'experiments'.

Authentic Research Projects

Through the four-year SUPI we offered three authentic research opportunities;

1. Lichen barcoding;
2. Antibiotics Unearthed Initiative-the hunt for novel antibiotics;
3. Space Weather Balloon.

UEA SUPI Professor Kay Yeoman

Lichen Barcoding

Lichens are a mutualistic symbiosis between a fungus and an algae. Despite their abundance in our environment, very little is known about the distribution of the algae partners in lichens and if this differs according to city or rural location. Barcoding is used for identification of species, it involves looking at a specific sequence of DNA. The aim of the research was to 'barcode' both the fungus and alga partners in lichens collected from across Norfolk, and the students gained useful data that was then added to the National Centre for Biotechnology Information DNA database (NCBI). This was a challenging project; pupils worked outside of school hours to complete the work and showed great tenacity when encountering problems. Students taking part were able to apply and then refine techniques. They also learnt that research is an on-going process, that there are many technical pitfalls, and as that many questions are raised by the data as answered.

Antibiotics Unearthed

The Microbiology Society launched 'Antibiotics Unearthed, in the UK and Ireland, a project that offered students and educators the opportunity to work with scientists as part of a global initiative to discover new antibiotics. Inspired by The Small World Initiative in the USA, Antibiotics Unearthed was initially trialed as a pilot project between the University of East Anglia and the Sir Isaac Newton (**SIN**) Sixth Form in Norwich with sponsorship from the Microbiology Society. The programme took place as an afterschool activity. Working in partnership with Laura Bowater and the University of East Anglia students hunted for antibiotic producing bacteria from their own soil samples. At the end of the project, students were invited to Birmingham, to attend the Annual Conference of the Microbiology Society to present their research as a poster and to attend the talks that took place within the science session devoted to Antibiotic Resistance,

https://www.microbiologysociety.org/news/press-releases/the-society-for-general-microbiology-is-bringing-students-and-the-public-together-in-the-search-for-new-antibiotics.html

Students also presented their poster at the Annual School of Biological Sciences Colloquium at the University of East Anglia in the summer of 2015.

Outcomes from the projected included;

- extremely positive evaluations from the students who were able to write about taking part in the project in their UCAS applications for university places.
- Projects rolled out across several school university partnerships across the UK and subsequently rebranded as Antibiotics Unearthed.
- OFSTED visited the school during the project and attended one of the afterschool club sessions. Within their report they commented that "*Participation in enrichment activities […] and working with scientists to discover new antibiotics provides a valuable opportunity for a small number of students to gain research experience*''

UEA SUPI Professor Kay Yeoman

Space Weather Balloon Project

This research project is being organised by Yellobric, a charity involved in STEM education in Africa. This is still an on-going project, with the balloons being launched in 2017. We applied for Institute of Physics Virdee funds, and we were successful. We received money to allow schools in Africa to partner with our UEA SUPI schools in Norfolk. Teachers attended two training sessions, one run by Raspberry Pi, to learn how to programme the computer, and the other by the SAW Trust which allowed pupils to think about a cultural exchange of art, science and poetry. The payload of the balloons and the programming was done by the pupils with support from teachers. The Balloons are being launched in Cambridgeshire at a designated site.

"*The skills that the students have developed include being able to work as a team and using the expertise of each of the students, an understanding of coding, an understanding of the physics that is involved and an understanding of radio waves. Overall, the project has been successful and the students have thoroughly enjoyed it. They can't wait to launch*." Teacher lead at City of Norwich School-An Ormiston Academy.

Other Impacts

The questionnaire developed during this study is also acting as a key teaching tool to teach students studying education at BA, MA and PhD levels about questionnaire design. For example in EDU, it has been used in research methods modules in programmes from across these three levels in which the students are asked to consider the methodological principles underpinning questionnaire design. Nardi (Co-PI) has also done an EPQ session in schools using our questionnaire and to raised awareness of what research consists of.

b) Please list the most important learning points from your SUPI project

1. Encourage schools to offer the Extended Project Qualification (EPQ) at A-level and extended project at GCSE. 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.
2. Join 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 5 to experience the full research process and data collected through these projects can also be used for the EPQ.
3. 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.
4. 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 through observing this in other countries (e.g. Germany) where research experience, at least at Masters level, for teachers is mandatory.
5. Consider clearly where the partnership is to be located. There are advantages to being directed from an academic school, e.g. access to researchers, equipment and laboratory space, but there are also

advantages with it being directed from an outreach department, e.g. access to funds, and dedicated staff who could take on managerial roles for the partnership.

6. Instigate a steering group, comprising of teaching staff, university staff (academic and outreach) and representatives from external organisations
7. Clear aims and objectives to be reviewed by a steering group on a biannual basis-this allows the partnership to remain focussed on the key aims and objectives.
8. Schools having clear influence over projects, initiation from the bottom up. It has been our experience that projects initiated by the schools e.g. the Radio Link with Major Tim Peake to the International Space Station had more traction as the schools buy-in to the project and find the time and the resources to devote to the development of the project. In these instance, the university acts more to facilitate the process, especially in the early phases around the writing of bids and grant applications; but also later in the evaluation.
9. Schools working together to organise activities has been excellent, e.g. City of Norwich School-An Ormiston Academy and the Norwich school worked closely together to run the 6th form American Civil Rights conference; the radio link to the ISS. This comes from building trust in relationships over time. Personal connections have been made by teachers in different schools and these have been facilitated by UEA. These connections will remain, even if teachers move schools.
10. Good, regular communication is key to the success of the partnership; we have found the weekly bulletins to be really useful. These allow teachers to know what is coming ahead and to decide if their school wishes to take part.
11. To allow schools to decide on their level of interaction, to remain flexible with that interaction and to be sensitive to pressure points in the school year which teachers and pupils face. We developed a tool which would allow schools and universities to identify both light and heavy times within an academic year, to try and aid in finding best times for activity to suit both types of institution.
12. Activities within schools have to be placed into a school calendar well in advance. This is really important if you want to reach a certain target audience within a school, for example pupils on pupil premium (to target social mobility). These pupils are often targeted with interventions, and can have timetable 'fatigue'. It has to be borne in mind that the key objective of the school is to support these pupils in gaining their GCSEs, other activity can be seen as peripheral to that.
13. Building trust and strong relationships between all project participants. This will allow longevity, and teachers working together can create powerful projects, our best examples are the Radio link to Major Tim Peake on the ISS and the authentic research project around the launching of weather balloons into space to collect atmospheric data.
14. Work with external education providers, but be aware of time and cost and be clear on what is to be achieved. It is important that there is a clear understanding of what it to be achieved with an external provider. A contract needs to be put into place, to allow both parties a share understanding of expectation.
15. Allowing schools to develop at their own pace, not to expect all schools to get involved with all activity. Schools are constrained by time and budget, they need to plan initiatives well in advance, and they need to be sure that new initiatives meet a need within the school. This means that not every school can take part in all activity as part of a SUPI.
16. Not to feel that we have failed when initiatives don't achieve full traction with schools. This can be the case for initiatives which have come from the top down (ie proposed by the university, and not by the school).
17. Being aware of change of roles of staff within school and being sensitive to that. Teachers within schools will often change roles within the school, or move school entirely to achieve career

progression. This can feel like a backward step if a particular strong relationship has developed between the university and the school. To mitigate the risk, it is best that a team of teachers within the school are aware the projects and can step in to take over if necessary.

18. Have more than one contact within a single school is important as that reduces risk of projects stalling. Staff turnover in schools can be quite high, so having a wider school investment is crucial to success.
19. Make use of PhD internship opportunity-PhD students are an amazing human resource. Often many PhD programmes have a period of time built into them where the student is required to develop professional transferable skills, tapping into this activity can be immensely valuable (see report by Claire Bushell in section 8).
20. Design projects (where possible) which reach across school disciplines. Cross-disciplinary teaching has proven benefits as detailed by the education literature. Being mindful of the arts when doing science activity can really enhance the learning experience, and often motivate pupils for whom science can seem hard. In contrast pupils who find creativity difficult can really benefit when they are given a clear direction for art and poetry.
21. Design a suite of activities which cover short interventions for a large number of pupils to more intense, longer interactions for smaller groups of pupils. It is important that a partnership provides a variety of interaction. Some schools will be able to nurture longer, more intense projects, others lack the time and resource to do so.
22. Undergraduate students are a wonderful human resource of ideas and interactions

c) Please list all engagement activities that were developed and run during your SUPI project

We have grouped activities into themes, and illustrate the themes with examples indicating when they ran, and calculated the SUPI hours (table 2.1). We mapped our SUPI activity against a published research perception framework. In 2001 Angela Brew conducted a phenomenographic study into how research was experienced by established researchers[1]. Her investigation uncovered four different ways in which research is perceived:

- **Domino variation**-where research is viewed as comprising tasks, events, things, activities, problems, techniques, experiments, issues, ideas or questions.
- **Trading variation**-where research is seen as product and social phenomenon, e.g. in terms of publications, grants and social networks.
- **Layer variation**-where research brings to light ideas, explanations and truths.
- **Journey variation**-where the activities in which the researcher engages enables them to grow or transform.

SUPI hours were calculated according to the paper by Holliman and Davies (2015)[2]. This metric captures the investment of time by teachers, researchers and pupils, it adds together the hours of investment multiplied by the numbers taking part.

[1] Brew, A. 2001. Conceptions of research: A phenomenographic study. Studies in higher education, 26, 271-285.
[2] Holliman, Richard and Davies, Gareth (2015). Moving beyond the seductive siren of reach: planning for the social and economic impacts emerging from school-university engagement with research. Journal of Science Communication, 14(03), article no. C06.

Activity	Date ranges of activity	Subject	Total Audience Number (total per event)	Length of event	SUPI hours over total project	Framework (Brew)
Conferences						
6th form conference-Biodiversity	2013-2016	Biology/Geography	240 (60)	5 hours	1600	Journey
6th form conference-Civil Rights	2013-2015	History	600 (200)	5 hours	3200	Journey
6th form conference-Humanity Matters	2015-2016	Humanities	150 (75)	5 hours	1600	Journey
Authentic Research						
Lichen Barcoding	2014-15	Biology	30	1 year	1872	Domino, Trading, Layer and Journey
Small World Initiative	2015-16	Biology	20	1 year		Domino, Trading, Layer and Journey
Weather Balloon space project	2016-17	Physics/Geography/maths Art and poetry	30	6 months	2320	Domino, Trading, Layer and Journey
Work Experience						
Summer School	2013-2016	Biology/chemistry	80 (20)	1 or 2 weeks	6000	Domino, Layer and Journey
6th form placement	2014-2015	Biology	3	2 weeks	450	Domino, Trading, Layer and Journey
Science Clubs						
DNA detectives	2013-2016	Biology	80 (20)	10 hours over 5 weeks	1160	Domino and Journey
Lab rats	2013-2016	Biology/physics/chemistry	80 (20)	1 hour over 1 year	2500	Domino and Journey

Crest Award Clubs	2014-2016	Biology	5	1 hour over 1 year	170	
Go4SET	2014-2016	Engineering	180 (30)	2 hours over 1 year	2000	Domino, Trading, Layer and Journey
Workshops						
DNA workshop	2015-2016	Biology	40 (20)	2 days	300	Domino
Biotechnology Business Competition	2014-2015	Biology	30 (15)	2 days	288	Domino, Layer and Journey
Courses for pupils						
Brilliant Club (Thetford Academy)	2015	Biology	15	7 weeks	230	Domino, Layer and Journey
EPQ online mentoring (City of Norwich School & SIN)	2015-16	All disciplines	30	5 hours	150	Domino, Trading, Layer and Journey
Cross-disciplinary						
SAW Workshops (x7)	2013-2016	Science/art and writing	700 (70)	5 hours	3250	Domino and Journey
Career Events						
City of Norwich School, Thetford, Flegg High	2013-2016	STEMM	1400	4 hours	1440*	Journey
Raising aspiration						
Super Science Saturday event	2013-2016	STEMM	2000(visitors)-(400 per event) 40 pupils helpers/60 undergraduates	5 hours	1120**	Domino and Journey
ISS radio link	2016	STEM	150	2 days	1800	Journey

Youth STEMM Award	2014-ono	STEMM	200	40 hours (bronze award)	8000	Domino, Trading, Layer and Journey
Girls into Physics	2016	Physics	80	2 hours	200	Journey
Publications for pupils						
Scientia Magazine	2013-16	STEMM	800 copies	Not applicable	2000[+]	Journey
YSA STEMM Magazine	2016-17	STEMM	100 copies	Not applicable	150[+]	Journey
Courses for PGR and teachers						
PGR Training	2014-ono	STEM	40 (5)	4 hours	200	Journey

Table 2.1 SUPI activity across the four year project

*Each pupil would have done an average 1 hour at the event

** SUPI hours based on the secondary school pupils who helped at the event and the undergraduate students who designed and delivered activity

[+]Preparation time for the magazine

A minimum 42,000 SUPI hours for the four year project. As there are 35,040 hours in four years, this indicates that there was SUPI related activity for every single hour over the course of the entire project.

UEA SUPI Professor Kay Yeoman

The Brew framework can be applied to both the National Curriculum (NC) and also to SUPI activity. In the published research we have concentrated on NC STEMM activity and mapped learning outcomes and UEA SUPI activity against Brew's framework (table 2.2).

Table 2.2 Mapping UEA SUPI activity and the National Curriculum for Science against Brew's research perception framework

Variation	National Curriculum for Science	UEA SUPI Activity
Domino	68%	77%
Layer	22%	52%
Journey	19%	98%
Trading	11%	10%

The majority of activity in the NC is around 'Domino variation', as this is concerned with the 'doing' of science. Very few of the other variations are represented in the National Curriculum. What is striking about this information is that SUPI activity can supplement potential areas of neglect from the National Curriculum, especially around 'journey' variation which encourages individual growth and transformation. Neither the NC nor the UEA SUPI provide much activity in the way of 'Trading variation' which is concerned with areas such as publications and grants.

3: THE IMPACT AND INFLUENCE OF YOUR SUPI PROJECT

a) Please summarise the impact(s) of your SUPI project across its lifetime

In order to assess the value of the UEA SUPI to its stakeholders an external evaluator was appointed (Dr Richard Watermeyer from the University of Bath).

Methodology

The evaluation comprised a series of twenty-five in-depth qualitative interviews involving individuals directly involved with the partnership. This group included the SUPI's academic team (including the authors of UEA's initial proposal to RCUK and doctoral researchers) (n=14); senior managers and individuals with leadership commitments at the SUPI's partner schools (n=4); teachers and STEM coordinators at the SUPI's partner schools (n=8). Interviews were conducted using a semi-structured schedule to elicit the various experiences and interpretations of the SUPI from across these different groupings and over a period of approximately six weeks.

Benefits for *pupils* in schools

Interviewees stated that pupils' interactions with UEA researchers had

1. caused to stretch them academically,
2. enabled learners to connect the curricula to 'real-world' and applied contexts of knowledge.
3. allowed pupils to grasp the relevance of their school-based learning to their futures.

4. Allowed a social equality mechanism providing pupils, especially from disadvantaged backgrounds or from schools suffering from a dearth of resource, with educational opportunities ordinarily out-of-reach
5. empowered pupils by nurturing a can-do mentality and enabling their self-actualization in the present context of their being school-learners of STEM and their potential in being scientists of the future (figure 3.1).

Figure 3.1 Benefits for Pupils

Benefits for *researchers* working in schools

Involvement in the UEA SUPI had allowed researchers to;

1. expand professional and career development
2. reflect upon professional identity and through direct experience of communicating science with young learners consider the legitimacy of alternative futures.
3. self-locate themselves within their research. Different to others, this emerging critical reflexivity was not causing them to focus on interests and enthusiasm beyond their research but was seen instead felt to produce a greater affinity and closeness to their research.
4. be confident pedagogically where they were challenged to talk in different ways to different audiences and for an altogether different purpose (figure 3.2).

Figure 3.2 Benefits for researchers

Benefits to *teachers* and *schools*

Teacher interviewees, spoke of how the UEA SUPI had

1. increased their confidence and sense of agency in the dual context of being classroom practitioners and as providers of subject and careers guidance to their pupils.
2. increased their knowledge and awareness of research activity in STEM and humanities subject disciplines and the diversity of careers options and trajectories available to young people.
3. enabled project funding they had accessed in supporting extra-curricular and enrichment activities – particularly for pupils coming from disadvantaged families – and physical resources such as laboratory equipment, that schools were without yet could access through the university.
4. provided a means for teachers and schools to secure an equality of opportunity for all of their pupils especially those whose socio-economic status might otherwise preclude them the kinds of experiences that tend to influence learners' formative development and future trajectories.
5. brokered a more fluent relationship between schools at UEA as the host HEI, which had also contributed to the revision and redevelopment of work packages and lesson content (figure 3.3).

Figure 3.3: Benefits to teachers & schools

b) Please summarise any influence your SUPI project has had on your institution, its culture, or that of any other institutions, cultures and projects/initiatives.

City of Norwich School-An Ormiston Academy (lead school in the partnership)

City of Norwich School-An Ormiston Academy has been proud to be the lead partner of the UEA in a helping to promote STEMM and specifically Science through a variety of projects.

- UEA have run regular projects with the City of Norwich School and the other seven partner schools, many of which are sustainable and will ensure the legacy of the effective partnership. Through this other larger projects such as the live link to Tim Peake on the ISS and the Youth STEMM Award have arisen.
- The ongoing link between the Science communications course is hugely successful. The UEA students are inspiring to the school students; the activities they choose each year for Super Science Saturday are engaging and interesting. The students are well prepared in how to communicate with young children and parents which is so important in the successful nature of these days. With our own City of Norwich School students working alongside the UEA students, it allows them the opportunity to find out about UEA courses, the world of university and the research that goes on there; this is valuable in their own career development. The Super Science Saturdays welcomes around 400 people over the period of the day and therefore helps to engage many in our local community.
- The Year 10 Summer School that is now funded by the university is an incredible opportunity for GCSE students to work alongside students and academics at the university and immerse themselves in the university environment. Schools students get to carry out their own research as part of their experience which can be very different to the experience they have in schools.

- The partnership has also established long term working relationships across the schools taking part. This has allowed the staff themselves to develop and take part in projects they might not have otherwise done so. Even the opportunity to meet with the other SUPI project leads and discuss ideas and research has been an interesting dynamic of the project.
- On a staffing level, the key staff that have engaged in the project within school have gained recognition for their work toward enrichment, engagement and research. Both two leading staff in the lead school have been promoted through this time.
- The importance of the project and key roles within the school is further recognised as it now features as a job description requirement, where enrichment and reference to current applications in Science are valued within the teaching role.

Norwich Castle Museum and Art Gallery

The UEA SUPI project money has supported an annual conference for A level students on Biodiversity which plays a large part in the museum's offer to KS5. The funding has allowed us to develop and refine an effective template for a successful day. It has also been significant in developing new partnerships for the museum. Our Natural History curators and our Learning Team have benefitted from working with UEA staff and other local organisations involved in conservation work. (Norfolk Wildlife Trust, The Broads Authority, Norfolk County Council Natural Environment Team, Hawk and Owl Trust). The partners have also been very happy to be involved, particularly as has given them access to work with young people aged 17-19 (traditionally an age group that has been relatively hard for them to reach). Students and teachers alike have relished the chance to find out how the museum's work is relevant to current scientific research and current environmental science theory and practice.

Yellobric

Yellobric has consistently sought and failed to effectively link UK schools with schools we work with in Sub-Saharan Africa but this was achieved with the SUPI. The SUPI project has been incredibly successful in raising ambitions of our students in Africa as they have been able to experience genuine interaction and take interest in the their UK counterparts through the School Space Race and the partnership modelled used. For example one of our female students from South Africa who was involved with the Imagine Scholar Launches (2015 and 2017) has now successfully landed a place at United World Collage in the Netherlands and will be studying [astronomy]. The programme has seen a shift in Yellobric's culture towards student engagement and the School Space Race has been able to deliver much better learning outcome as a result. We believe it has also been able to open up a window into very different cultures for the two sets of students across the development divide. This has broken down stereotypes and allowed each partner student group to see the other with a much clearer understanding of who they are.

The SAW Trust

The SAW initiative started in 2005 and since that time the majority of the projects we run have taken place in primary schools and most of our teacher training provision has also catered largely for primary. Therefore, the SUPI project provided an excellent opportunity to trial different methods of disseminating the SAW approach to secondary schools. We were also able to run SAW training workshops specifically for

secondary school teachers, inviting members of the science department, English department and art departments to all come and train together to enable them to design and deliver their own SAW projects once back in school. We have found that although secondary schools vary in their ability and willingness to participate in this style of cross-disciplinary learning, there are flexible approaches we can use to accommodate their needs and often found that teachers were looking for 'an excuse' to work with another department within their school and so SAW provided the perfect opportunity. The experiences we have gained through the SUPI programme learning alongside teachers as well as generating some excellent case study examples that we can use to show other secondary schools how to implement SAW have been of real value to us and will enable us to work with secondary schools more regularly.

Sir Isaac Newton 6th form

The UEA RCUK SUPI has given students from Sir Isaac Newton a wealth of experiences that have engaged, challenged and extended them beyond the curricula. Working alongside undergraduate and postgraduate students and lead researchers in their fields has shaped degree and career choices and raised aspirations in sixth formers who may have doubted their abilities. By bringing research into schools 'the point' of science has been made clear and pertinent to those young minds that may have doubted the academic path upon which they have embarked. Through collaboration with university students and key education stakeholders other schools within the Inspiration Trust have benefited from science days, guest speakers and extra curricula activities. Not only do these events and activities inspire young people they also serve to embed links between primary and secondary school and highlight the opportunities that arose via higher education. Access to funding streams via the RCUK has enabled Sir Isaac Newton to purchase equipment, such as DNA electrophoresis kits, ordinarily beyond the scope of a school. This has ensured that all students have access to analytical techniques and procedures that place the current biology and chemistry curricula in context, bringing relevance to the classroom and stimulating enquiry. The legacy that results from the UEA RCUK SUPI ensures that for years to come students of all ages will continue to be inspired by science.

Impact upon UEA as an institution

Through training PGR student activity in the area of public engagement has increased, they are organising national events, for example 'Pint of Science' events. Some of the initiatives developed through the UEA SUPI, most notably the Summer School and the Youth STEMM Award are now helping colleagues with impact statements for research grants.

The project has facilitated links between faculties at UEA, and this has led to further collaborations, e.g. grant applications, and applications for a PhD studentship (see section 7).

There have been many positive benefits, to pupils, teachers, schools and researchers (as detailed in the preceding section), but there were also institutional barriers (from both the HE institution and the secondary schools themselves) to effective partnership and the issue of sustainability. These were themed as;

- an issue of funding
- an issue of value, relevance and priority
- an issue of time and location

An issue of funding

- A continuation of funding (and in-kind support) was deemed to be vital in maintaining the commitment and active involvement of all parties, particularly the university, which, some felt, had not fully grasped the significance and/or potential of the partnership.
- Some also considered that the perpetuation of the partnership depended on partner schools 'buying-in' the university activities. It was, however, acknowledged that such a transaction would be compromised by reductions in school budgets and a constriction of spending priorities.
- The significance of continuous funding to the maintenance of the network was stressed by interviewees who also referenced the incompatibility of such a wish with the funding formula of RCUK and the difficulty of justifying a proposal for university funding where the SUPI's school partners were unlike those recognized by and belonging to an institutional widening participation agenda:
- Interviewees also situated the funding dilemma in the context of an overall contraction of schools' operating budgets and this scenario making it harder to justify expenditure on 'non-essential' items, even where a positive benefit was patent and well recognized:

An issue of value, relevance and priority

- The future of the SUPI at a university level was felt by members of the academic team to be threatened where it was confused or conflated with other activities within the university, such as widening participation (WP) and/or admissions that were, furthermore, perceived to be explicitly administrative and not academic responsibilities
- Where the SUPI was seen to be different or dissimilar to existing administrative priorities such as WP – and in being located within an academic school, and not a recruitment and/or outreach unit – that it suffered from a sense of ill-fit with core university interests.
- The contribution of the SUPI was seen predominantly in terms of local gain. It was felt by interviewees to fall short of the kinds of more national and international reputational capital sought by most universities, as universities wish to promote themselves within a global higher education market.

An issue of time and location

- Scarcity of time in schools to diarize and integrate the kinds of interactions engendered by the SUPI; the asymmetry of university and schools' timetables; and the absolute need for in-school support.
- Interviewees considered that though the wealth of membership of the SUPI was a strength, it also presented logistical difficulties, especially where partner schools were remote and at some distance from the nucleus of activity and therefore at risk of exclusion:

4: PUBLICATIONS AND PRODUCTS

a) Please list any publications that have resulted from your SUPI project

Callum McGraffin[1], Elliott Wilders[1], Chris Wilebore[1], Daniel Harris[1], Michael Galloway[1] ,Francis Varela[1] Osama Elhakeem[2], Romesh Tirimanna[2], Carlotte Simonds[2], Gemma Buckle[2], Esther Ayuba[2], Ella Viale-Sole[2], Chloe Langley[2] , Hannah Drane[3], Dan Smith[3], Dan Sutton-Docherty[3], Jack Fielding[3], Emily Andrews[3], Tilly Ansell[3], Luke Ellwood[3], Kirsten Kean[3], Emma Lindsay[3], Katherine Mead[3], Krista Scarl[3], Josh Tate[3], Hannah Moseley[4], Zachary Taylor-McCrohon[4], Mark Awad[4], Miles Bate-Weldon[5], Emily Lewis[5], Liam Powers[5], Lauren Nesbitt[5], George Mills[5], Alexander Davey[5], Lewis Dawes[5] and Anastasia Page[5].
[1] Thetford Academy, [2]East Norfolk 6th Form, [3]CNS High School, [4]Norwich School, [5]Wymondham Academy
Using DNA barcoding to identify the fungal and algal partners in the lichen symbiosis (2014) British Lichen Society Bulletin, no 115, pp74-79.

Bowater, L., Nardi, E. and **Yeoman. K.H** (2015) Enquire Within, *Teach Secondary*, issue 58, 50-51.

Yeoman K, Bowater L and Nardi E. The representation of scientific research in the national curriculum and secondary school pupils' perceptions of research, its function, usefulness and value to their lives [version 2; referees: 2 approved]. F1000Research 2016, 4:1442 (doi: 10.12688/f1000research.7449.2)

Yeoman, K., Nardi, E., Bowater, L. & Nguyen, H. (2017). "Just Google it?": Pupils' perceptions and experience of research in the secondary classroom. British Journal of Educational Studies 65(3), 281–305.

Watermeyer, R and **Yeoman K** (2017) Issues of connectivity and continuity in STEM engagement: Lessons from a schools-university partnership. In preparation.

Online material to support the new Science A-level text books for the examination boards OCR and Edexcel:

ISBN 9781447977445 OCR AS/A level Biology A Teacher Resource Pack 1
ISBN 9781447977421 Edexcel AS/A level Biology B Teacher Resource Pack 1
ISBN 9781447977452 OCR A level Biology A Teacher Resource Pack 2
ISBN 9781447977414 Edexcel A level Biology B Teacher Resource Pack 2

Commissioned book by the OUP 'The Scientific Method'-coming from the perceptions of research investigation which was part of the evaluation programme.

STEMM magazine-2016 compiled and printed by City of Norwich School-An Ormiston Academy (lead school)

UEA SUPI Professor Kay Yeoman

Scientia Magazine (four issues-2014-2017) written by undergraduate students for a GCSE/A-level audience. Printed by UEA

b) Please list any products e.g. artistic, creative or educational material outputs that have resulted from your SUPI project.

The UEA SUPI websites hosts a range of case studies with outputs

Maths in Biology video for OCR-this highlights the importance of maths in the biological sciences, and is part of a pack of resources being developed at UEA in collaboration with OCR.

https://www.youtube.com/watch?v=iU9yzqLG7sg&feature=youtu.be

ARISS Contact with Major Tim Peake on the ISS

https://www.youtube.com/watch?v=24c6h_wN1d8

Table 4.1 Case studies of real research lesson plans

Case study title	**Institute/ University**
Ant-ibiotics	University of East Anglia (UEA)
Bio Batteries- Electricity from waste	University of East Anglia (UEA)
Can cloning save our sugar	University of East Anglia (UEA)
Controlling Destructive Insects with Genetic Modification	University of East Anglia (UEA)
Diet and Osteoarthritis	University of East Anglia (UEA)
Dust and Nitrogen Fixation	University of East Anglia (UEA)
Ethics and Clinical Trials	University of East Anglia (UEA)
Eye Malformations Under the Microscope	University of East Anglia (UEA)
Herschel Space Observatory	Cardiff University
Human Models for Human Disease	University of East Anglia (UEA)
Hydrogen and Energy	University of East Anglia (UEA)
Model Organisms	University of East Anglia (UEA)
Natural Products	The John Innes Centre (JIC)
Natural Selection and Variation	University of East Anglia (UEA)
Novel Chemical compounds to fight disease	University of East Anglia (UEA)
Plants and Vaccines	The John Innes Centre (JIC)

Seven new BSc (hons) degree programmes-these degrees are being taught from the academic year starting 2018/19 with support from our current partner schools. The PI of UEA SUPI has a 0.2 FTE buy-out to facilitate these programme and to interact with the UEA SUPI schools.

- Biological Science with Education
- Chemistry with Education
- Computing Science with Education

UEA SUPI Professor Kay Yeoman

- Environmental Science with Education
- Geography with Education
- Mathematics with Education
- Physics with Education

STEMM magazine-2016 compiled and printed by City of Norwich School-An Ormiston Academy (lead school)

Scientia Magazine (four issues-2014-2017) written by undergraduate students for a GCSE/A-level audience. Printed by UEA

Kate Nichols from City of Norwich School-An Ormiston Academy and the Pi developed the Science Progression map which highlights keys skills to be developed as part of STEMM activity from GCSEs through A-levels to undergraduate studies (see appendix 7)

5: AWARDS AND RECOGNITION

Please list any awards or recognition associated with your SUPI project

Received

1. Members of the SUPI team were short listed for an HEA award for their collaborative work around embedding science communication in the bioscience curriculum. This involved undergraduate students working as part of SUPI projects. https://www.heacademy.ac.uk/cate-2016
2. The Pi (Kay Yeoman) achieved a Chair in Science Communication in 2014
3. Ms Kate Nichols promoted to deputy head at City of Norwich School-An Ormiston Academy, our lead partner school
4. Ms Rachel Jarrold-Hunter promoted to vice principle of Sir Isaac Newton 6th form, honorary lecturer in the School of Biological Sciences
5. Dr Laura Bowater (Co-Pi) promoted to Chair in 2016)
6. Dr Jenni Rant- honorary lecturer in the School of Biological Sciences

Put in Place

1. The Youth STEMM award has three levels, Bronze, Silver and Gold; 40 pupils received bronze awards in 2016.
2. A number of pupils received Bronze, Silver and Gold Crest awards as part of UEA SUPI activity

6: COLLABORATIONS AND PARTNERSHIP

Please provide details of any significant collaborations and partnerships that have resulted from your SUPI project

UEA SUPI funded the Youth STEMM Award-The Youth STEMM* Award (YSA) scheme provides a focused framework for young people to further their passion, knowledge and skills in STEMM. The core aims of the YSA are:

- To **inspire** the next generation of STEMM professionals.
- To **engage** multiple sectors through a shared responsibility, creating a connected approach to building future capacity.
- To provide a framework that allows young people to **develop** their own personalised paths and understand their potential is limitless.
- To **shape** the way we think about engagement and outreach so it tackles disadvantage, inequality and prejudice.

A key challenge in education is linking together the wide and varied range of learning opportunities in the STEMM field, whilst avoiding detracting from their individual value. The Youth STEMM Award (YSA) pulls together disparate threads of engagement, inspiration and education in the STEMM arena in just such a way. The initiative has sustainability built in, the schools pay to be involved. Professor Kay Yeoman is now part of their steering committee and will help in the management in the post-SUPI environment.

Yellobric and the Weather Balloon Space Race Project

The UEA SUPI has one project still running with Yellobric, which is a school collaborative project with funding from the SUPI and the Institute of Physics (which the SUPI helped the schools to write). Schools in Norfolk have been partnered with schools in Africa in a competition to launch a weather balloon into space (http://www.schoolspacerace.com/) and to collect atmospheric data. The teachers involved in the project completed a training programme run by Raspberry Pi, to learn how to code. They also attended a training session run by the SAW Trust team to run cultural workshops with their pupils, and to share these outputs with schools in Africa. The African schools taking part in this project were funded by the Institute of Physics Virdee fund. The project has been supported by UEA academics in the School of Environmental Sciences.

Norfolk Amateur Radio Society and the International Space Station Radio Link

The partner schools collaborated with academics at UEA and Norfolk Amateur Radio Club (NARC) to host a link to Major Tim Peake on the ISS. This collaboration has been maintained, and NARC have now taken part in two Super Science Saturday events. The UEA SUPI was fully involved in all stages of this project, helping to write the bid, providing funds and equipment, as well as designing and delivery of the two-day event.

A new 'with education suite of degrees UEA

City of Norwich School-An Ormiston Academy, Norwich School and Sir Isaac Newton 6th Form are collaborating with UEA on designing and delivering a new suite of 'with education' science degrees, first entry in 2018. This significant project would not have been feasible without the four-year relationship built through the UEA SUPI.

The SAW Trust

Over the last four years the SUPI has worked closely with the SAW Trust. They have provided training for teachers in schools as well as supporting special projects such as the radio link to Major Tim Peake on the

ISS, and the weather balloon space race project. UEA PGR students are completing internships with SAW, and they have also taken undergraduate project students.

Norwich Castle Museum & Art Gallery

Over the course of the project we have worked in collaboration with Norwich Castle Museum & Art Gallery to put on events such as the Biodiversity Conference and also the Humanity Matters Conference. Academics from across the university have been involved in delivering these events. Undergraduate students have also worked for the organisation and we are now exploring the Museum University Partnership Initiative to further extend our collaboration.

7: FURTHER FUNDING

Please list all further funding that your SUPI project has leveraged across its lifetime

- Use of laboratories and technical support free of charge for school projects (approx £5,000 per annum). This has been an essential element to allow projects such as the Biotechnology Business Competition, teacher training programmes and the year 10 summer school to continue.
- Teaching budget (UEA)-£100 per student (total (some £6,000) on the Science Communication module-this goes towards project development.
- Use of UEA rooms and conference facilities free of charge for school activity (£5,000 per annum). Examples of this has enabled the gold award of the YSA to go ahead.
- Support from the UEA Science Faculty to run the 2017 Summer School for Year 10 pupils (£5,000). We are also getting support from UEA Outreach to enable pupils from widening participation backgrounds to take part, and they will pay for their travel costs to the summer school.
- We are also exploring with UEA outreach how we can embed activity as part of the National Outreach Programme. This is particularly associated with the Youth STEMM Award (YSA).
- Support from UEA to cover Open Access Publishing-this has enabled us to publish papers in journals which are open access, but charge a paper submission fee (£250 per paper).
- Staff support from Ogden Trust Teaching Fellow at the Norwich School for the Tim Peake ISS radio link project
- Support from Norwich School for the Agri-Tech Taster days (£10,000)
- Grant from the Institute of Physics Virdee Fund (£2,400) for the space weather balloon project
- 0.2FTE time for Pi Prof Kay Yeoman to work with our SUPI partner schools in delivering a new suite with ‘with education’ degree programmes with first entry in September 2018 (approx. £10,000)
- Consultancy from Pearson Education to review new A-level text books and write online support material (£20,000). These funds have been placed into a consultancy account and I am able to draw on these funds to support SUPI activity in 2017 and 2018.
- Grant from the Royal Society of Biology for National Fungus day at Norwich School (£500)
- Organisations, such as the Norfolk Amateur Radio Society have given their time for free to work on events such as the radio link to Tim Peake and Super Science Saturday.
- HUBS workshop (£2,000)

- 2015-18. Society for Microbiology. Cross-disciplinary match-funded PhD studentships scheme. Investigating and challenging public perceptions of antimicrobial resistance. Supervisory team: Laura Bowater (MED), Elena Nardi (EDU), Gary Rowley (BIO). £40K.

Grants applied for, but not awarded (important to show that the SUPI was working towards diversification)- they also represented significant investment of time.

- STFC Athena Astrophysics HUB (£200,000)
- Wellcome Trust Science Learning Plus (£70,000)

8: SKILLS AND PEOPLE

a) Please list any skills related developments that have taken place as part of, or as a result of your SUPI project

Skills have been developed across a range of project stakeholders, the pupils, teachers, researchers and students, both undergraduate and postgraduate.

Pupil Skill Development

Pupils gain their confidence from a wide range of different experiences, and it's important that a SUPI provides a variety of activity from a sufficiently early age to keep them inspired. This is exemplified by the quote from the student below who took part in as many UEA SUPI related activities as she could over the four year period. Prior to that she had taken part in junior school activity, as well as a synthetic biology CREST award prior to SUPI funding both of which the PI had run.

"*Overslept today (……). Went and sat in the front row because those were the only seats available. So I was 2 metres away from Brian Cox giving a lecture on relativity.*
I have Brian Cox for a lecturer and I have seen him in real life (……). And I had a conversation with Tim O'Brian during freshers (…….). AND I got to go to Jodrell Bank. I can say all of those sentences and list all of the other wonderful things I've done this past fortnight and it's not a lie!!

As there is no chance I'd be here without you lot, I thought I'd give you one final massive thank you. Thank you for putting up with me for 2 lots of CREST awards, YSA, Maths challenges, work experience, summer schools, classroom assistance, EPQ, countless lunchtimes of me pestering you all, and for all of your fantastic teaching which got me to do all of these incredible things in STEMM from the age of 10".

Postgraduate research Students (PGR) skill development

We developed a postgraduate research (PGR) student training course as part of their professional development. The PGR students gain credit for the course, as a requirement of their qualification. The course was titled 'Taking your research into secondary schools'. The course is a four hour training programme led by the Pi of the project and the head of Science of Sir Isaac Newton 6th form. During the course the PGR students develop a 50 minute lesson plan, which they then have an opportunity to deliver to one of our partner schools. The course has run for four years and has trained 40 PGR students, several of whom have subsequently trained as teachers. The course has recently been linked to the Year 10 research

summer school, PGR students on the course get a paid opportunity to develop and deliver a research-focussed session for the pupils. The course fits with the researcher development framework in Domain D. Engagement, influence and impact, which is the knowledge and skills to work with others and ensure the wider impact of research. Through;

1. Working with others;
2. Communication and dissemination;
3. Engagement and impact.

PGR internships

As part of the project we hosted Claire Bushell as a PhD intern (see section below), she described her skill development within a university report, and these are summarised below:

- I had great networking opportunities through interactions at UEA, local schools and businesses, and through attending national meetings.
- I was able to develop my self- management skills, balancing visits to schools with work on projects in the office through planning, preparation and prioritisation.
- I was exposed to areas of professional conduct with my work for Pearson. For example, copyright, co-authorship.
- I had to make considerations towards health and safety when designing activities for school pupils and for Fungi Day.
- I was exposed to finance, funding and resources issues.
- Through the RCUK funded research, I learnt about the ethics, legal requirements, respect and confidentiality and appropriate practice associated with conducting social science research with school pupils.

Undergraduate Student Training

The final year Science Communication module predated this project, but the SUPI allowed us to reflect on the content of the module and to provide a lot more opportunity for students to work in our partner schools. Over 200 students have gained training through this module over the course of the UEA SUPI. The students gain really key transferable skills in communication, management, design and delivery of secondary school based projects. The science communication is a sustainable model through which to continue activity with secondary schools. The School of Biological Sciences has committed to funding their work with schools as part of this taught module.

Taking Your Research into Schools-a PGR training course

We developed a training programme for postgraduate research students called ‘Taking your Research into Schools’ this was offered in the Science graduate school. The course fits with the researcher development framework in Domain D. Engagement, influence and impact, which is the knowledge and skills to work with others and ensure the wider impact of research. Through; 1. Working with others; 2. Communication and dissemination; 3. Engagement and impact.

We have trained 40 PGR students, many of whom have delivered lessons with our partner schools and or interacted with the Year 10 summer school. The course is split into two separate stages.

1. The session begins with information about the RCUK School:University Partnership Programme and the importance of engagement with a secondary school audience. Rachel Jarrold, the Head of Science at Sir Isaac Newton 6th form then delivers a training session on how to communicate scientific concepts within the different Key Stages of Education and for different ability groups. Participants then work on developing their own research area into a lesson plan, paying attention to how it could reinforce and extend the national curriculum.

2. Participants are given an opportunity to deliver their lesson to the appropriate Key Stage within one of our Partner Schools, and or they can take part in the Year 10 summer school at UEA.

The learning outcomes are:

- Able to design a lesson plan for secondary school pupils at different Key Stages;
- Able to break your research down into broad themes and link it to the National Curriculum;
- Able to gain confidence in science communication through the delivery of a lesson in one of our partner schools.

b) Please list any secondments placements and internships to or from other organisations associated with your SUPI project

1. Claire Bushell PhD intern supported the project for 6 months. Claire was involved with writing research Case studies and associated lesson plans. These were written for distribution by Pearson as supplementary material for the new linear Science A-levels (see section 8a for Claire's report)

2. Huyen Ngen (PhD student) supported literature searches for the baseline study on research perceptions. She is listed as a co-author on the paper "Just Google it" recently accepted for publication in the British Journal of Education Studies, This has therefore been beneficial to her for own skills and career development.

9: OTHER

Please state here any other information associated with your SUPI project that you would like RCUK to know as part of final reporting.

Sustainability

The strategy taken by the UEA project for real sustainability is to align SUPI activity with the core business of the University, namely, teaching, research, recruitment and impact. We have identified projects and initiatives within the UEA SUPI which aligned with these objectives and we are in the process of ensuring their long term future within the institution.

Teaching

1. Science Communication Module-this module trains undergraduate students in science communication, and as part of the module they do a project. We offer projects with our partner schools. The students are supported by the school and the projects are paid for by the UEA School of Biological Sciences teaching budget (£100 per student). This module and the benefits it offers students or the skill development and employability was short-listed for an HEA Collaborative award in 2017. Science communication students will continue to work with UEA SUPI schools to deliver projects, such as the DNA Detective science club.
2. We are also establishing a Science Communication Consultancy Programme, where organisations (including schools) can post projects which we can match to students. This is being initially set up for undergraduate students, but the plan is to have this as an initiative for postgraduate research students as well. This initiative is currently being established by two undergraduate students.
3. New Science Communication/Education Research Module for undergraduate students-. We will be offering projects which allow science students to develop social science research skills. Students receive £500 for their projects. There is a potential to link this to EPQ, where a school pupil could work with an undergraduate student to collect data around a social science research question.
4. The UEA is offering a suite of seven new 'with Education' degree programmes. There will be a compulsory 'Education in Action' module which our UEA SUPI partner schools are going to help us deliver, with students going into the school environment on placement. The Pi has a 0.2 FTE buy-out to develop these new programmes for the Science Faculty, and will also be working closely with the School of Education who have been part of the research perceptions study which has been so successful. Teachers in our partner schools will benefit by having a UEA campus card, those teachers who come and actively teach on the module as well as host students, will benefit by applying for honorary lecturer status. Pupils in the associated schools will have first opportunity at initiatives such as the Summer School.
5. We are continuing the 'Taking your Research into Schools' course for PGR students and linking this to the Year 10 summer school. The summer school is being funded by the Science Faculty.

Research

1. We have invested in equipment, which can be borrowed by schools to allow them to take part in authentic research opportunities. We are currently trialling a suite of synthetic biology activity using the equipment with Wymondham College (not an original UEA SUPI school-but one with whom we have developed a recent link). The scheme of work for this project was developed during the 2016 Year 10 summer school.
2. We are continuing our contact with the Institute for Research in Schools and we are hoping to work with them in the future

Recruitment

1. Recruitment and outreach activity at UEA is largely targeted towards schools where there are widening participation (WP) issues. UEA outreach is now working with the Youth STEMM Award (YSA) team to see how we can work together to promote WP, with UEA outreach being able to fund some YSA activity to raise aspiration. The Pi is now chairing the YSA steering committee. UEA is

involved in the National Outreach Programme (run by Cambridge University), and we are currently in talks with how current UEA SUPI activity aligns with a local and regional WP agenda.

2. Outreach and EPQ-we are working with the UEA outreach team to develop a set of resources to help teachers with the EPQ. In particular I will be advising on how to establish wet laboratory projects, but there is also the potential to link undergraduate students on our new research module.
3. The weekly bulletin will migrate to the outreach department, and we are seeking to establish a network of science teachers across the region.

Impact

1. We are hoping to develop a REF impact case study from the research perceptions study-with the developed school resources and the OUP book around the scientific method.
2. We are working in collaboration with research scientists to help them write funding applications around the impact statement where these activities are related to schools.

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ISBN 978-1-911343-98-1

First published 2018

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To cite this work:

Yeoman, K., McMahon, W., Bowater, L., Nardi, E., Nichols, K., Jarrold-Hunter, R., Watermeyer, R. and Rant, J. (2018), Engaging Secondary School Pupils with Research Experiences. The RCUK School-University Partnership Initiative (SUPI). The University of East Anglia.