Pilot Evaluation Protocol: SMART SPACES (Chemistry Teaching - Pilot Trial)

Evaluator: UCL Institute of Education
Principal investigator: Jeremy Hodgen

Template last updated: March 2018

PROJECT TITLE	SMART Spaces: Chemistry Teaching - Pilot Trial
DEVELOPER (INSTITUTION)	Queen's University Belfast / Hallam Teaching School Alliance
EVALUATOR (INSTITUTION)	UCL Institute of Education
PRINCIPAL INVESTIGATOR(S)	Jeremy Hodgen
PROTOCOL AUTHOR(S)	Jeremy Hodgen, Jake Anders, Nicola Bretscher, Mark Hardman
TRIAL DESIGN	Pilot trial with mixed methods implementation and process evaluation
PUPIL AGE RANGE AND KEY STAGE	14 – 15 year olds in Year 10 studying science (Chemistry)
NUMBER OF SCHOOLS	15 (5 Community of Practice development schools; 10 pilot trial schools)
NUMBER OF PUPILS	1500 (approximately 150 pupils per pilot school)
PRIMARY OUTCOME	N/A
SECONDARY OUTCOME	N/A

Protocol version history

VERSION	DATE	REASON FOR REVISION
1.2		
1.1		
1.0 [*original*]	14th Nov 2018	*[leave blank for the original version]*

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Abstract

This evaluation protocol describes the pilot trial of the GCSE teaching version of the SMART Spaces programme (SMART Spaces: GCSE Chemistry Teaching), a pilot trial funded by the Education Endowment Foundation (EEF), designed to investigate whether the SMART Spaces approach has wider applicability beyond the previously trialled GCSE revision version. Specifically, the pilot will examine whether the teaching version has sufficient evidence of promise, feasibility and readiness to justify an efficacy trial. The trial will investigate the intervention group only (and there will be no control group). It will consist of a mixed methods implementation and process evaluation (IPE) together with an evaluation of the impact on students' attitudes and on the teaching of chemistry. The trial will take place over the 2018/19 academic year. Final publication of the results will be in Summer 2020. This protocol outlines the rationale for the project, describes the intervention using the TIDieR framework and outlines the methods of data collection and analysis for the impact evaluation, the IPE and the cost evaluation. A separate evaluation protocol describes the SMART Spaces revision programme efficacy trial, which takes place concurrently to this pilot.

Introduction

This evaluation protocol describes the design and methods for the evaluation of SMART Spaces: teaching programme (SMART Spaces: GCSE Chemistry Teaching), a pilot trial funded by the Education Endowment Foundation (EEF), investigating whether the use of spaced learning intervention lessons can have a broader impact upon pedagogy and learning of chemistry, beyond that of the previously trialled GCSE revision version. The intervention, SMART Spaces: GCSE Chemistry Teaching, is developed by a team from Queen's University Belfast (QUB) and Hallam Teaching School Alliance (HTSA) [the developer]. The evaluation will be carried out by a team from the UCL Institute of Education (UCL) [the evaluator].

The pilot evaluation will consist of a mixed methods implementation and process evaluation (IPE) together with an evaluation of the impact on students' attitudes, on teachers' attitudes and on the teaching of chemistry, in order to assess evidence of promise.

The pilot will take place in Year 10 classes over the 2018/19 academic year. This is a pilot of only the first year of what will ultimately be a two year programme (incorporating both Year 10 and Year 11). This pilot follows a promising evaluation of a pilot study into the revision version of the programme, also funded by the EEF (O'Hare, Stark, McGuinness, Biggart & Thurston, 2017). This is one of two concurrent studies; the other, an efficacy trial of the revision version of SMART Spaces, is described in a separate evaluation protocol (Hodgen, Anders, Bretscher & Hardman, 2018).

Intervention

The intervention being piloted in this study is a further development of the SMART Spaces revision programme, incorporating a similar underlying theory of change with regard to using spaced learning principals. The short provisional description that follows is based on the *Template for Intervention Description and Replication* (TIDieR) checklist[1], which should be read in conjunction with the provisional logic model (Figures 1a and 1b). A SMART Spaces manual will provide further guidance on the intervention for teachers and schools. One key aim of this pilot evaluation is to develop the TIDieR description and the logic model, and we expect this to description to be better specified in the final evaluation report.

1. Brief name

SMART Spaces: GCSE Chemistry Teaching

2. Why (rationale/theory)

A pilot evaluation showed evidence of promise that a revision programme for AQA GCSE chemistry for double (or combined) award science students enhances the pupil's recall of science knowledge. The revision programme, which involves a combination of short (10 minute) and long (approximately 24 hour) spaces between learning, provides a promising model of spacing (see O'Hare et al., 2017). This further pilot will investigate whether the SMART Spaces approach can be utilised throughout a GCSE chemistry course, to facilitate the improvement of not just the factual recall but also the application of skills and knowledge, and the ability of pupils to analyse and evaluate science.

[1] http://www.bmj.com/content/348/bmj.g1687

The hypothesis to be tested is that the delivery of condensed course content with appropriate spacing, throughout the course, leads to teachers being able to change the content of their teaching to further develop application and evaluation skills, as well as recall. The primary mechanism in the theory of intervention is that using the robust spacing effect will improve pupils' recall of science facts. This in turn may allow teachers to spend more time to teaching the application of knowledge and scientific processes and skills. It is expected that teachers will assess pupils' relevant knowledge and understanding following SMART Spaces sessions but prior to each teaching sequence. This is expected to lead to teacher confidence in pupils' knowledge and understanding which will in turn lead to streamlining the teaching of the aspects of the course focused upon presenting factual information. Consequently, this will free up lesson time, allowing teachers to spend more time engaging pupils in application of knowledge, enquiry skills and evaluation of science, which constitute the curriculum areas beyond knowledge and understanding.

In addition to this main theory of intervention there are other possible intervention drivers. Where SMART spaces sessions take place before formal teaching of content, it is anticipated that there is a priming which makes supports recall of content during later formal teaching. Where content has been taught prior to SMART Spaces delivery, repetition provides reinforcement. This combination of appropriate spacing, time efficiency (for additional application and analysis instruction), priming and reinforcement will allow the pupils to improve their acquisition of science knowledge, its analysis and application and subsequently perform better on the GCSE chemistry exams. The logic model also includes the possibility of pupils being more engaged with SMART lessons material over repetition (through increased self-efficacy), and this positively influencing outcomes.

3. Who (recipients)

Year 10 and 11 pupils in schools across England, studying AQA double science. The pilot will evaluate the impact upon Year 10 pupils only, as well as their chemistry teachers.

4. What (materials)

PowerPoint chemistry revision slides covering the entire GCSE double science chemistry curriculum content to be used in intervention lessons (half of the content within Year 10). SMART Spaces manual, and SMART Spaces activity pack to be used by teachers. Materials for spacing activities during intervention lessons (e.g. juggling balls). Guidelines for schools as to how to develop teaching to maximise the benefit of the additional time created by condensed learning.

5. What (procedures)

Recruitment and training

Five schools who have previously used a SMART Spaces revision approach, will form a community of practice (COP) to develop guidelines around how teaching might be adapted to maximise impact of the SMART Spaces sessions throughout the year. The community of practice will also include the developers. Teachers of chemistry and the head of science/chemistry will be trained in this new approach and the COP group will meet to develop some initial guidelines. 10 further schools will be recruited who do not have experience of SMART Spaces. Teachers of chemistry will be trained in the SMART Spaces teaching approach, including the initial guidelines. This training involves a half-day workshop, at which the approach is discussed and practiced by teachers. Head of department buy-in will also be developed through either direct attendance at the training, or through contact prior to intervention.

Following training, all involved teachers will conduct a practice SMART Spaces lesson, part of which is observed by a trainer who provides feedback on delivery to the teacher.

Implementation of SMART Space Lessons

The process of SMART Spaces, as well as its anticipated benefits will be explained to students by their teacher(s) before chemistry is taught.

During SMART Spaces lessons in Year 10^2, chemistry topics for AQA Paper 1 are taught in three short 12-minute sessions: A, B and C, with 10-minute spaces between each topic; A-B and B-C. Additional spacing is assumed to occur before and after the lesson (-A and C-) due to changes in activity. Therefore, where SMART Spaces lessons take place in the second part of a double lesson, there should be a short sensorimotor activity to separate any teaching of content from the initial spaced materials being delivered. The spacing involves a sensorimotor activity from a menu of suitable activities, including juggling. This process is repeated over three days, ideally consecutive (thus providing additional spaces of around 24 hours between content repetitions, during which pupils sleep).

The sequences of three lessons are repeated at three points during the teaching of chemistry in Year 10. Although the content of the sequence of three lessons will not change across the year, there is an expectation that teacher explanation will differ according to whether they are being introduced to content knowledge via the slides and seeing it for the first time, or whether they are revising content that has been covered in previous lessons. Some GCSE content will be covered by schools in Year 9, and some will be familiar as an extension of Key Stage 3.

Implementation of Practice Guidelines

Beyond the intial meeting to develop the intial guidelines, representatives of the five COP schools will meet a further three times within the academic year, in order to refine and develop the guidelines around how to implement change in practice, to best utilise the anticipated additional time freed up from more efficient learning/recall of content knowledge. Changes to the guidelines will be communicated directly to the additional ten pilot schools. The process for this will be established during the pilot by the developers in consultation with the COP group.

6. <u>Who (implementers)</u>

The SMART Spaces intervention lessons are delivered by GCSE science teachers who have had SMART Training.

Training is provided by trainers experienced in the delivery of SMART Spaces. Heads of Science will also be present at SMART training to ensure that departmental implementation is coordinated and supported, and that the guidelines can be developed and implemented in order to change science teaching practice.

7. How (mode of delivery)

A whole-class programme that is conducted during blocks of three normal science lessons, at three times over the course of Year 10 chemistry.

8. Where (setting)

SMART Training is conducted in an out-of-school session, or twilight session in a participating school. The SMART Spaces intervention is conducted in standard GCSE classrooms.

9. When and how much (dosage)

The SMART Spaces slides are set out in three 12-minute chunks of GCSE chemistry content (A-B-C) to be taught in one-hour lessons, repeated on three consecutive timetabled science/chemistry lessons (A-B-C x3). Each SMART Spaces lesson in Year 10 covers half of the content of AQA GCSE chemistry in a high intensity way. There must be at least one sleep between each lesson (so two lessons cannot be delivered on the same day). There is an expectation that a teacher's delivery of the 12 minute chunks becomes more efficient over the three consecutive days, as less elaboration takes place in repetitions.

The blocks of three SMART Spaces lessons will be delivered throughout the teaching of chemistry within Year 10. The timing of these will vary according to how chemistry is organised within the school curriculum. However, there should be a minimum of 6 weeks between blocks of SMART Spaces lessons, and ideally at least 12 weeks between them.

The timing and dosage of additional activities around the application of content knowledge and aspects of science enquiry will be supported by the guidelines developed over the course of the pilot by the COP group of five schools.

10.Tailoring

SMART Spaces Lessons are manualised and optimal fidelity is emphasised. Teachers can choose from a menu of spacing activities. Nonetheless, it is expected that teachers will become more efficient over the course of delivering the three intervention lessons, which will allow for some adaptation of the time spent on particular topics and the provision of more feedback to pupils. Teachers may provide the slides to pupils and may encourage pupils to adopt spacing in their self-study.

It is also expected that teachers will frame the SMART Spaces lessons differently according to where they are delivered within the chemistry curriculum and year, and what exposure pupils have already had to the content being presented.

The tailoring of the content and organisation of 'normal' science lessons beyond the SMART Spaces lessons will be supported by the developed guidelines. The guidelines may be tailored by teachers, and this is to be encouraged within the pilot in exploring their feasibility.

11.How well (planned)

Effective implementation of SMART Spaces lessons requires training teachers in all pilot schools before they deliver the intervention lessons. This training will consist of modelling, practice, and feedback on programme delivery. It is anticipated that teacher enthusiasm will influence the delivery of the intervention lessons. Effective implementation and adaptation of practice also requires support from a Head of Science to promote and develop the use of the guidelines, and facilitate curriculum development.

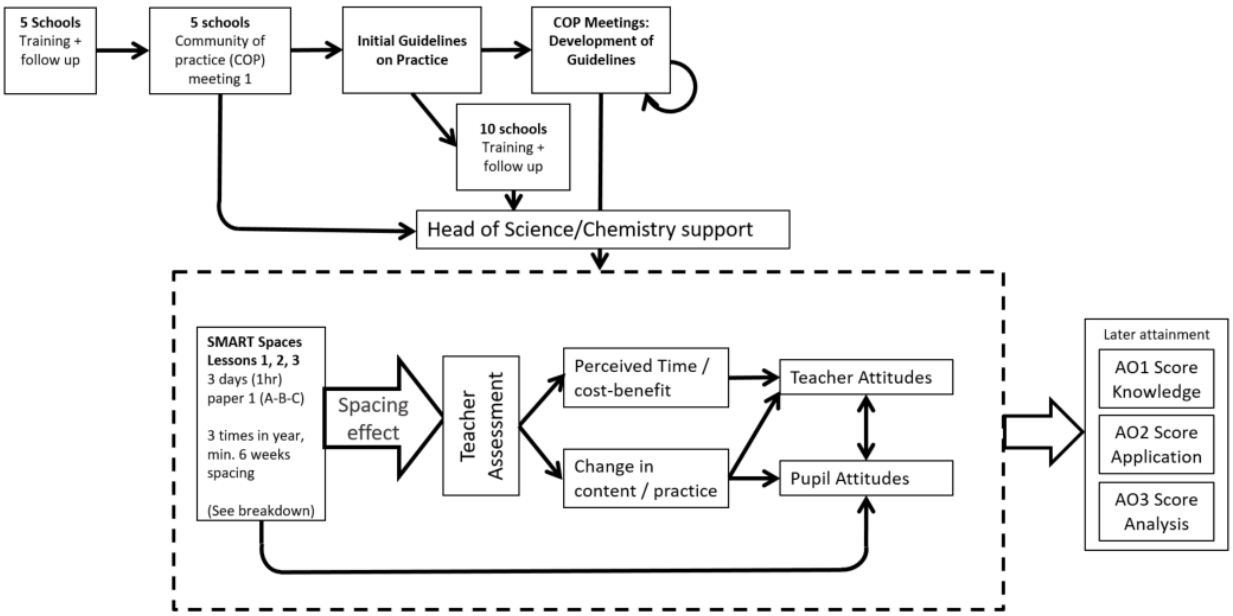

Figure 1a: Provisional SMART Spaces Chemistry Revision Logic Model (overall)

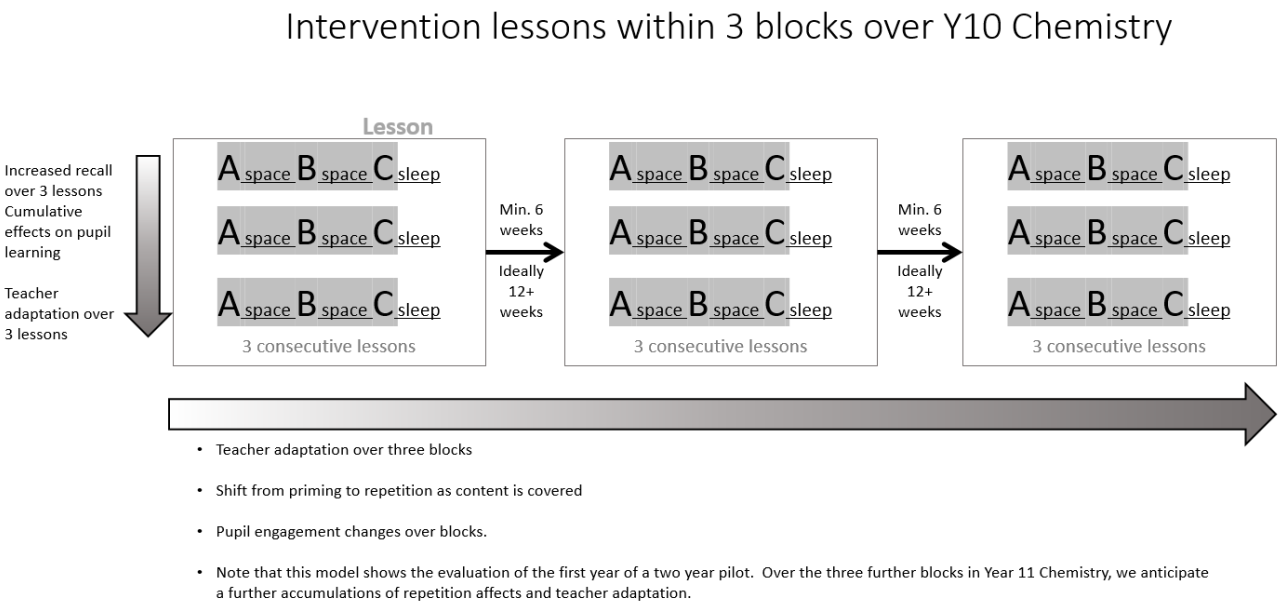

Figure 1b: Provisional SMART Spaces Chemistry Revision Logic Model (intervention lessons element)

This logic model was agreed with developers on 12th Sept 2018. This is an evaluation of a pilot and it is anticipated that the logic model will be modified during the evaluation as a result of formative feedback from the staff leading the pilot, pilot schools and teachers (particularly those involved in the community of practice element) and from the evaluator. Aspects that are likely to change and develop include the role of the head of science and the need for a practice session prior to the first intervention sessions.

Study rationale and background

Spaced learning is a promising development for science education (with important implications for other subjects, such as mathematics). In the pilot evaluation, O'Hare et al. (2017) provide an informative review of the evidence highlighting that, whilst the neuroscience and cognitive psychology literature indicate a robust spacing effect, the mechanisms underlying the spacing effect are poorly understood and there are several competing theories of how spacing affects learning (see, e.g., Smolen, Zhang and Byrne, 2016). The parallel efficacy trial of the revision version of SMART Spaces investigates the effects of spaced learning on academic attainment. However, the parallel trial is focused on revision immediately prior to the GCSE examination. There are several open questions relating to the wider use of spaced learning, primarily concerning the application and implications for learning beyond simple recall. This pilot is premised on the hypothesis that in supporting more efficient learning of content knowledge, greater time will be available for pupils to apply this knowledge, and to learn about scientific enquiry, techniques and procedures. This will require teachers being able to recognise more efficient learning of content knowledge, and also adjust their structures and pedagogy. The community of practice group schools will be developing guidance to support the transition of pedagogy, and the pilot investigation will focus upon how this supports 10 further schools in maximising any impact of more efficient learning of content knowledge. The significance of the pilot is therefore in ascertaining whether intervention spaced learning lessons, and a developed guidance manual, show evidence of promise in supporting the modification of pedagogy towards greater application of science knowledge, and greater time engaging with the processes of scientific enquiry. Whilst such evidence would itself be important for the science education community, it would further pave the way for an efficacy trial in order to establish whether changes in pedagogy translate into gains in the areas of GCSE assessment associated with application and scientific processes.

Impact Evaluation

The analysis of impact will involve measures of change in content and practice within science lessons, the perceptions of teachers of the intervention, and teacher and pupil attitudes. Since this is a pilot evaluation, this analysis is outlined within the Implementation and Process Evaluation.

Implementation and process evaluation

A suitably robust and in-depth implementation and process evaluation (IPE) is vital to investigate whether the SMART Spaces teaching intervention has promise, whether it is feasible, whether the mechanisms of intervention are adequately described by the logic model and whether this could be replicated at scale. Our IPE will take a mixed methods approach.

Research Questions

In the process evaluation, we will address the following research questions:

A. Does the SMART Spaces Teaching approach show evidence of promise in changing teaching practice?

B. Does teacher evaluation of the SMART Spaces Teaching approach indicate that it would be feasible at scale? Do pupil and teacher attitudes towards the approach also support feasibility at scale?

C. Is the SMART Spaces Teaching approach feasible to school science leaders? Are there any barriers to implementation at the school or departmental level?

D. What are the potential barriers (and affordances) to implementation at the classroom level?

E. Is the SMART Spaces Teaching approach ready for trial? How would fidelity be defined within such a trial? Can the approach be replicated at scale whilst maintaining fidelity and affordability?

F. To what extent does the logic model (see Figures 1a and 1b) adequately describe the mechanism by which the SMART Spaces intervention effected change (if any), and in what ways should it be adapted to better describe these mechanisms?

Implementation and process evaluation data collection

Data collection will involve questionnaires and surveys, case studies and interviews as set out below. In Appendix 2, we set out how these data are linked to the logic model.

The IPE covers the EEF dimensions for pilot programmes, as specified in Humphrey et al's (2016) "*Implementation and process evaluation (IPE) for interventions in education settings: An introductory handbook*":

Pilot Objective	RQs	Data
Evidence of Promise	A	Primary: change of lesson-time use analysis from teachers and pupils; observations of 'normal lessons' and interviews from case studies. Secondary: Teacher cost-benefit analysis; pupil attitude to science survey
Feasibility	B, C, D	Teacher cost-benefit analysis; pupil attitude to SMART teaching survey; teacher and pupil fidelity questionnaires; Head of Science survey; Head of Science and Teacher interviews in case studies.
Readiness for Trial	E	Teacher and pupil fidelity questionnaires; Head of Science interview in case studies; Head of Science survey; programme cost analysis.

Questionnaires and Surveys: Questionnaires and surveys will be short and use online technology.

Surveys and questionnaires will be validated through piloting them with teachers and pupils from the Community of Practice (COP) schools. This will also allow collection of supplementary data about these schools. Once piloted, we will validate this survey more fully using statistical techniques (e.g. Rasch modelling) and further piloting as necessary. We propose the use of the following surveys:

A pupil attitudes towards science survey will be deployed pre- and post- pilot, to all pupils in the 10 pilot schools (n~1500). This will assess the impact of the pilot on pupils' attitudes towards science and the nature of scientific learning.

A fidelity questionnaire will be administered to the same pupils, post-pilot only. This will enable comparison of fidelity with teacher level data.

Pupils will be surveyed on their attitudes towards the SMART Spaces teaching approach, post-pilot only.

All teachers of Y10 chemistry in the 10 pilot schools (n>50) will complete a survey post-pilot, which will assess both fidelity and the perceived costs and benefits of the SMART teaching approach ('cost-benefit analysis').

Heads of Science (or Heads of Chemistry) in pilot schools (n=10) and COP schools (n=5) will complete a questionnaire evaluating the pilot and identifying barriers to implementation.

Lesson-time use analysis

In order to evaluate change in practice, teachers of chemistry in pilot schools (n>50) will provide percentages of the preceding 5 chemistry lessons which were spent on specific categories of activities (e.g. delivering content knowledge, engaging in debate, undertaking practical enquiry). This will be piloted with the COP school teachers (n>40) in order to validate it. The lesson-time use analysis will be sought pre-pilot (likely at training), after the second block of SMART Spaces lessons, and post-pilot.

Pupils will also undertake lesson-time use analysis, although they will rate the proportion of time spent on different categories of activities using a Likert scale rather than percentages. This will be validated using a sample of COP pupils (n~ 150) and administered to all pilot school pupils (n~1500). It will be conducted pre- and post- pilot.

Case Studies

The primary indicator of evidence of promise is a change of practice, resulting from more efficient learning and recall of subject content. Therefore case studies are essential in evaluating this change in practice through observation and interview. We will conduct 5 case studies of school implementation, each primarily following 3 teachers, as well as the Head of Science/Chemistry. Schools will be selected purposefully in order to cover a range of levels of school engagement with the SMART Spaces revision programme. Data collected will include:

- Observation of SMART Spaces lessons during the first, second and third iterations throughout the year. This will allow observation of adaptation and how pupils respond to the lessons differently before and after formal teaching of the associated content. This will require analysis of rotas and schemes of work/learning to understand how these lessons fit with content teaching across the year. We anticipate observing part of one lesson for each case study teacher in a school (n=3) at 3 points in the year (so n~3x3x5=45). We will observe at least some of the lessons in full.

- Observation of 'normal' lessons at three points throughout the year will allow evaluation of how practice is changing within lessons. Specifically, how pupils recall content (whether formally taught it or not) and therefore any efficiencies in teaching and learning (n~45)

- Brief interviews with each case study teacher (n=15)

- Interviews with Head of Science (n=5)

Observations will follow a pre-determined protocol, and interviews will be semi-structured.

Implementation and process evaluation data analysis

Questionnaire and survey data: Surveys will be analysed descriptively and, where appropriate comparisons can be made, using inferential statistics. If the measures of student engagement in science are judged to be sufficiently robust, we will explore the effect of student engagement quantitatively through interaction analysis using the models from the impact evaluation.

Case Study Data: The case study data and interviews will be analysed thematically (e.g. Braun & Clarke, 2006) and informed by the survey results. *Table 4: Overview of how data addresses IPE dimensions, factors and research questions*

Non-compliance analysis

Since this is a pilot trial, compliance will not be modeled statistically. However, data on compliance will be collected and will include attendance at training and coaching sessions and the delivery of SMART Spaces lessons. These will be presented descriptively and we will also discuss how compliance could be analysed in a future efficacy trial.

Cost evaluation

We will follow the June 2016 EEF Guidance on Cost Evaluation in estimating the costs of the delivery of the intervention. We will collect cost data from the developer via a short interview and a pro-forma. We will collect data on costs incurred by schools. In addition to staff time to attend training, we will estimate the staff time required to plan, implement and support SMART Spaces using evidence collected during the process evaluation, using both survey data from teachers and data from the case studies. We will exclude any costs or staff time associated with the development of the pilot interventions as well as costs associated with research. As per the EEF guidance, we will report 'staff time' required separately to other costs.

Ethics and registration

The trial has had approval from the relevant ethics committees of both UCL and QUB:
UCL IOE Research Ethics Committee Reference: REC 1107.
QUB Research Ethics approved 19th June 2018 by SSESW, QUB Research Ethics Committee.

Since this is a pilot evaluation, the study aims to describe the intervention and to explore the promise, feasibility and scalability of the intervention, the evaluation will not be registered as a trial.

We intend to process personal data for public interest purposes. (See data protection below.) Nevertheless, we will provide an opportunity for parents/ carers and pupils to withdraw their own, or their child's data, from any data processing as part of the research to ensure that they have no objection to their data being processed in this way. Teachers/school leaders will also have the right to withdraw their data. This will demonstrate that the processing does not

impinge on anyone's rights and meet our responsibilities under the BERA Ethical Guidelines for Educational Research (particularly regarding informed consent, openness and disclosure).

Parents, and participating pupils, will be informed of the research through information sheets distributed by schools, along with withdrawal forms to support the process described above. The information sheets and withdrawal forms for this purpose explain the intervention and the research being conducted in simple language, provide opportunities for parents to ask additional questions, and provide clear steps to follow if they wish their child to be withdrawn from any data processing as part of the research. The sheet and form also make it clear that data can be withdrawn at this point or at any point during the research, in line with requirements to ensure participation is free from coercion.

Where the research involves more active participation of teachers and pupils, including lesson observation and interviews, we propose to collect unambiguous consent from participating teachers, the parents and carers of participating pupils and the pupils themselves. Information sheets and consent forms for this purpose are included with this application.

If information that raises safeguarding concerns is raised by a teacher or pupil during their discussions with us we will liaise with the relevant school's safeguarding officer regarding the appropriate course of action. Our information sheets make clear that disclosures of this type cannot remain confidential and will be reported. The researchers carrying out these interviews understand the need to manage disclosure carefully and sensitively. If in doubt, they will request advice from a senior colleague.

Outcomes of the project will be publicly reported through an EEF evaluation report and subsequent academic publications. No outcomes will include reporting that could allow for the identification of particular schools or pupils that participated in the research. Evidence of promise will be reported as aggregated statistics while the implementation and process evaluation reporting will ensure that any references to individual schools, teachers and pupils are anonymised or removed, where residual risk of identification remains.

Data protection

Data will be processed in line with data protection legislation (including the General Data Protection Regulation, GDPR), and in line with the interests of the participants. The project is registered with the UCL Data Protection Officer (registration number: Z6364106/2018/07/61 social research). Each organisation has carried out an assessment of their legal basis for processing data. Data will be processed by UCL and QUB on the basis of the public task purpose (as per condition 6(1)e of the GDPR), and by HTSA on the basis of the legitimate interest purpose (as per condition 6(1)f of the GDPR). UCL has reviewed current ICO guidance available here: https://ico.org.uk/for-organisations/guide-to-the-general-data-protection-regulation-gdpr/lawful-basis-for-processing/public-task/, and has determined that this research forms part of its performance of a task in the public interest, as one of its core purposes provided for in its Charter and Statutes. (See Appendix 2 for a statement of the lawful basis and public tasks assessment for data processing).

We do not believe that any of the data we process falls within the definition of special category data under the GDPR. This would require an additional justification under Article 9(2) of the GDPR.

Pupils and their parents or carers, and teachers, will be informed of the proposed data processing and given an opportunity to object to this, and withdraw their, or their child's, data. The information which will be provided to parents/carers, pupils and teachers explains in clear

and plain non-technical language language the purpose to which we will put the data, that they can object to this data and this will be respected, contact details of the organisation, and categories of data that we will be processing and that the data processing will be compliant with the GDPR and data protection legislation. Further details on the lawful basis for data processing are available on request.

The evaluation team at UCL have carried out a data protection impact assessment and will put in place a data management plan. As part of this data management plan, data will be checked and cleaned to ensure the GDPR principle (d) of accuracy is met.

Data security

All personal data collected or obtained as part of this project will be treated as "Highly Restricted" under UCL Data Protection classification guidance. Personal data (pupil names, UPNs, dates of birth, FSM eligibility, sex, national test results, class and teacher, as well as teacher names and survey data) will be stored, processed and analysed on the UCL Data Safe Haven (DSH), the technical infrastructure that UCL has built specifically to host sensitive research data.

Qualitative data will be pseudonymised. Once pseudonymised it will be stored in a secure folder on the UCL network within a project folder only accessible to project team members (using appropriate access control methods), and the pseudonymisation key stored on the DSH. Fieldnotes and audio recording will be stored in a locked filing cabinet within a locked office at UCL to which only the SMART Spaces research team will have access.

Some data transfer will be required between collaborators on this project at UCL and QUB. This will be conducted by making a secure remote connection (e.g. VPN) to between the university networks and transferring data across this. In addition, the data will be encrypted before sharing using a password shared between research team members by separate communication.

Schools will be required to submit personal data to UCL. This will be conducted via the Data Safe Haven's direct data transfer portal. Schools will be provided with clear guidance on securely submitting and protecting this data.

Online surveys for teachers will be administered through UCL's REDCap survey system whereby data is uploaded directly to the DSH in an encrypted form.

A risk assessment has been conducted for the storage, processing and transfer of all personal data for the SMART Spaces project. All team members undertake regular annual data security training.

The DSH environment is certified to ISO27001:2013 with BSI – certificate number: IS 612909. The most recent external audit was in May 2017. The hosting is on a thin client system (DSH) with dual factor authentication. This is a multi-user system with permission-based access control. The DSH is subject to penetration testing on an on-going basis. The DSH has its own firewall separating it from the UCL corporate network and the UCL network has a corporate firewall with a default deny policy for inbound connections. The DSH remote access mechanism is protected by a SSL certificate issued by Terena as well as DualShield dual factor authentication, which couples an Active Directory password with token-based authentication. Connections are AES256 encrypted. Data is transferred into the DSH system

via a secure gateway technology which uses SSL/TLS with data retained via policy and systems that prevent data leakage.

Data will be kept for at least the duration of the project, until successful submission of the data to the EEF's data archive has been agreed by the funder. We may keep anonymised data beyond this period for the purpose of supporting submissions and revisions to submissions to academic journals. They will be kept for no longer than 10 years in line with UCL's guidance on retention of records for research.

UCL and QUB will sign a data sharing agreement outlining data security and protection issues.

Personnel

QUB and HTSA Development and Delivery Team:

Dr Liam O'Hare (QUB): SMART Spaces Co-designer and overall project direction
Alastair Gittner (HTSA): SMART Spaces Co-designer and training lead
Dr Patrick Stark (QUB): SMART Spaces Project Manager
Dr John Coats (HTSA): Director of Hallam Teaching School Alliance and HTSA lead
Dr Maria Cockerill (QUB): Recruitment Manager and school contact lead
Professor Alan Thurston (QUB): Expert Advisor
Professor Carol McGuinness (QUB): Expert Advisor
Ewan MacRae (QUB): PhD Student, Teacher CPD
Research Fellow (QUB - TBA): Fieldwork, analysis & contact with schools

UCL Institute of Education Evaluation Team:

Professor Jeremy Hodgen: PI, overall direction and impact evaluation lead.
Dr Jake Anders: Advice on the impact evaluation and statistical techniques.
Dr Nicola Bretscher: will undertake the statistical analysis under guidance from Hodgen and Anders, and will contribute to all other aspects of the evaluation.
Dr Mark Hardman will lead the IPE and will contribute to all other aspects of the evaluation.
Research Officer (TBA): IPE fieldwork and analysis & contact with schools.
Administrator (TBA): day-to-day support to the project, including supporting data collection.

Risks

Table 2 outlines an assessment of the potential risks associated with this evaluation and the action proposed to address them.

Table 2: Risk assessment for the evaluation

Risk	Likelihood	Impact	Action
Failure to recruit	Low	High	• Establish timeline for recruitment involving a variety of methods • Regular developer and evaluator team contact
Pilot school drops out	Low / Moderate	Moderate	• Sufficient data would be collected for pilot if one or two schools dropped out
COP school drops out	Low	Moderate / High	• Ensure school is fully informed on required commitment at start and that this is specified in the MoU. • Regular developer team contact
Poor response rate to pupil and teacher surveys	Low / Moderate	Moderate	• Monitor through regular contact with schools. • Ensure data submission process is clear.
Loss of staff	Low / Moderate	Low	• UCL IOE has a large staff team and would reallocate staff

Timeline

Table 3 outlines the main activities of associated with the delivery and evaluation of the SMART Spaces intervention. A more detailed timeline is provided in Figure 3.

Table 3: Timeline of the main activities

Dates	Activity	Responsible/ leading
Mar-Sept 2018	Recruitment of 5 COP schools and 10 pilot schools	QUB & HTSA
Sept 2018	First meeting of COP schools inc. drafting guidelines	QUB & HTSA
Sept 2018	Validation of surveys with COP schools	UCL
Oct 2018	Training for pilot schools inc. baseline (observation)	QUB & HTSA (UCL)
Oct 2018	Baseline teacher and pupils time-use surveys	UCL
	Initial case study visits to observe teaching	UCL
Autumn-spring 2019	COP meetings to further develop guidelines	QUB & HTSA
Spring 2019	Mid-point surveys (timing dependent on teaching calendar in schools)	UCL
	Mid-point case study visits to observe teaching	UCL
July 2019	Final surveys	UCL
July 2019	Final case study visits: interviews	UCL
Autumn 2019	Analysis	UCL
Dec 2019 – Jan 2020	Write report	UCL
31 Jan 2020	Submit draft report	UCL
Spring 2020	Respond to EEF comments	UCL
July 2020	Report published	UCL / EEF

References

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Humphrey, N., Ledrum, A., Ashworth, E., Frearson, K., Buck, R., & Kerr, K. (2016). *Implementation and process evaluation (IPE) for interventions in education settings: An introductory handbook*. London: Education Endowment Foundation.

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Appendix 1: Logic model and data collection

Figures 3a and 3b indicate how data collected link to key elements within the logic model.

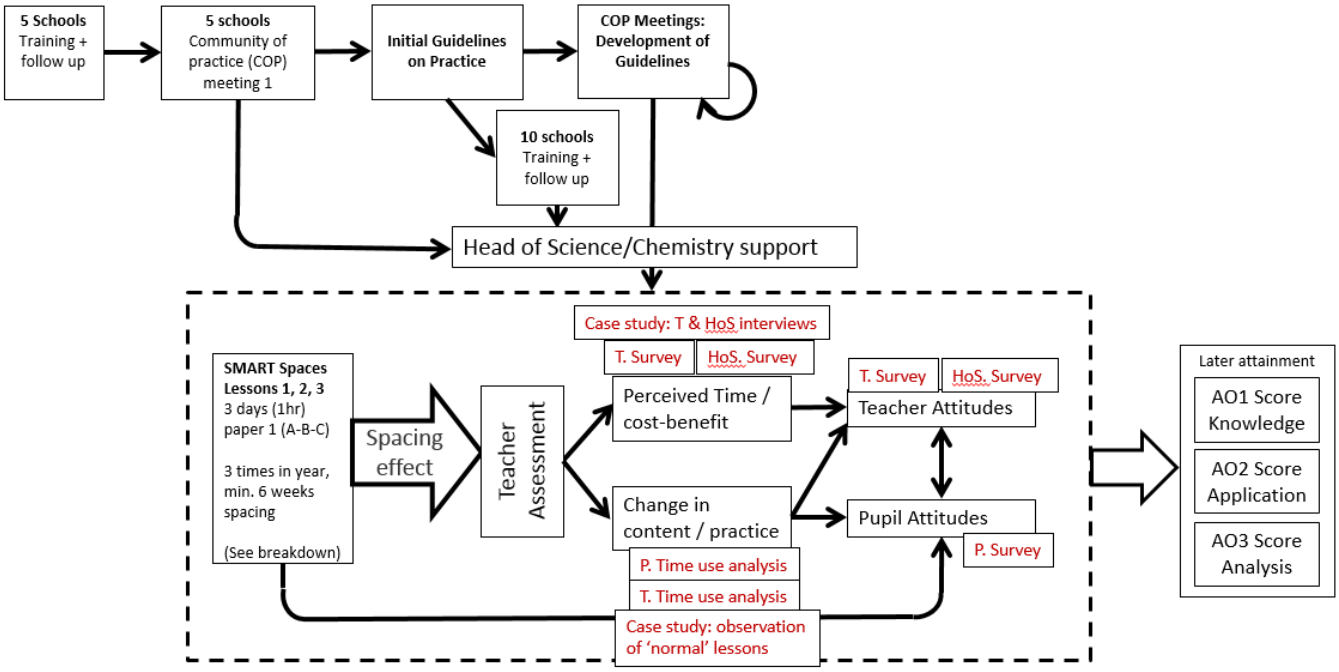

Figure 3a: Provisional SMART Spaces Chemistry Teaching Logic Model (overall), with IPE measures

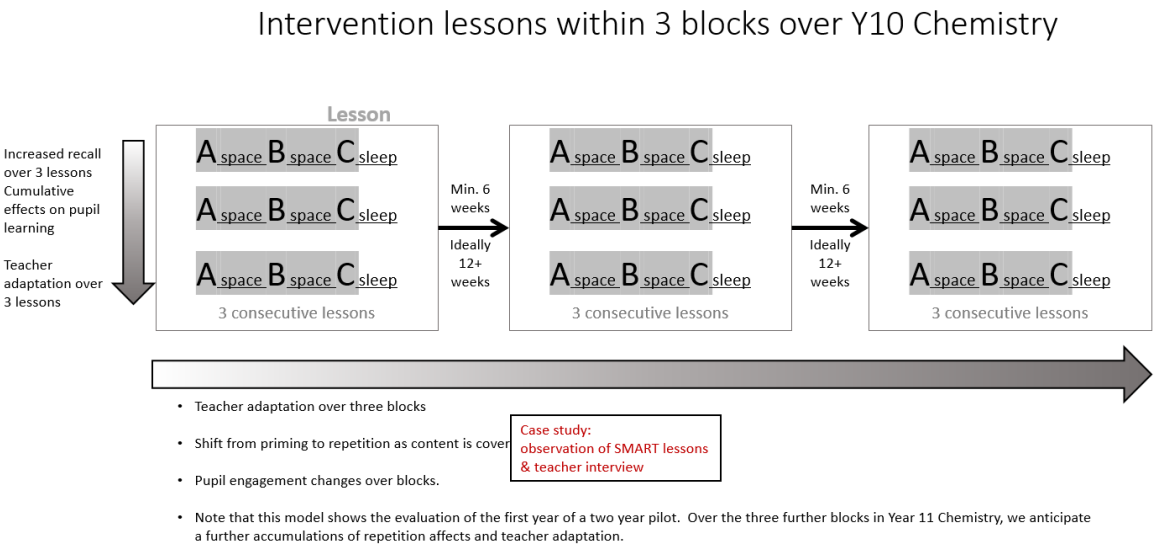

Figure 3b: Provisional SMART Spaces Chemistry Teaching Logic Model (intervention lessons element), with IPE measures

Appendix 2: Statement of legal basis for processing data

As part of this project, we process pupils' personal data. For this reason, it is important that we process this data lawfully, following the principles laid out in the Data Protection Act 1998 (DPA) until May 2018 and the General Data Protection Regulation (GDPR) thereafter. We explain the lawful basis below with respect to the GDPR but there are equivalent regulations in the DPA for the justifications set out below.

We use Article 6(1)e of the GDPR as the lawful basis for processing personal data as part of this project. This is generally known as the "public task" basis. UCL has reviewed current ICO guidance available here: https://ico.org.uk/for-organisations/guide-to-the-general-data-protection-regulation-gdpr/lawful-basis-for-processing/public-task/, and has determined that this research forms part of its performance of a task in the public interest, as one of its core purposes provided for in its Charter and Statutes. We do not believe that any of the data we process falls within the definition of special category data under the GDPR. This would require an additional justification under Article 9(2) of the GDPR.

In order to use the public task basis we set out below how this is a task in the public interest and demonstrate that the processing is necessary to achieve the purpose of the processing.

Public benefit: Use of pupil's personal data as part of this evaluation is to understand the benefits to pupils, teachers and schools of participating in the SMART Spaces programmes in chemistry education in terms of academic attainment, improved pedagogy and other related benefits. This has public benefits that we believe are significant in terms of understanding whether this programme has the potential to benefit children in schools across England. If we could not do this then it would not be possible to provide this new evidence. Our proposed research has been reviewed by the UCL Institute of Education research ethics committee [REC1052] and the UCL Data Protection team [Z6364106/2018/03/25 social research], meaning we believe our use of the data to be ethical and lawful.

Necessity: This processing does help to further the interest of providing evidence on what works in promoting academic attainment among pupils in English schools by providing high-quality evidence based on a sufficiently robust design. For the evaluation of the SMART Spaces Revision version, we do this using a randomised controlled trial (RCT) together with a mixed-methods implementation and process evaluation (IPE) to gather evidence about *inter alia* the necessary conditions for success. This is a recognised high-quality research design applied internationally to provide evidence of this type, meaning we consider this is a reasonable approach. For the evaluation of the SMART Spaces Teaching version, we propose a pilot study that will collect evidence of the promise, feasibility and scalability of the intervention, which we consider to be a reasonable approach. It would not be practical in either case to provide this quality of evidence without processing pupils' and teachers' data.

NPD Access: When applying for NPD data the relevant lawful reason for requesting that data will be that our task is specified in the Education (Individual Pupil Information) (Prescribed Persons) (England) Regulations 2009: Regulation 3 (1)(b) and (6)(d), including as amended by the Education (Individual Pupil Information) (Prescribed Persons) (England) (Amendment) Regulations 2013.