Action Research: Applying the principles to frame a professional development project

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There are many approaches to educational research that can support professional development for teachers. Currently, there is much discussion about 'evidence-informed practice', 'close-to-practice research', 'teacher enquiry' and 'practitioner research'. Action Research (AR) is a particular approach that could be included within each of these types of activity. It may feel that the practice of teaching itself, of energetically collecting, scrutinising and analysing evidence from pupils might be deemed AR. This is, however, a somewhat limited view of AR. It usually involves generating an intervention or novel approach to improve something. An educational AR project designed to support professional development can involve an individual teacher, a department of colleagues, a whole school or even a group of schools.

What is Action Research?

AR is more commonly understood as a particular form of practitioner research that is usually centred around a teacher wishing to develop or transform their practice (Brydon-Miller *et al,* 2017) in some way. It is a research project designed to investigate the impact of some kind of intervention or change in pedagogy. It is assumed that the changed teaching will impact on learning in some way. In science classrooms, this could involve changing a scheme of work for a particular topic; trying out a new questioning strategy; or adopting a fresh formative assessment approach and judging (through varied kinds of evidence) how the changed teaching tactics influence students' learning. AR projects could also explore whether or not boys and girls respond in similar ways to different aspects of learning science or whether disadvantaged children benefit more from one intervention than another. Evaluative measures of impact, though, require careful planning. A little like the commonly adopted view of a fair test, all variables apart from that which comprises the intervention need to be controlled. This is often a pitfall with AR. Deciding what matters and how to change something identifiable to make a difference is not always straightforward. There are often dilemmas in deciding what that 'something' is, such as, for example, 'motivation' or 'ability', and how to measure it in a quantifiable way to assess impact.

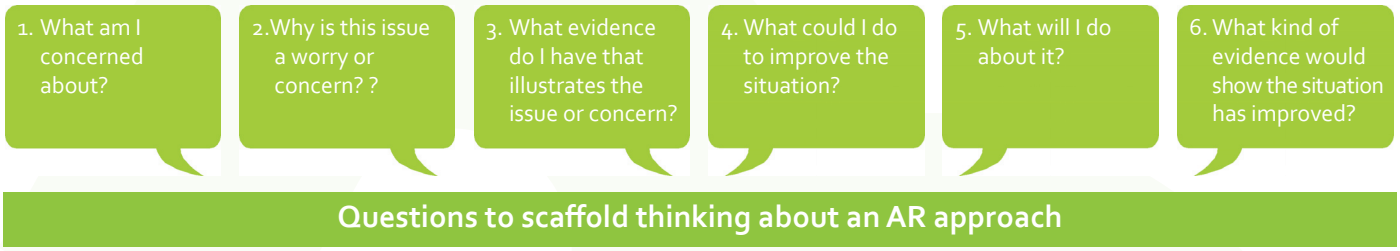
As a research approach, AR requires a systematic methodology. The altered practice needs to be clarified so that assessment of the effects measure only the impact of that and not also the use of different teaching media, materials or presentational approach, for example, if looking at a new science scheme. AR therefore requires criticality to ensure that the research is focused, and evaluates the outcomes that are directly related to the new approach. Exploring *how,* for example, the use of two stars and a wish, or comments, rather than simply numerical marks, through formative assessment might improve students' practical or written work would require careful focus to elicit whether practical skills and/or knowledge and understanding are being developed through the new approach. Findings from the research could then confirm that 'y' change in a teacher's practice had resulted in 'x' outcomes.

When setting up an AR project, McNiff and Whitehead (2005) suggest that there is a series of questions to consider. Thinking about these questions can be the first step in preparing for AR.

Scaffolding an AR project

As an individual teacher, or with a group of colleagues or even a group of schools, it is possible to frame or 'set up' an AR project by thinking about

Figure 1. A sequence of questions useful to consider when planning an AR project.



a series of questions (see Figure 1) that include considering what is of concern and why that particular issue is troubling. Thinking about the evidence (from different sources) that indicates that something isn't working well is also useful, as it might suggest what kind of data are needed to show that something is improving.

Planning what could be done differently to enhance attainment or provide equality for disadvantaged students, for example, can inform the nature of the intervention and highlight what changes to the current situation are possible. Deciding what course of action, such as providing a quick questioning guide to all staff, promoting storytelling across the curriculum, or adopting a new behaviour policy, comprises the intervention that is done differently. Deciding, too, what kind of evidence would show that the situation has improved is also important.

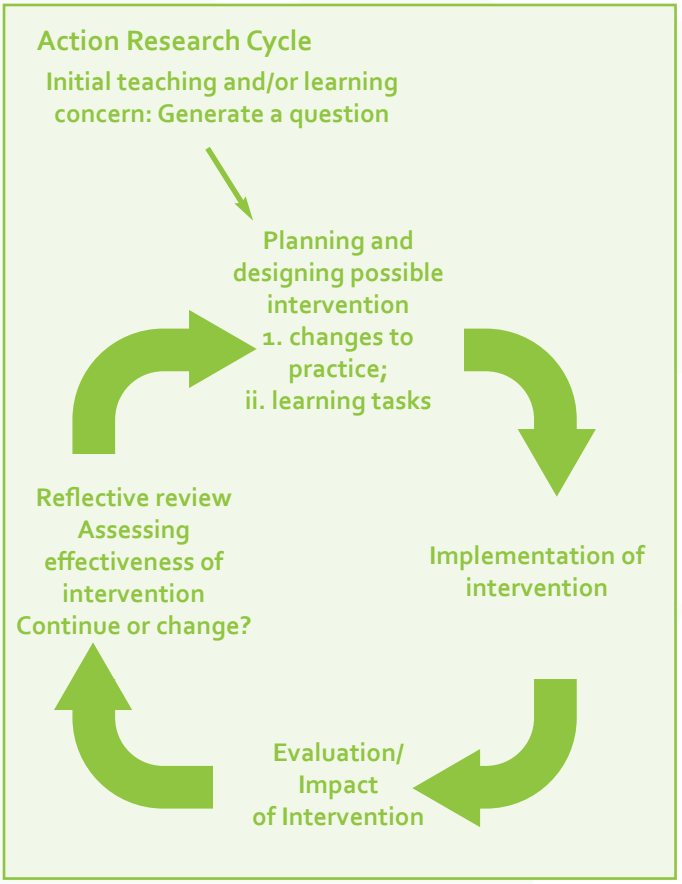
The types of questions that focus discussions and preparatory thinking about what is important to consider in planning a new 'intervention' or trying out a different innovation in the classroom are summarised in Figure 1 .

AR is a common (sense) approach for practitioners (Taber, 2013) to develop their teaching and research the impact of different pedagogic approaches to address a particular issue. The questions provided above (in Figure 1) could help teachers to plan and design an AR approach that subsequently transforms their practice (Brydon *et al*, 2017). AR, therefore, can enable teachers (McGregor & Cartwright, 2011, p.240) to:

- systematically examine an aspect of their teaching;
- collect information and evidence about a particular situation;
- enact a changed (or potentially improved) aspect of practice;
- evaluate and analyse the (new) information (or data generated) in order to review whether the situation has improved or not; and
- use the fresh evidence to substantiate the changed practice.

The steps outlined above inform the diagram (Figure 2), which maps out the cyclical nature of AR. This kind of research is not characterised by particular forms of data or, indeed, specific data collection techniques, but by collating evidence of impact after changing some aspect of practice. As McNiff and Whitehead (2005:1) corroborate, it is '*...a common-sense approach to personal and professional development that enables practitioners everywhere to investigate and evaluate their work, and to create their own theories of practice'.*

Figure 2. Mapping out the cyclical nature of AR (adapted from McGregor & Cartwright, 2011, p.244).



Evidencing impact to improve performance

The recent BERA (2018a) statement, which centred on close-to-practice educational research, presents strong arguments for teachers engaging in research to develop their practice. This builds on the Carter Review, published in January 2015, which identified how research could be employed to develop evidence-based teaching that contributes to high quality teacher education (BERA, 2014). Carter emphasised how *'high-performing systems induct their teachers in the use, assessment and application of research findings'* (DfE, 2015: 8). The review also highlighted how teachers could and should research their own practice and that 'teacher as researcher' is important for curriculum development, pupil assessment and school improvement.

Practitioners introduced to new sets of science materials that claim to improve pupils' test performance might wish to validate the impact on their classes. Similarly, teachers might wish to examine how much an innovative approach to encouraging peer assessment or a different way to teach about particles can improve science learning. Researching how the application of these new ideas might improve pupils' academic attainment would need careful thought and preparation to ensure that the data collected provided the correct 'evidence' of impact.

Usually, classroom-based research like this will inevitably be small-scale. However, it is possible to engage groups of schools in different forms of AR (McGregor, 2014; McGregor *et al,* 2020) to offer more generalisable findings that might apply to other teachers' practice in similar contexts or situations. Individual teachers' findings will not be directly generalisable for others, but they can offer credible information to help practitioners transform their practice (with particular classes or groups) and for other teachers to consider how it might impact on their pupils.

The ethics of any study should be considered if the intention is to share outcomes with colleagues (within or beyond the school). Gaining permission to conduct data collection with younger pupils will be required through the Headteacher, pupils' parents and the pupils themselves. Anyone participating in the research process should not cause discomfort or disadvantage to particular groups in any way. It is the responsibility of the teacher-researcher to carry out the study in an ethical manner (BERA, 2018b). Widely disseminating significantly improved test results, for example, may dismay the children (and parents) who are not in the (successful) experimental group! Thinking about the type of data needed to evidence impact will be closely linked to the research intentions. Clarity about what data will evidence the positive impact of an innovation is needed before embarking on the AR.

Collecting data to inform impact evidence

Data, collected through various means or methods, which can be used to inform the evidence of impact, are usually thought of as either quantitative or qualitative. Very simply, quantitative data are numeric (such as the proportion of students achieving a grade A, B or C, for example) and qualitative data are not. Qualitative data tend to take a wider variety of forms: textual, auditory (and subsequently transcribed), or visual (including photographs, video or even examples of students' written work or images of work-in-progress). For example, if assessing the impact of a new science programme, collecting results from pupils' test performances would elicit more quantitative data. The numerical averages and ranges of the test scores could 'evidence' the improvement (or not) of the new science programme. Alternatively, eliciting students' views about peer assessment would provide more qualitative data, in the form of responses to questions such as 'How did it help to have a peer assess your practical work?'.

The *ASE Guide to Research in Science Education* (Johnston & Toplis, 2012) is a helpful guide to initially support you in thinking about what data to collect, together with Thomas (2017). Also, Hopkins' (2002) *A Teacher's Guide to Classroom Research* offers pictorial illustrations of different research tools, including a range of in-depth observational instruments that can be adapted by teacher-researchers to directly collect data in class.

There are many different ways in which research data can be collected for an AR, including questionnaires, interviews, observations, pupil work and pupil voice (narratives). Some of the more common ways of eliciting data are outlined below and those most often used are summarised in Table 1 (see p.9).

Questionnaires

When considering questionnaires, teachers usually think of a series of questions with several options possible to be chosen as the response. This is referred to as a Likert (1932) scale, multiple-choice rating or rank ordering. These may be best used with older pupils, but it is also possible to elicit views from younger pupils, where more creative approaches to present the options may be needed. Pictures or illustrations can be presented and the questions can be read out for the children to respond to by selecting the picture that best represents their views (Figure 3). These pictures are often used to try to discover emotional feeling and this is referred to as sociometry (see Hopkins, 2008).

With very young children, there may be pictures around the classroom and they could be asked to stand next to the picture showing how they are feeling at the time of the lesson. With older children, it is possible for questionnaires to be completed online, which would give more autonomy in responding. Google Forms and Survey Monkey (https://www.surveymonkey.com/) can provide teachers with tools to develop online questionnaires.

Interviews

Interviewing individual children is often tricky, as they often want to share what they want to say rather than respond to the questions being asked. Thinking about the location and timing of the interviews, as well as who asks the questions, is as important as the questions themselves. Also, thinking about the sequence and ways of simply posing questions is important. Providing stimulus material or recollecting events with which you know they are familiar can sometimes help with both one-to-one and group interviews. Interviews carried out immediately after experiences that are the focus of conversations are more likely to elicit rich data.

Thinking about how to capture the data from the interviews, usually by audio-recording, is helpful in enabling repeated listening and analysis (with ethical approval, of course). Transcribing the audio data provides a version of the data that is much easier to analyse.

Observations

Observations can be made directly in real time, or from videoed lessons or activities (again with ethical approval). Preparatory thought about what data to collect through observations can be open (unstructured), focused, structured or systematic. Hopkins (2002; 2008) offers many different frameworks to consider for this. Collecting video data requires thinking about the location and angle of the camera if the recording of a whole lesson or small group is required. Consideration also needs to be given to the quality of dialogue, as one camera may not be sensitive enough to capture the detail needed.

Pupil work and pupil voice

Scrutiny of pupils' written work can provide indications of pupil progress at the moment of collection and be compared with earlier work (from other classes or cohorts). This might be class work, homework, pupil presentations, displays, project work, tests and exam marks. Pupils could record an activity and provide a narrative of what they are doing and why. They could also photograph things that they are thinking about, or they could be asked to capture specific aspects of what they perceive to be the most important part of a practical and then analyse what they perceive/understand about these photographs (an application of photovoice). Pupils' views could be elicited through adult-pupil conversations or even discussions between peers (pupil voice, see Flutter, 2007). Pupils could draw diagrams (see Chambers, 1983, or http://www.pstt.org.uk/ext/cpd/a-scientist-in-your-classroom/hosting-scientist-pupils-perceptions-of-scientists.htm), which can be used directly as evidence or as a stimulus to further question the pupils. Asking pupils to do some 'free writing', for instance, can provide another source of data, for example, about what makes a good scientist (see Beishuizen *et al,* 2001).

How did doing x in science make you feel?				

Figure 3. Excerpt from a questionnaire with pictorial representations of the children's views.

Journals/reflective logs

This is an increasingly popular way of teacher-researchers recording their plans, thoughts and reflections to inform their research. Reflection-in-practice, or after practice, can be related to the work of Schön (1983). Reflections could take the form of written notes, jottings on lesson plans or recorded voice memos on smart phones. These types of tools can be used to capture observations and thoughts as they emerge through the AR project. These you can then use to reflect back upon and pull together threads that link closely with your research questions. As the AR project develops, ideas and reflective thoughts will emerge. Ensuring that these are noted somehow and inform the collation of evidence is important.

Research approach	Nature of data commentary
Questionnaires: This is probably the most common method used to collect data in research. It is generally perceived to be an easy and quick way to gather copious amounts of data. Planned well, however, this tool can be adapted to garner a range of different kinds of data, including quantitative data (through large-scale surveys and evaluations); semi-quantitative data through choices of responses to 'agree' or 'disagree', such as Likert (1932); test or attainment data reflecting conceptual understandings (like multiple choice options) or more qualitative informative insights (through gathering personal views, beliefs or opinions about something) by posing more open questions.	Quantitative data can be gathered (e.g. the number of 'categories', options to choose from in a LIKERT scale or multiple choice to discern knowledge/understanding about science concepts or themes of responses), as well as textual responses to open questions (recognised as qualitative data).
Interviews: This is also a common method used to gather data. Usually, though, it is adopted to probe for more 'in-depth' information than from a survey or evaluative questionnaire. These can be carried out one-to-one or be organised to harvest several people's views about something (often referred to as a 'focus group'). This method often takes much longer to gather the data (and then process it).	Discussion that can be audio-recorded and transcribed. The transcription can offer 'text' that can be scrutinised for 'literacy', use of particular words, general themes or threads of argument, etc.
Observations: These can be made in a variety of ways, depending upon the focus of the AR. Many frameworks are offered in Hopkins (2002) that can be adapted to collect data exploring responses of pupils to questions, gender differences in behaviours, etc. Videoing lessons is increasing in many schools (through study lesson approaches, for example) and the use of IRIS Connect http://www.irisconnect.co.uk/. However, in order to make sense of, and focus on, the data to respond to a research concern, careful preparation is needed. Scrutinising discussion or dialogue between pupils is not easy without the correct kind of microphone, for example, to capture clear recordings. The audio recordings also then need to be transcribed prior to analysis. Images and photographs can also provide research evidence: for example, the way that students have written about or illustrated their thinking in some way.	This can range from collecting recordings of actions (presentations or performances), talking (during practical activity or working as a small group), and actions (whilst tackling particular tasks) from either the learners' or the teacher's (or even teaching assistant) perspective. It can enable a focus on specific groups of students or even particular individuals.
Interrogating existing data (ex post facto): A wealth of secondary data (that is not collected by teachers) can be used in AR. Examples include: in school information (e.g. behaviour logs, attendance data, statistical performance data from departments, pupil premium data, socio-economic data, SATS test results, phonics/reading/writing data). Research data:https://www.nfer.ac.uk/ https://educationendowmentfoundation.org.uk/ Governmental data http://www.education.gov.uk/schools/performance/ Ofsted Inspection data and Ofsted Research data https://www.gov.uk/guidance/school-inspection-data-summary-report-idsr-guide and https://www.gov.uk/government/publications/exploring-ofsted-inspection-data-with-data-view	This type of data already 'exists' and has been collected for a different reasons (Ofsted inspections, school league (performance) tables, etc.) other than teacher-researcher projects. The data can be interrogated for AR projects, but consideration should be given to the 'tools' and reasons that the data may have been collected initially. The focus (and therefore emphasis) may be quite different to the teacher-researcher's intention.

Table 1. Collecting data for your AR project: Some common sources to consider.

Once the data are collected, analysis is the next phase. Hopkins (2008), Cohen, Manion and Morrison (2018), Johnston and Toplis (2012) and Thomas (2017) are all useful sources of guidance for this phase, but the bespoke nature of ARs means that it is difficult to suggest generally how to complete this phase. In Table 1, there is a summary of more common research approaches or methods that could be considered for use in AR projects. There is also commentary about the nature of data that can be collected through these means.

Extending the initial AR cycle

Once an AR cycle has been completed, teachers may decide to modify further a particular aspect of their teaching, assessment or classroom environment (Figure 4). In the case of a new science teaching scheme, further AR might delve deeper into why test performance was improved, or not. If particular questions in the tests were all answered well or badly, it could be helpful to find out more about how the pupils understood those specific questions, through pupil discussion, thus developing the AR into a second iteration. This second phase would then involve collecting qualitative data. A peer assessment AR project could also be extended further by considering the impact of different kinds of grouping, all-boy or all-girl groupings, or mixing friendship and non-friendship groups, for example.

However, a teacher, department, a whole school or even a group of schools may decide that several iterations of AR are needed before they reach the level of improvement that they need. So, it is possible to focus on a particular area of development and refine it several times through consecutive AR cycles before achieving the final goal.

Examples of AR in science classrooms

AR in the science classroom carried out by an individual teacher who is also 'the researcher' can work, either on their own or working collaboratively as part of a wider team. Many Initial Teacher Education (ITE) programmes now include Masters' level credits and these trainees are asked to research the development of their own practice. AR provides a useful methodology for beginning and qualified teachers to develop research skills and to reflect to develop and/or transform their own practice. Carefully planned AR can provide a clear theoretical guidance for systematic research of phenomena in the classroom. This type of research therefore can enable curriculum innovations, greater understanding and a confidence to develop and test new teaching ideas. These kinds of studies can be small-scale, but are useful for individuals, whole-school and even clusters of schools interested in improving a particular aspect of their pupils' academic performance.

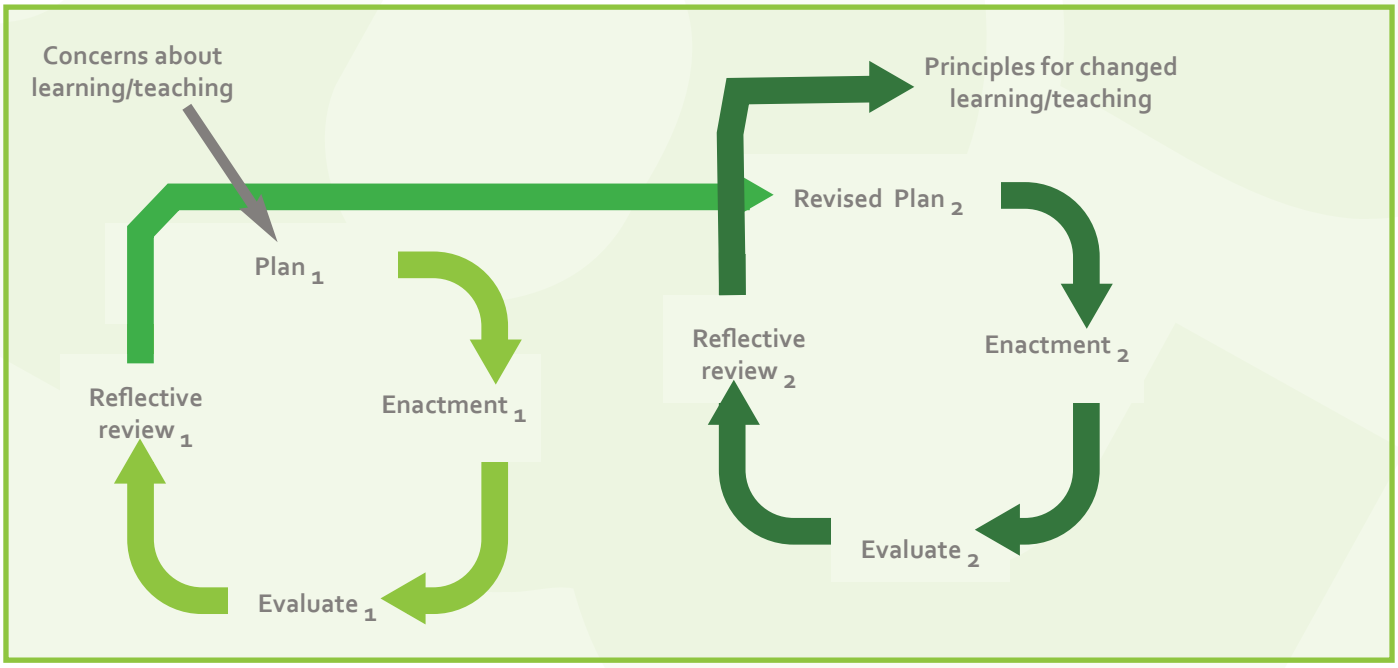


Figure 4. Two cycles of AR (1 = 1st cycle of AR; 2 = 2nd cycle of AR).

The range of areas that teacher-researchers have researched through AR include the following:

- Hewson *et al* (1999) applied AR to support prospective teachers in becoming more reflective about what it means to teach for conceptual change.
- McGregor, Frodsham and Deller (2021) have shown how, through AR, conceptual understanding of evolution is possible with 9 and 10 year-olds through the adaption of drama pedagogies.
- Mallinson (2011) examined the impact of a Researcher in Residence Programme in her school.
- Hutson (2012), concerned with ways of helping science pupils with low levels of literacy, evaluated the impact of different teaching strategies.
- Dollive (2012) critically assessed how to develop more active learning through the use of practical work.

These small-scale studies carried out by practising teachers adopted AR to structure how to improve teaching and learning in their classrooms. As BERA (2018a, p.3) suggests, these types of small-scale investigations do not necessarily produce *'insights about practice in general'*; rather, they generate outcomes that are *'useful and acceptable to the practitioners themselves'*. However, Halai's (2012) meta-study of 20 AR science dissertations identified common issues that these teachers faced when combining their roles of researcher with teaching. Similarly, a three-year teacher enhancement project funded by the National Science Foundation summarised a range of outcomes from AR projects to provide guidance for teachers to develop their own action research (Spiegel, 1995).

Teachers have also worked in collaboration with other researchers to develop curriculum innovations or enhance learning, for example:

- McGregor, Frodsham and Deller (2021) illustrated how adopting scientific stories from history can innovate enquiry pedagogy and also promote learner creativity.
- The ARIELS (Action Research Inspiring and Enhancing Learning in Science) project (2011) involved an AR partnership between the University of Exeter and the Exmouth Area Learning Community (one secondary school and 14 primary schools) to improve teaching and learning in science, focusing on the planning and delivery of lessons at the Key Stage 2/3 transition (ages 11-12).
- The Institute of Physics (2010) initiated the Girls into Physics AR project, involving 100 teachers who were supported to understand issues related to girls' participation in physics and then to evaluate interventional changes in their own classrooms, departments and schools.

Sometimes AR projects can offer significant insights and contributions to knowledge. For example, Concannon *et al* (2013) considered pre-service teachers' conceptions of science theories before and after interventional input on misunderstandings of scientific 'theories and laws'. Findings from this study provided new perspectives about ways to develop teaching this central aspect of science.

Occasionally AR projects can be seen as pilot studies and develop into a more significant research project. The adoption of the *Thinking, Doing, Talking, Science (TDTS)* interventional lessons has informed a Randomised Control Trial research design whereby thousands of pupils' performance in experimental classes have been compared with those in control groups (McGregor, Wilson & Frodsham, 2020). The combination of quantitative and qualitative impact evidence has shown how a focus on challenging thinking in science can improve attainment of 8 and 9 year-olds.

Conclusion

An AR approach not only offers versatility in close-to-practice research, but also provides a structure and systematic framework that enables teachers and researchers to examine the impact of a changed pedagogy or learning approach.

Not only is it applicable to individual teachers, but also consortia can adopt the framework to explore generalisability across schools and contexts.

Impact outcomes can also inform significantly larger projects, such as TDTS, and be adapted across the country by schools interested in achieving the same kinds of research aims.

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