Research FOCUS

Introducing Action Research for science teachers

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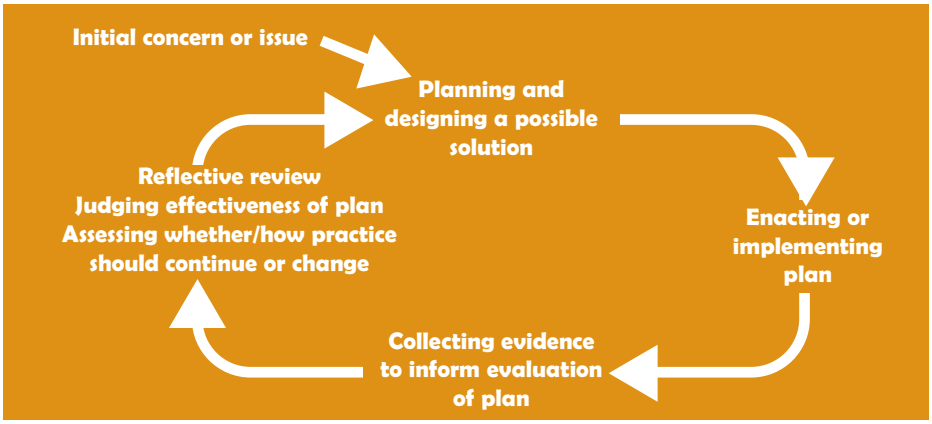
When teachers discuss and consider Action Research (AR), there is sometimes a prevailing view that it is just about being active in carrying out research! That is, data and evidence are actively gathered to inform the making of a conclusion about improving something related to practice.

In other words, rather than being passive, teachers might energetically collect, scrutinise and analyse evidence (perhaps test results or homework quality, for example) that edifies an aspect of their students' learning and consider that they have carried out 'Action Research'. This, however, is a form of evaluative or practitioner research. It is not AR in the accepted sense (McNiff & Whitehead, 2002) unless there is clear recognition of influential factors (that are purposely changed or altered in some way) and the impact of this modification systematically assessed.

Defining Action Research

AR is an approach designed to investigate the impact of some kind of intervention or change in practice. In science classrooms, this could involve a teacher changing his/her approach to formative assessment (or Assessment for Learning – AfL) and judging (through varied kinds of evidence) how the altered practice influenced their students' learning. However, to make clear evaluative measures of impact, the teacher would need to ensure that all students received and/or engaged with formative assessment in similar ways. This would be a challenge as, ideologically, formative assessment should be personalised to support individualised development; therefore, how can a teacher make clear and easy (generalised) assertions from their changed practice? Thus, there are many pitfalls and dilemmas within AR. As a research approach, it requires a systematic methodology that validates and verifies the assessment of the effect of some aspect of altered practice; it requires criticality to ensure that the research is focused and evaluates the outcomes that are directly related to the new practice. Exploring, for example, how the AfL use of two stars and a wish, or comments rather than marks on written work, might improve students' work would require careful focus on whether practical skills, written work and/or knowledge and understanding are being developed. Findings from the research would then confirm that the change in a teacher's practice had resulted in x or y outcomes. McNiff and Whitehead (2005) suggest that there is a series of questions that can structure progress through an AR approach to develop practice:

Figure 1. Reflective review adapted from the Action Research cycle (McNiff with Whitehead, 2002: 41).



Possible questions to scaffold an AR approach:

- What am I currently concerned about?
- Why is this issue a worry or concern?
- What evidence do I have that illustrates this issue or concern?
- What could I do to improve the situation?
- What will I do about it?
- What kind of evidence would show that the situation has improved?

As Taber (2013) suggests, AR is a common (sense) approach for practitioners to research their teaching. He lists possible kinds of issues that a teacher might address through this approach: poor student behaviour; limited student understanding of a topic; lack of interest in a topic; poor quality homework; not enough student involvement in discussion; boys more engaged in practical work, etc. For science teachers, the questions identified above could help shape their AR approach to develop their practice (McGregor & Cartwright, 2011).

AR enables teachers to:

- systematically examine an aspect of their teaching;
- collect information and evidence about a 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 are depicted in Figure 1. AR, then, is not characterised by particular data collection techniques, but by the attitude to the evidence generated after changing some aspect of practice. As McNiff and Whitehead (2005:1) describe, *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'. This is corroborated by Elliot (1991), who describes how the aim of AR is to improve practice rather than produce knowledge.

Individual, co-operative and collaborative AR

Interventions designed to improve practice in some way can be carried out by individual teachers in classrooms, or they can involve a range of other additional participants, including pupils, teaching assistants, parents and even other staff in the school (or college). If others are involved, but not necessarily working to achieve the aims of the project, this has been defined as co-operative AR. The others involved may necessarily be needed (such as technicians) to provide equipment for practical experimentation or support students (as teaching assistants do) to read and use resources in the classroom. Although involved to ensure the research proceeds as planned, these participants should not be influential in the AR project itself; they would just be supporting day-to-day running of the lessons. A collaborative project, however, would require that all participants are aware of the venture and are actively assisting in the intervention (and even the collection of evidence). This could be something like a Thinking Science intervention (McGregor & Gunter, 2001), where the technicians are as crucial as the teacher for conducting the intervention.

Examples of AR in science classes

AR has been used by initial teachers as well as practising teachers. Many Initial Teacher Education (ITE) programmes now include Master's level credits and beginning teachers are being asked to research development of their own practice. AR provides a useful methodology for embarking upon research to reflect and hone personal practice. Hewson *et al* (1999) used AR to help prospective teachers become reflective about what it means to teach for conceptual change. A useful outcome of this research showed that beginning professionals tended to focus on learner understandings, conceptions and explanations, which supported their own teaching of conceptual changes in science.

Practising science teachers can also use AR to develop a research project, which can count towards Master's qualification, as it provides clear theoretical guidance for systematic research in the classroom. This kind of research can include curriculum innovations and subsequently promote greater understanding and confidence to develop new teaching ideas. Mallinson (2011) looked at the impact of a Researcher-in-Residence programme to enhance the thinking about science and aptitude for science of her pupils. Hutson (2012) considered curriculum development with pupils of low scientific literacy, evaluating the impact of different teaching strategies, whilst Dollive (2012) critically evaluated the development of more active learning through the use of practical work. These were small-scale interventions carried out by practising teachers that evaluated the influence of changing practice in some way.

Teachers working in collaboration with others can also develop curricular innovations or alternate teaching interventions to enhance learning. Markic and Eilks (2006) explain how science education researchers worked alongside classroom teachers over a six-year period to develop student-centred teaching and learning materials to enhance the teaching of electrochemical cells in chemistry. Similarly, Vaino *et al* (2013) report an AR project involving five chemistry teachers with researchers to explore the role of collaborative AR in eliciting change in teacher beliefs around integrating new teaching pedagogies. Whilst this research added to the knowledge towards understanding how professional development can help inform teacher beliefs, it had a wider outcome of enabling change in the wider chemistry community through the impact the five teachers had within their school and wider communities.

Conclusion

Besides catalysing practice, AR can offer new understandings (akin to traditional research). Concannon *et al* (2013) considered prospective teachers' conceptions of science theories before and after intervention input. The intervention focused particularly on teachers' misconceptions about theories and laws, a challenging area in science teaching. The findings from the study highlighted how new understandings can be gleaned to help inform and develop teaching in science classrooms.

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