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McGregor, Debra, Oversby, John and Woodhouse, Fiona

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Original Citation

McGregor, Debra, Oversby, John and Woodhouse, Fiona (2013) Science education research and teacher professional development. *Education in Science*, 251. pp. 26-27. ISSN 0013-1377

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- John Oversby
- Deb McGregor
- Fiona Woodhouse

Different kinds of information informing professional development

Well-designed and thoughtful approaches to practitioner research can bring about very positive impacts to improve teaching and learning in science classrooms. A teacher reviewing students' average test results over the last few years can proffer much numerical data, which could be statistically analysed to 'show' how one group or another performed better in learning about electricity, forces, living things or materials and their properties. Annual GCSE results can also be scrutinised for trends or patterns in students' achievements of A-C grades. This kind of quantitative data can be

used to illustrate the proportion of learners achieving better or worse in examinations.

Copious information of this kind can be used to judge teachers' performance in a very scientific manner. Schools and teachers can be directly compared in a seemingly systematic way, variables are controlled, all students sit the same examination at the same time, standard methods (i.e. the same GCSE specifications and questions) are posed and graded. This approach to collecting quantitative data resonates with what is described by educational researchers as 'positivist' (Johnston, 2012: 191), an approach that gathers hard numerical evidence about the extent of success in classrooms. This kind of information can

be used to proclaim that this or that intervention or approach has made a significant difference to students' learning.

In an article for *EiS*, written in April 2005 by Oversby and Harlen, it was noted that the most highly-valued education research was normally of a quantitative nature, based on empirical evidence, generating much numerical information and involving subsequent statistical analysis, usually deemed to be a valid and reliable approach to educational research. Readers, though, of these kinds of studies tend to be the authors' peers who are other academics also in Higher Education Institutions (HEIs). Esteemed science education research reported on in journals such as the *International Journal of Science Education* or *The Journal of Research in Science Teaching* is subject to rigorous peer review, but is unlikely to be read and acted upon by classroom teachers. Readers of highly-rated research also need to appreciate and understand research design, literature critique, appropriate data collection, methods of analysis, theoretical frameworks, statistical tests of significance, and be able to apply critical skills to interpret the validity and applicability of conclusions.

For teachers, this kind of research can provide indicators and illustrations about developments or focused studies that can inform or impact on practice.

Often, though, science teachers want to know more about 'why' something has made a difference or impacted positively (and sometimes negatively) on their children's performance. They wish to know what kind of difference was made and how, so that they can consider what might be appropriate to apply to their own teaching. This kind of research exploring the reasons behind happenings is more qualitative. The kind of evidential data collected in these kinds of studies seeking to understand how

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Science education research and teacher professional development

Research FOCUS

■ John Oversby
■ Deb McGregor
■ Fiona Woodhouse

and why things arise or occur as they do may demand reflective observations, interviews, focus group discussions, textual scrutiny, discourse analysis, etc. All these kinds of more subjective interpretations delving into the back story, contextual influences or drivers behind educational developments are quite different in nature to the numerical types of substantiation indicating how much of something is happening. Examining how and why something worked can offer insights into effective practices and offer greater understanding of our own teaching, suggesting ways in which improvements in practice might be made. An evaluative case study (Johnston, 2012: 196) or action research approach (*ibid*) is often difficult to generalise from and reapply in other contexts, but findings can resonate with practitioners seeking to develop their pedagogy.

Engaging with research to further professional development

Collating and analysing data that have been gathered through sound research methods can enable teachers to feel confident that what they are doing is substantiated, appropriate and can, in time, make a difference, thus contributing to their professional development. As Loughran (2003) indicates, teacher-researchers are at the forefront of the challenge to better understand daily concerns and implications of practice. Inferred from this is the view that there can be no educational change without teacher change, so a reflective research focus on development of personal practice should lead to improvement in teaching. One can draw on the work of Glassick *et al* (1997), Lewis and Munn (1997) and Gossman, Haigh and Jiao (2009), who corroborate that engaging in scholarly activity to develop professional practice can aid understanding of teaching and learning.

Key questions that highlight important characteristics of professional activity that can scaffold teacher development through research could be:

- **Clear goals:** Does the teacher-researcher state the basic purposes of his or her work clearly? Does the teacher define objectives that are realistic and achievable? Does the teacher identify important questions in the field?
- **Adequate preparation:** Does the teacher show an understanding of existing literature in the field and build a justified case for investigation? Does the teacher bring the necessary skills to his or her work? Does the teacher bring together the resources necessary, in a timely manner, to move the project forward?
- **Appropriate methods:** Does the teacher acknowledge the context and situation of the project? Does the teacher use methods appropriate to achieve the goals? Does the teacher apply effectively the methods selected? Does the teacher modify procedures in response to changing circumstances?
- **Significant results:** What do the data or evidence gathered suggest? Do the findings respond to the goals of the project? Does the teacher's work extend or complement existing knowledge and/or practice(s)?
- **Effective dissemination:** Does the teacher communicate the approach, findings and conclusion in an appropriate manner for different audiences? Does the teacher present his or her key points with clarity and integrity?
- **Reflective critique:** Does the teacher critically evaluate his or her own work? Does the teacher bring an appropriate breadth of evidence to his or her critique? Does the teacher use evaluation to suggest the nature of quality future work?

These points are intended to offer some useful incremental questions that teacher-researchers could use to initiate and develop research into their own practice.

Conclusion

Teachers engaging with research processes to purposely improve or develop their professional practice will not only enhance and develop their practice, but will also engage with thinking critically about research processes and outcomes and thus become more research-knowledgeable. As Loughran (2003: 188) states: '*a most important outcome of teacher research is to help facilitate a better understanding of the complex nature of teaching and learning, so that both teachers and students can benefit from the development of knowledge through the research venture*'.

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John Oversby is Chair, and Deb McGregor and Fiona Woodhouse are members of the ASE Research Committee.