The Association for Science Education

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A response to the Joint Royal Society-British Academy call for views on educational research

The **Association for Science Education (ASE)** is the largest subject association in the UK. Members include teachers, technicians and others involved in science education. The Association plays a significant role in promoting excellence in teaching and learning of science in schools and colleges. Working closely with the science professional bodies, industry and business, ASE provides a UK-wide network bringing together individuals and organisations to share ideas and tackle challenges in science teaching, develop resources and foster high quality continuing professional development. The Association for Science Education can trace its origins back to 1900. Incorporated by Royal Charter in October 2004, the ASE operates as a Registered Charity.

The Association welcomes the opportunity to respond to the Royal Society and British Academy call for views on educational research. This response has been formulated in consultation with ASE's national Research Group and ASE Futures (teacher educators). Together these groups bring expertise in primary and secondary science education, from a range of viewpoints, including classroom practitioners, educational researchers, teacher education tutors and professional development providers. Our response focuses on the questions for researchers and subject associations.

Summary of main points

• The Association is a unique group which brings together teachers, educational researchers, teacher trainers, professional development providers, technicians and others and so offers the opportunity for an exchange of ideas and genuine debate about research into practice.

• The Association's Research Group helps teachers and other members to realise the potential and scope of different forms and approaches to research. As a result that they can begin to understand, and develop their ideas in practice, that research can provide insights, interpretations and answers about current interests in educational practice.

Questions for researchers

1. What broad area of educational research do you work in, and what is your role?

ASE's Research Group members work in a range of university and other settings, covering research in science education, effective pedagogy, learning, curriculum development and assessment.

2. Describe the contribution your field has made to educational research, policy,[1] teaching and learning, and society?

The Association has a long standing reputation for undertaking educational research and influencing policy. Recent policy examples include ASE's leading role in shaping the current national curriculum programme of study in England for primary science with its strong focus on the integration of 'working scientifically', and the assessment of primary science through an influential Nuffield Foundation publication from a working group led by a past ASE

[1] This need not necessarily be limited to educational policy.

President, Professor Wynne Harlen[2]. At secondary level, a current policy into practice example is the Nuffield Foundation supported Language of Mathematics in Science publications which provide guidance on effectively addressing the issues of effective teaching and learning of mathematics in science classrooms[3]. For other examples of ASE projects that have been influential on informing practice, see our response to question 3.

We have many members who have made a significant contribution to their specific research fields through their publications and advocacy. For example:
Professor Paul Black - Science Education and Assessment
Professor Jonathon Osborne – Argumentation
Professor Judith Bennett – Curriculum Approaches
Professor Keith Tabor – Nature of Science
Professor Shirley Simon – Teacher Professional Learning & Argumentation
Professor Robin Millar – Physics Education, practical work & Assessment
Professor Michael Reiss – Science education & Bioethics
Professor Justin Dillon – Informal Learning and Fieldwork
Professor Wynne Harlen – Primary Science & Assessment

The Association provides a wide range of opportunities for these researchers and others enable teachers to be informed of and engaged in educational research. These opportunities include ASE's annual conference and several regional conferences, regular meetings in each of its 18 regions, five journals[4], publications and teaching resources.

The Research Group has published a specialist book entitled 'Research in Science Education, which was edited by a former Chair of the group. Many members of the group have contributed chapters, and a new edition is under development for publication in late 2017-early 2018. A feature of ASE publications (and project outputs in general) is that less experienced writers are supported by leading writers and editors in their fields, in doing so identifying and encouraging the next generation of science education leaders.

3. In the past 10 years, what would you judge as the most significant contributions your field has made?

The Targeted Initiative on Science and Maths Education (TISME)[5] was a programme of five research projects, funded by the Economic and Social Research Council in partnership with the Institute of Physics, the Gatsby Foundation and the Association for Science Education. The overall aim of TISME was to uncover new ways to encourage greater participation, engagement, achievement and understanding of science and mathematics among young people. Between them, TISME's projects covered extensive ground in mapping how young people engage with science and mathematics education, their aspirations for the future, the effects of recent changes to the curriculum and its teaching, and how students' understanding of the subjects might be improved.

The Improving Practical Work in Science (Getting Practical) programme of professional development. A report from SCORE (authored by ASE)[6] requested by the Department for Children, Schools and Families (DCSF) formed a basis for the DCFS tender on Improving Practical Work in Science, which was won by a consortium led by ASE (with

[2] Developing policy, principles and practice in primary school assessment http://www.nuffieldfoundation.org/sites/default/files/files/Developing_policy_principles_and_practice_in_primary_school_science_assessment_Nuffield_Foundation_v_FINAL.pdf
[3] The Language of Mathematics in Science: A Guide for Teachers of 11-16 Science and The Language of Mathematics in Science: Teaching Approaches http://www.ase.org.uk/resources/maths-in-science/
[4] http://www.ase.org.uk/journals/
[5] http://www.kcl.ac.uk/sspp/departments/education/research/Research-Centres/cppr/Research/pastproj/TISME/Index.aspx
[6] https://www.stem.org.uk/elibrary/resource/33088

core partners CLEAPSS, Centre for Science Education Sheffield Hallam University and Science Learning Centres, and with support from a large range of other organisations). The programme was underpinned by a past ASE President, Professor Robin Millar's work on practical science[7]. One of the outputs from the Getting Practical programme was a framework for practical science in schools[8]. Other outputs included a CPD toolkit which was made freely available at the end of the programme (and previously had been available only to the trainers involved in providing the Getting Practical CPD programme). The programme was independently evaluated by the Institute of Education[9]. This report was available on the ASE website and articles by the authors from this report were published in ASE's peer reviewed journal – School Science Review (SSR). Some of these articles are available to ASE members only[10].

One of the most authoritative research programmes that has influenced policy and practice in schools has been the work on Assessment for Learning, initiated by the review by Paul Black and Dylan Wiliam in 1998[11]. This work has and continues to influence the teaching and learning of science in schools led by Chris Harrison (past Chair of ASE) through a range of collaborative action research projects and more recently an international MOOC.

4. What are the priorities in your field of educational research, and what is driving these?

A recognition of the importance and relevance of Action Research and Practitioners Research to teachers' professional development and progress in developing their practice in classroom situations (of pedagogy, understanding learning, modes (and methods) of assessment).

Inquiry learning – the UK research in science education community has acted as partners in several EU FP7 funded projects in recent years (INQUIRE<SAILS< ASSISTME< MASCIL) and the findings and resources built up through these projects need to be disseminated more broadly within the STEM community.

5. What particular barriers and challenges do you face in undertaking educational research, and what changes might help overcome these? Please say whether these barriers and/or challenges apply to 'blue skies' or 'applied' research.

Seed-corn financial support to enable early ideas for educational research projects (both 'blue skies' and 'applied') to be tested before engaging partner organisations (where appropriate) and seeking larger scale funding.

Challenges when involving personnel in schools in educational research:

- Time (and supply cover funding) for teachers to be involved in re-developing their practice and/or gathering evidence of impact of any changes implemented.
- Ethical issues involving children/students in studies of classroom happenings, events or projects.
- Research assistance, that is of a good quality, to generate research tools; carryout evidence gathering and process data (in various analytical ways).

6. What opportunities (including opportunities for dissemination) exist to deepen the contribution that your research field makes to policy, teaching and learning, and society?

In addition to the Association's own wide ranging dissemination opportunities which include ASE's annual conference and several regional conferences, regular meetings in each of its 18 regions, five journals (particularly

[7] https://secure.ase.org.uk/membersarea/shop/details.asp?Id=52&Red=True
[8] https://www.stem.org.uk/system/files/elibrary-resources/legacy_files_migrated/27107-getting%20practical.pdf
[9] https://www.ase.org.uk/documents/getting-practical-report/
[10] http://www.ase.org.uk/journals/school-science-review/search/?keyword=abrahams&month=0&year=0&submit.x=34&submit.y=8
[11] http://www.tandfonline.com/doi/abs/10.1080/0969595980050102

the peer-reviewed Journal of Emergent Science, Science Teacher Education and School Science Review), publications and teaching resources, ASE is represented on a number of national groups focusing on policy research and policy into practice.

7. How do you disseminate your research?

ASE's Research Group members disseminate their work through the European Science Education Research Association, International Council of Associations for Science Education, Commonwealth Association for Science, Technology and Mathematics Educators and the British Council, amongst others.

Within the UK, dissemination is through British Educational Research Association and ResearchED, amongst others. Additionally, ASE's Research Group members use the wide ranging dissemination platforms of ASE to promote their work (see response to question 6).

Association staff and members are regularly represented on national committees beyond ASE, act as governors and mentors in schools, using these opportunities to disseminate their research work, and engage teachers to interact with it, as appropriate.

8. Are there demonstrations of effective links between educational researchers, policy-makers and practitioners in this country, or internationally, that the Working Group should be aware of?

The various EU projects, such as Creative Little Scientists, Engage, SAILS, ASSISTME and MASCIL all demonstrate effective links between educational researchers, policy makers and practitioners.

See also our response to question 3.

Questions for subject associations

1. How do educational research findings inform your work?

Through generation of various publications that researchers, practitioners and educational leaders work on collaboratively (as suggested earlier). These publications address curricular, teaching, learning and assessment issues, usually from the perspective of the practitioner, but increasingly we inform policy makers too.

A Research Group that is comprised of teacher educators, teachers and researchers working in a range of geographic locations and settings across the country, as well as within HEIs and school partnerships of different kinds.

2. How easy do you find it to identify, access and make use of educational research, and what are your main sources of educational research findings?

Through Research Group activities, comprised of university educators, researchers and teachers there are discussions that relate research to practice and vice versa.

Much of what has already been stated in the earlier section, 'Questions for Researchers'.

3. What would be your priorities for educational research, and why?

More in-depth studies (and longitudinal work) that examine 'why' particular large scale (or indeed smaller scale studies) do (or do not) produce quantifiable and statistically significant outcomes. There is an increasing trend, currently, for Randomised Control Trials (RCTs). The outcomes of these kinds of studies indicate how 'far' or how

much of an impact an intervention has had. The Education Endowment Foundation (EEF) with the Sutton Trust have produced Teaching and Learning Toolkits that indicate the extent of impact from the 'effect sizes' (and evidence) that the findings from these studies have claimed to show. The toolkit covers 30 topics, including aspects of learning such as 'Collaborative learning', 'Digital Technology', 'Peer Tutoring' or 'Small Group Tuition'. It would be helpful for teachers to know what the key elements of the interventions (i.e.; in the classroom setting what 'must' they do and what should they 'not' do!) should be paid attention to, to produce the significant effect sizes.

Examining why some studies produce contradictory evidence, e.g. two significant studies have shown both positive and negative outcomes of the impact of Teaching Assistants. This indicates there needs to be clarity or further investigations into the methodologies of (large scale) research studies. At first glance, of course, Teaching Assistants can be employed in a wide variety of ways, so the extent of their effectiveness in different schools will vary significantly.

Another example is Cognitive Acceleration through Science Education (CASE) and the EEF-funded Let's Think project for secondary schools. The most recent evidence this autumn indicates there is not a significant effect size, yet in the 1980, 1990s and even into noughties there were well received studies that showed a statistically significant benefit for students 5 years later (after the Thinking Science intervention). There is a need for research that provides more detailed and nuanced accounts of the methodologies used and applied, particularly in large scale RCT projects so that when studies focusing on the same or similar issues show significant (or not significant evidence) there is an open opportunity for reflective discussion about the nature of the research carried out. RCTs can be very expensive and labour intensive to carry out; perhaps there is a need for more public (educational research community) scrutiny of the approach of these trials. There certainly needs to be thorough evaluative studies looking at the ways these trials are conducted to explore what lessons there are for teachers, educational researchers and funders of this type of research.

We also recommend studies that look at the ways that Hattie's meta-analyses work (illustrated in *Visible Learning*)[12] is taken up by schools; how and why the various factors work for teachers and schools in differing circumstances, in both the short and longer term.

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See our response to question 8 (Questions for researchers). Other examples where ASE's Research Group members have been involved include Leadership for Learning in Oxford which has provided influence at a local level to change policy and practice, but not yet nationally. There is scope for the principles from projects such as this to be applied more widely.

[12] http://visible-learning.org/2009/02/visible-learning-meta-study/