RESEARCH SUMMARY

PROJECT CODE: STUZ

TITLE **INCREASING CAPACITY IN STEM EDUCATION RESEARCH: A STUDY EXPLORING THE POTENTIAL FOR A FELLOWSHIP PROGRAMME**

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INTRODUCTION

The National Foundation for Educational Research (NFER) was commissioned by the Royal Society (the UK's Academy of Science: see www.royalsoc.ac.uk/education for the Society's work on education) to complete a study exploring the potential of a Fellowship programme for early- to mid-career education researchers in STEM (Science, Technology, Engineering and Mathematics). The study was set within the broader context of increasing capacity in STEM education research and was intended to assist the Royal Society in its aim to ensure that the next generation of leading STEM education researchers are recruited and sustained in their careers.

KEY FINDINGS

Factors that affect the commissioning of research

The type of STEM education research undertaken was primarily said to be driven by policy concerns, the availability of funding and the motivation to advance knowledge and understanding. It was also noted that sometimes STEM education research was undertaken because of practice concerns, and may depend upon the availability of quality researchers capable of carrying out a study.

These commissioning factors may well have some implications for the capacity building in STEM education research. For example policy concerns were identified as the main driving factor of research, yet policy-related research can be subject to certain constraints (for example Research Assessment Exercise (RAE) lack of recognition of policy-focused research, the lack of attractiveness of some policy research, and the lack of impact of STEM education research on policy). This apparent incongruence between STEM education research commissioners and researchers may highlight a bias in the interview sample (for instance, a lack of input from research funders less concerned with policy, such as the research councils). However, more worryingly, the data presented here may allude to a mismatch between funders' needs and what researchers offer.

The availability of suitable researchers was also mentioned as a factor that sometimes influences the commissioning of research. Commissioners may require researchers in particular specialist areas, in particular regions and to undertake research in a particular timescale. A fellowship programme could potentially replenish the capacity of researchers in each of these ways. For instance, a fellowship scheme could release people from teaching responsibilities to focus on research.

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Competitiveness

Some interviewees experienced the competitiveness in UK STEM education research as high and healthy, a number of others felt competition was low and varied. Very often though, competitiveness was seen to be conditional depending on a number of factors: attractiveness and status of the research, the availability of funding, the reputation of the institution and researcher, the specific expertise required and the commissioning process.

The finding that competitiveness is variable perhaps raises some implications for building the capacity of the community. Given the current picture of UK STEM education research as a market monopolised by a 'small pool' of centres of excellence, should investment focus on building the capacity of the current centres of excellence or develop new and additional centres of excellence across the UK? Meanwhile, as STEM education research is a more competitive market-place for early- and mid-career researchers, should greater emphasis be placed on supporting researchers to acquire the 'survival skills' of successful bid writing? The availability of funding for STEM education research was reported as an issue by respondents, in particular that 'piecemeal' funding appears to be relatively unattractive to researchers. Thus, the capacity for research may be strengthened by a more collaborative and consistent approach to funding. Finally, it was observed that quality researchers may be constrained by their dual roles as researchers and educators, limiting the number of research projects for which they can compete . A fellowship programme could potentially release researchers from their teaching roles for periods to enable them to participate more in the STEM education research market place.

Career pathways into STEM education research

The most common route into STEM education research is to undertake a STEM subject degree (and possibly higher degree), followed by teacher training and teaching experience, and then make the transition into teacher education and education research at a higher education institution. The transition from school teaching to academia is often achieved by completing a higher degree or becoming involved in research or with a university while teaching. Interviewees in this study had often received funding support to undertake further study and taken time out from employment. Maximising the availability of funding support for higher degree study would appear to be a crucial feature of building the capacity of the STEM education research community.

Less frequently, interviewees described entry via social science and STEM subject specialist routes. Many respondents reported a lack of career structure and clear career routes into the profession. If there are viable alternative routes into the profession, perhaps these could be made clearer and potential career progression routes could be more clearly associated with fellowship study. In addition, the fellowship programme could also consider facilitating the careers of those who do not wish to pursue a route which leads to a lectureship.

The most important factor influencing participants' career routes into STEM education research was their own interest in and motivations for improving teaching and learning. Capacity building exercises may thus need to focus not only on supporting people in making the entry to the profession but also in retaining them. Other facilitating career factors included getting a permanent position in a university and whether or not researchers could win funding for projects (which was felt to depend on the status of the institution). For more recent entrants to the profession, being part of a strong research culture was seen as very beneficial. Institutions seeking new researchers, as well as the design of a fellowship programme, may need to consider how they will provide a solid structure of support, particularly from senior colleagues.

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Availability of expertise

Pedagogic and subject knowledge were reported to be strong areas of expertise. Interviewees suggested a lack of expertise in terms of methodology, perspectives and theory, interdisciplinary work and specific subject areas. Respondents' views about the areas of insufficient expertise have implications for the focus of capacity building exercises.

In order to address the lack of methodological and theory/perspectives expertise in the STEM education research community a fellowship scheme could focus on both increasing the routes into the field (for example from social sciences backgrounds) and on equipping researchers with the necessary methodological skills. The fellowship scheme could offer certain quality standards of training to ensure equity of support was available to students in a similar way to the Economic and Social Research Council (ESRC) funded studentships.

A lack of interdisciplinary working could also be addressed at least partially by a fellowship scheme. The scheme could encourage collegiate working between those on the scheme by offering programmes of support that brought cohorts of researchers together. This structured system of support would ensure greater consistency rather than simply relying on senior colleagues to provide support.

Providing opportunities to engage with practitioners would also seem to be a feature of maintaining and building expertise in the STEM education research community. Contact with practitioners would allow educationalists to stay informed about current practices and help those entering from primarily social science backgrounds to develop their educational knowledge.

International collaboration

Although some researchers felt that international collaborations were not relevant to their research, others clearly wanted to be involved in such research. Early-career researchers tended to be interested in such work, but were the least likely to have been involved in internationally collaborative research. There are several aspects that could be included in a fellowship programme to encourage international collaboration:

- ensuring that researchers are involved in international networks in their field, and are given opportunities to go to conferences and meet other researchers
- funding to support researchers in developing collaborative bids with colleagues abroad, as this can be an expensive process
- a fellowship could give support to help researchers, especially early career researchers, bid for and administer funding.

Innovation in STEM education research

Overall, interviewees in this study did not feel STEM education research is particularly innovative. Interviewees called for more innovation in terms of methodology and approaches that would ultimately improve the relevance and usefulness of STEM education research.

Some STEM education researchers in this study believed that greater innovation could be achieved with more large scale, quantitative, representative and internationally comparative research. Some STEM education researchers called for greater emphasis on research and development and engagement with practitioners. Funders would seem to have a key role to play in facilitating innovation in terms of the type

of research they commission and the extent to which the requirement for innovation is specified and prioritised.

Some interviewees contended that innovation in STEM education research was constrained by a dominant natural science research ideology. Policy makers and funders were reported by participants often to require research that measures educational approaches in a scientific way, which does not always suit the social phenomenon of education. The introduction of new approaches and ideas may therefore help the education community (including researchers, practitioners and policy makers) to move beyond the constraints of a dominant natural science research model. Specific attention should perhaps be paid to how this could be achieved in the designing of a future fellowship programme. Research fellows would be well placed as new entrants to the community to bring new and innovative ideas and approaches.

For many respondents innovation was about working with practitioners to move educational practices forward. In order for this to happen the interplay between researchers and practitioners needs to be strengthened and greater emphasis placed on translating research findings into practical applications (Ratcliffe *et al.*, 2004). Indeed in a working paper undertaken for NERF (National Educational Research Forum) the authors Dyson and Desforges (2002) recommend research capacity is considered as a system, embracing both research-producers and research-users and that capacity building exercises should aim to strengthen the system of research holistically. A potential fellowship programme may consider how students will learn innovative ways to engage practitioners in research and place emphasis on presenting and conveying research findings to practitioners in an accessible and useful way.

Quality of STEM education research

The quality of STEM education research was reported as variable across the field, and interviewees suggested that high quality work tends to be concentrated in a small number of institutions and individuals. One of the issues around less high quality research was a lack of methodological rigour. Therefore, a key issue for a fellowship programme is to develop methodological expertise in the STEM education research community, and to ensure that all have access to high quality training, especially those from a teaching background.

Interviewees felt that methodological rigour and relevance were the most important criteria for assessing the quality of STEM education research. Researchers also stressed the importance of theory use, suggesting that all research should be well underpinned by theory and should contribute to advancing theory. Those earlier in their careers were more likely to say that having impact is a mark of quality research than those further on in their careers, suggesting that it is important for the former to know that their work is making a difference.

Impact of STEM education research

The impact of STEM education research is an important issue for researchers, as the aim of their work is eventually to impact on teaching through policy or practice. Interviewees suggested that the most common impacts of research were that it affirmed existing ideas and contributed to the body of knowledge. Other more direct impacts on policy or practice were less common, and researchers were keen to see their work have more impact. They suggested that research does not have impact due to ineffective communication of findings, and the fact that much research is small scale and not part of a coherent set of findings. The characteristics of successful research suggest that to have impact, researchers need to take account of the needs of policymakers and practitioners, involve them in the whole research process, and ensure that findings are effectively and appropriately disseminated.

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There are several implications here for a fellowship programme. Firstly, more impact could be achieved if practitioners are involved in the research that is carried out. A way to achieve this could be to target teachers who are interested in doing research for the fellowship. Secondly, if the fellowships had a research theme, all the individual pieces of work carried out could fit together and complement each other, leading to a more coherent set of messages than would emerge from a body of more disparate work. Lastly, research carried out as part of the fellowship programme needs to take note of the characteristics of research that has impact and apply them appropriately to the work. Part of the support given to researchers could be to help them ensure that their research incorporates these characteristics as far as possible.

CONCLUSION

Access to training, support and better career prospects were highlighted as the main factors that could help build and sustain expertise in STEM education research. Difference in the backgrounds of entrants was felt to affect the kinds of training that would be needed. It was suggested that those entrants coming from a classroom environment might well benefit from training which focuses on developing their research skills. For those entrants with a social science background it was recommended that they receive training in the education system and pedagogic issues. In terms of longevity as a STEM education researcher, it was deemed essential that all new entrants to the profession quickly acquired the practical business skills associated with research (for example writing bids, managing projects).

According to interviewees, the life of a STEM education researcher can be insecure (due to temporary contracts) and relatively stagnant (with few opportunities to move forward). In terms of capacity building therefore, any strategy (a fellowship or other) would need to address the longer term issue of career progression and to consider how an individual's prospects could be improved and the progression of his/her career facilitated. The disparity between researcher and teacher salaries was cited as a factor that deterred prospective researchers from leaving the classroom.

Interviewees were unanimously positive about the suggestion of a fellowship programme. In terms of its style and composition they suggested that it could:

- be offered within a structure of support, training, mentoring
- develop the practical skills associated with research (writing bids, managing projects)
- give recipients freedom to pursue their own research interests
- provide opportunities for collaboration between disciplines and institutions
- release staff from some/all of their teaching commitments in order to dedicate time to research.

ABOUT THE STUDY

The main aim of the research was to inform the Royal Society about the support needs of the STEM education research community in general, and in particular about the need for a fellowship programme for early- to mid- career education researchers in STEM education. The study therefore set out to determine the current climate of STEM education research by examining relevant issues such as:

- career routes into STEM education research
- the drivers of STEM education research
- the distribution of expertise within STEM education research

- the interactions between STEM education research, policy and practice
- aspects of international collaboration and competitiveness
- the enabling factors and barriers to building and sustaining expertise in STEM education research.

The study was organised into four phases of data collection, beginning with a rapid-response search of literature. This was followed by collecting the views of 16 policy and practice representatives via telephone interviews/proforma. The third strand of data collection involved interviews with 30 STEM education researchers across the UK (25 from England and the remainder from Scotland, Northern Ireland and Wales). Towards the end of the project a focus group was held to discuss emerging findings and consider in more depth the possible contribution of a fellowship programme.

PUBLICATION AND DISSEMINATION

Halsey, K., Harland, J. and Springate, I. (2007). *Increasing Capacity in STEM Education Research: a Study Exploring the Potential for a Fellowship Programme.* Slough: NFER.

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