Commentary, Research Papers in Education

**Engaging in and with research to improve STEM education**

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The demand for students to continue studying STEM subjects at post-16 and higher education levels remains high. Since the curriculum reforms in Science and Mathematics across phases in England were initiated in 2014, uncertainty remains on the impact that these reforms will have on students and teachers as the reforms continue to be implemented with the new GCSE curriculum for Mathematics starting to be implemented in 2015 and in 2016 for Science subjects. Although there seems to be a slight increase in Mathematics uptake in 2015, students choosing to study science subjects has decreased; most importantly, the gender gap in those choosing to study science and mathematics post-16 is still evident, with more boys choosing to study Mathematics, Chemistry and Physics than girls since 2010 (DfE, 2016). At the same time, research into students’ attitudes and aspirations towards STEM careers indicate that interest in STEM careers is decreasing. Even if students enjoy science activities, they are likely not to consider it as a possible career pathway (Banerjee 2017; DeWitt, Archer and Osborne 2014). These issues are influencing both genders, but more so girls in mathematics and science subject areas. These important and current issues in STEM education are explored using different research approaches in the studies by Cropp, Bedford and Rigby (this issue). The three studies based in STEM subjects provide an illustration of how teachers can engage in and with research in order to make sense of their own teaching practices and their students’ learning processes and needs within their respective subject areas and school contexts.

The three authors report on interventions based on strategies they have designed and implemented in their own teaching practices in order to help their students overcome challenges with studying science and mathematics, and that can increase their interest and motivation in these subjects. Cropp utilises an exploratory qualitative approach to investigate how a peer tutoring strategy can support Year 10 students with mathematical anxiety, focusing specifically on female students, who have been reported to experience higher levels of mathematical anxiety than male students, and who as a consequence perform worse in maths (Devine et al. 2012; Carey et al. 2016; Hill et al. 2016). Cropp explores the students’ experiences of providing and receiving peer support to overcome this barrier for learning mathematics. Students that took part either as mentors or mentees in this intervention reported positive views and experiences, and lower mathematical anxiety, although the causes of this change need further investigation. Positive learning experiences in mathematics education may result in greater motivation of studying the subject beyond compulsory education. The study reported by Rigby focuses on this issue by reporting on students’ perceptions and experiences of the transition between GCSE and AS Level Mathematics. Rigby’s study focuses on students’ perceptions of the gap between the two levels and their perceptions’ of mathematics as a challenging subject. Her study indicates that those students that have withdrawn or are currently studying at AS Level, see a gap between the two levels, whereas students that have been successful in their first year of post-16 education and have continued onto the final stage of their studies, do not consider the differences between the GCSE and AS Level Mathematics syllabi as an inhibiting factor for their success. This suggests that students’ resilience and motivation needs to be considered further within the design of learning environments as it affects their willingness to persist with studies and subjects they perceive as difficult. The theme of motivation is further explored in the context of science teaching and learning in the study reported by Bedford, who using the framework of ‘growth mindsets’ (Dweck 2017) investigates factors that affect Year 10 (aged 14-15 years-old|) students’ motivation to study science and how to remediate this. Results from this study indicate that students’ motivation can be affected by task value, and the students’ self-regulation and self-efficacy skills. A 10-week growth mindset intervention was designed and implemented, and results indicate that it was successful in moving students of both higher and lower attainment levels towards a growth mindset, suggesting that prior attainment should not be considered as a drawback in helping students develop their motivation and engagement with science learning.

In all three studies, the authors reflect on how their engagement with research has influenced their teaching endeavours. Bedford points out the importance of emphasising task value by making the science content taught personally relevant and interesting for her students and designing learning environments that promote autonomy and enhance students’ self-efficacy. Cropp reflects on how strategies for reducing mathematic anxiety such as peer support and increasing student resilience could be employed more systematically in her own teaching practices, and Rigby reflects on the importance of considering on a wider scale and beyond the classroom setting the factors that affect students’ learning and engagement in mathematics. Winch, Oancea and Orchard (2015, 210) attest that ‘engagement with research, in its diversity of modes, and awareness of research processes and findings may contribute to the richness of reflection required in practical deliberation’ in a way that informs and enhances classroom practice rather than replacing one strategy or idea with another. The three studies described here illustrate this point - how thinking and reflecting about one’s practice, and taking action upon it, can be enriched by the development of their research literacy.

**Disclosure statement**

No potential conflict of interest was reported by the author.

**Notes on contributor**

Andri Christodoulou, PhD, is a lecturer in Education at the University of Southampton. Her research focuses on the use of argumentation in secondary science education and the development of epistemic discourse in science classrooms. She has an interest in initial science teacher education and teacher professional development, students' understanding of the epistemology of science, argumentation and epistemic practices. She is currently involved in projects investigating students’ communication about socio-scientific issues, developing socio-scientific inquiry-based practices in secondary science classrooms, and learning to teach science using argument-based classroom discourse practices. Andri is a Fellow of the Higher Education Academy.

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