CHAPTER 13

Epilogue: What Now for STEM?

Linda Hobbs

1 Introduction

In 2018, Science, Technology, Engineering and Mathematics (STEM) education is in its formative years in countries like Australia (Timms, Moyle, Weldon, & Mitchell, 2018), as has been demonstrated in this book. There appears to be enough of a groundswell of interest in all education sectors for STEM to be moving beyond the rhetoric of what needs to be done to actual practice. While there is no STEM curriculum per se in Australia, and teachers are still working out what STEM can mean for them in their schools, there are now many examples of STEM innovation that teachers can seek out to guide local decision-making (see, for example, Australian Industry Group, 2016). The task now is to document, work together, and learn from each other.

This book makes a start on this. The key learnings offered in this book cover a range of issues: the broad discussion of what STEM is and can be (conceptualizations of STEM); preparing pre-service teachers (PSTs) as teachers of STEM (STEM in initial teacher education); how schools can introduce powerful STEM learning (STEM in schools); and making tertiary learning more focused on STEM (STEM at tertiary level). In the below I do not attempt to summarise the chapters in their entirety, as such summaries are provided in the Introduction, but I intend to highlight the key learnings offered in relation to each of these issues as they arise from the work represented here. I then propose a set of principles for effective STEM education, which include important considerations when bringing STEM to life in our schools and universities.

2 Conceptualizations of STEM

As discussed in the Introduction more generally, STEM is undergoing an identity crisis. Chapters 1 and 3 provide insightful discussions of the meanings attached to STEM in Australia. Along with a number of other authors in this book, in Chapter 1, Fraser, Earle and Fitzallen have focused on the cross-disciplinary opportunities that STEM affords (disciplinary as distinct from multi-, inter- and

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trans-disciplinary approaches). In Chapter 11 Berry, McLaughlin and Cooper provided a useful framework from Radloff and Guzey (2016) that shows how this emphasis on an integration and interdisciplinarity continuum is only one of three ways that STEM education is being promoted; the second being as an instructional focus where generic competencies are used to make connections between schools, community, and industry; and the third being STEM focused on stakeholders' needs and contexts, like solving industry-based problems. These diversity of approaches, ways of conceptualizing and involvement of different subjects and groups of people, give schools a variety of ways forward when deciding how to incorporate STEM, where to place the emphasis on learning, and who to get involved.

Fraser et al., however, point out that there is a need for data to show the effects of each model on student learning, aspirations, and career choices. They also echo the concerns raised by a number of other commentators of the need for deep understanding of the STEM disciplines being integrated (Honey, Pearson, & Schweingruber, 2014), in particular to "understand how they are connected and to make those connections explicit for students". They suggest that this can be achieved by teachers working within inter-disciplinary teams; and that if we expect students to achieve some level of understanding of the disciplines being integrated, then we should expect teachers to achieve a similar degree of understanding.

In Chapter 3, Jordan provides commentary on STEM as a national agenda and an educational priority. According to this analysis STEM is represented in policy documents in Australia as: (1) national enterprise, (2) sustaining economic growth, (3) maintaining prosperity, (4) not being left behind, (5) securing a workforce, and (6) declining. According to this analysis, increasing participation and performance in STEM is represented to be relatively straightforward. However, the analysis is both insightful and helpful in highlighting the silences in these documents, that is, the relative complexities involved in the STEM enterprise.

3 STEM in Initial Teacher Education

The initiatives being reported in Chapters 9, 10 and 11 all respond to the need to prepare teachers for the reality of having to attend to STEM when teaching in schools. An analysis of PST perceptions of STEM by Cooper and Carr in Chapter 10, has shown that, at present, STEM remains a relatively unknown quantity for many PSTs, and many do not see STEM being implemented during their professional placements. There needs to be deliberate linking of the