FOREWORD

In the United States in particular, millions of dollars have been poured into improving undergraduate education in science, technology, engineering and mathematics (STEM) education. This is in response to mounting concern about a lack of scientists, engineers and mathematicians to keep the United States in the forefront of research, innovation and technology. As the chapters in this book demonstrate this focus on STEM education has resulted in research into, and implementation of, a range of different classroom practices, the development of curricula designed for authentic STEM learning experiences and shifts in pedagogical models and frameworks. A prominent development has been that of inquiry-based learning (IBL) as applied to STEM education. Interestingly in Australia and the United Kingdom the terms IBL and problem-based learning (PBL) are used almost interchangeably albeit there are potential philosophical and conceptual differences between definitions of the terms.

There is a school of thought suggesting that PBL is one of the most innovative, instructional methods conceived in the history of education. As a pedagogical approach, PBL first came to prominence in response to the widespread criticism that traditional teaching and learning methods fail to prepare medical students for solving problems in clinical settings. This is not a dissimilar reason for IBL coming to the forefront in STEM education. The significant commonalities between PBL and IBL are that they are pedagogies which have their origins in the work of the American philosopher and educator John Dewey (1859–1952), father of the experiential learning movement. Dewey's view of learning essentially assigns a major role to what can be best described as a creative intelligence in the discovery of new ideas in the disciplines. At its best, IBL is a student-centred active learning approach, focusing on questioning, critical thinking and problem solving.

What makes IBL as applied to STEM education intriguing is the idea of STEM as a meta-discipline, that is, the creation of a discipline based on the integration of other disciplinary knowledge into a new 'whole'. STEM education is an inter-disciplinary, some might say trans-disciplinary approach where rigorous academic concepts are coupled with authentic real-world learning as students apply science, technology, engineering and mathematics

learning that can help to make connections between formal learning, community learning and work-based situations. It is in no way an easy task to achieve a meta-disciplinary approach in learning and teaching and it would be wrong to suggest that we have completed this journey with respect to integrative STEM education. However, by applying IBL within the STEM subject areas, we are by definition: facilitating student learning rather than pushing students through a content-driven curriculum (guide on the side rather than sage on the stage); supporting the development of self-directed learning skills (inquiring, questioning, researching – all of which are likely to encourage boundary crossing between disciplines); supporting co-creation of new knowledge (empowering students to create knowledge rather than having all knowledge imposed).

Clearly, the effective use of new technologies in the classroom greatly enhances the potential of IBL in STEM education. Learning is no longer confined to official classroom hours or the availability of textbooks. Most students in the 21st century carry with them their own personal digital environments; they communicate constantly using social media and they are consummate consumers of information instantly available to them. The real trick for meaningful learning lies in strategies that enhance their information literacy skills. Although IBL predates the technologies we have available to us today, new technologies might be said to be 'made to measure' for IBL and IBL as applied to STEM in particular. Digital technologies support a range of learning styles and strategies and their huge advantage lies in the potential for connectivity and creativity as well as access to increasingly sophisticated software and experimentation in learning.

The chapters in this book will inspire and motivate all STEM teachers and facilitators of learning to take the ideas into their own classrooms, to provide authentic learning experiences for learners and to increase engagement for STEM students.

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