Book Review

Maker Education Meets Technology Education: Reflections on Good Practices

Klapwijk, R., Gu, J., Yang, Q. & de Vries, M. (Eds.). (2023). *Maker Education Meets Technology Education: Reflections on Good Practices* (International Technology Education Studies). Brill Academic Pub. ISBN: 978-90-04-68190-3 (Hardback), $198.00

The Brill publication *Maker Education Meets Technology Education: Reflections on Good Practices* provides a comprehensive exploration of the intersection between Maker Education and Technology Education, emphasizing their shared goals of fostering creativity, problem-solving, and hands-on learning. Throughout its three parts, the book showcases diverse global case studies, illustrating the inspiring adaptability of Maker Education to various cultural, economic, and educational contexts. These case studies demonstrate this adaptability, whether through government-supported initiatives in China, grassroots efforts in Kenya, or creative approaches to sustainability in Mexico. The thematic reflections in the final section offer insightful analyses that link Maker practices to pedagogical theories, material engagement, social learning, and spatial ability.

The book is divided into three parts. Part One (Chapters one-three) introduces Maker Education and the Maker Movement. This movement originated outside formal education, where artists, hobbyists, and tinkerers came together to design and build projects. As the movement gained in popularity, the concept of *learning by making* entered the educational zeitgeist. Additionally, it provides an example of formal Maker Education in China and ends with a framework for establishing and sustaining informal makerspace initiatives in Denmark.

Elizabeth A. P. Larson (elizabethapl@vt.edu | ORCID: 0009-0008-2782-2289) is an elementary STEM education specialist at Margaret Beeks Elementary School, Blacksburg, Virginia and a PhD candidate in the Integrative STEM Education graduate program at Virginia Tech.

Part Two (Chapters four - ten) includes case studies on Maker Education worldwide, underscoring its global relevance. These case studies range from an organized and systematic approach in China, where national policy supports long-term implementation, to the challenges faced in Kenya during the COVID–19 pandemic, with limited resources and no long-term plan for implementation. They encompass all levels of education and learning contexts, providing a view of the global impact attributed to Maker Education.

Part Three (Chapters 10 - 16) reflects on the case studies presented through different thematic lenses associated with Technology Education, including Maker pedagogy, materiality, social learning, spatial ability, making in informal and formal settings, and sustainability.

Summaries

Part 1: The Rise of Maker Education across the World

The opening chapter by Klapwijk and de Vries introduces the global influence of the Maker Movement, suggesting that it can inspire and inform Technology Education worldwide. Both technology Education and the Maker Movement are viewed as sharing a focus on the material world and learners' agency. The introduction provides a comprehensive overview of the history, purpose, educational goals, and pedagogy of Maker Education, setting the stage for the case studies and offering a global context.

Specifically, this chapter emphasizes what appears to be a poignant reality for many: the Maker Movement is not a leisure activity but a necessity. Across the globe, working-class and impoverished people have turned to making out of necessity. Despite limited monetary resources, these populations have learned to repair household items, sew their clothes, do home repairs, and more. This echoes the works of Bonser (1930) and Bonser and Mossman (1923) in the Industrial Arts movement in the United States. The ability to choose, make, and use industry products is a foundational tenet of Industrial Arts that is being revived through the Maker Movement.

Chapters 2 and 3 explain what can happen when there is governmental, private sector, and educational support for makerspaces and Maker Education. Chapter 2 explores the history and evolution of Maker education in China, where Maker Education began with educators. Since then, its importance has been recognized and supported by national education policy, universities, and educators. The focus and drive behind Maker Education in China are innovation. Innovation education has been designed to "improve learners' innovative thinking and literacy through 'learning by doing' and 'creative thinking'" (p.29).

Chapter 3 examines a proposed six-step framework for creating sustainable makerspaces in Denmark. This research took place in eleven municipalities in Denmark that received donations from a private Danish foundation. The process described requires significant infrastructure, funding, expert engagement, and

stakeholder support. Kanstrup et al. acknowledge that this framework is unsuitable for most situations but should be inspirational when considering the creation and sustainability of maker spaces.

Part 2: Case Studies on Maker Education

The case studies presented in Part 2 provide a rich and varied picture of different types of Makerspace Education and makerspaces occurring worldwide. They range from primary students to teachers' professional development experiences.

Informal learning is the focus of Chapter 4, with eight vignettes that describe the learning taking place in makerspaces within the Amsterdam Public Library. These makerspaces are supported by trained Maker-space coaches and provide both school-based and after-school programs for students eight to 12 years of age. The vignettes provided remind me very much of activities and events that take place in my own elementary STEM classroom. However, this case study left me wondering how the authors would delineate between Makerspace education, Technology Education, and STEM education.

Chapter 5 explores Maker Education using e-waste to stimulate a Maker Education mindset in Mexico. A company that recycles e-waste created the EcoMaker Kits and donated them to teachers interested in STEAMS (science, technology, engineering, art/design, mathematics, and sustainability) education following a circular thinking approach (reusing, repurposing, or repairing objects to create artifacts). The goal of the case study was to get students involved in circular thinking and creating a making mindset. The Eco-Maker kits undoubtedly help students with technological skills, tool sense, and interest in sustainable practices, though the prescriptive activities align more with traditional science pedagogies than Technology or Maker education.

Westerhof et al. provide in Chapter 6 a glimpse of the adaptability needed to perform research during the COVID-19 pandemic. This study explores the creation of a workshop program in Kenya aimed at equipping primary students with design-related skills. The initial goal of the project was for students to design a toy that had the potential to be sold at the local market. The lack of appropriate materials shifted the focus from the outcome to the design and creation experience, which resulted in students using the materials available to develop tool sense, design, and tinkering skills. Learning by doing was more important than the outcome.

Chapter 7 examines a professional learning community of technology teachers in Maker Education in South Korea. Technology education in South Korea has six core concepts, including creation, efficiency, communication, adaptation, innovation, and sustainability. These concepts form the foundation of technology education in South Korea, emphasizing the importance of creativity, problem-solving, and sustainability. The essence of Maker Education in South Korea lies in elevating existing knowledge and practices to the next

level rather than simply repeating them. Maker and technology education naturally align and share commonalities in their processes, goals, and practices, fostering a sense of collective effort and engagement.

A model of what Maker Education can look like when fully supported and funded is the focus of Chapter 8. The case study presented in this chapter explains the infrastructure that begins with universities and trickles down to support primary and secondary students. It describes a design project developed by Tsinghua University students and completed by students aged 16-18. The design challenge calls for the creation of an LED lamp, with the set-up, constraints, and requirements reflective of a design challenge that might take place in any technology education classroom. The focus on authentic problems, design, and iteration are the same, which begs the question of how might the authors define the differences between the two fields.

The case study presented in Chapter 9 focuses on integrating Maker Education into the Applied Physics Bachelor program at Delft University. The authors describe the need to develop an appropriate makerspace for the program. The Applied Physics program was redesigned to make use of the makerspace where students were required to pass safety tests, learn new tools and machinery, and complete projects. This case study demonstrates how Technology Education can effectively incorporate makerspaces and Maker education.

Part 3: Thematic Reflections

The last section is compelling in how it connects Technology Education practices and pedagogy with the Maker movement. Each chapter examines the case studies from a different lens. As presented, the connections between Technology Education and Maker Education are easy to make, and in some cases allowing the reader to see the connections without explicitly stating them.

The case studies presented by P. John Williams in Chapter 10 examine *Maker Pedagogy* through Van der Akker's (2013) analytical lens for planning student learning and tailoring it to makerspace environments. Williams explores commonalities among the case studies, ultimately concluding that no singular, prescribed pedagogy for Makerspace Education guarantees success. Despite the distinctions between informal and formal settings, a shared characteristic is that active learning occurs through making and engaging with tangible materials.

Varpu Mehto and Kaiju Kangas examine in Chapter 11 the case studies on the constraints and learning opportunities arising from the available materials and the material environment. They explain how tangible materials and artifacts inspire makers to think, collaborate, tinker, adjust, and solve problems in novel ways. They advocate for careful facilitation with embedded instruction and thoughtful consideration of student needs. This chapter sparked my interest in materials and their impact on design, technology, and research.

In Chapter 12, Fox-Turnbull evaluates social learning during makerspace activities using three learning theories: Zewde's (2010) modified version of Kolb's Experiential Learning Theory, Social Learning Theory, and Participatory Social Learning Development Theory. These theories were applied to analyze various case studies, demonstrating that cooperation and collaboration significantly contribute to participant learning and agency. The author underscores the importance of sharing observations, outcomes, and reflections as critical components of the social learning process in Maker Education.

Buckley examines research on spatial ability in Chapter 13 within the context of Maker Education by posing the following questions: "(1) How does spatial ability relate to making? (2) How should spatial ability be prioritized within Maker Education? and (3) What are the implications of spatial ability development being an explicit intended goal of Maker Education?" While it is evident that making necessitates some level of spatial ability, its significance varies depending on the case study context. Although spatial ability could be emphasized and prioritized in Maker Education, Buckley concludes that more significant social and personal benefits may result from the experience.

In Chapter 14, Van Dijk and Savelsbergh contrast informal and formal educational settings in Maker Education. They examine the case studies through the following lenses: (1) Maker identity development, (2) learning through making, (3) motivation, (4) learning and making with materials, and (5) sustaining a making infrastructure (p.203). Despite the varied contexts and forms of maker education, all the case studies provided opportunities for learning about and evaluating technological issues. The shared key to successful making learning experiences was the role of the teacher or facilitator.

Beaumont, in Chapter 15, examines case studies to determine their sustainability based on the Danish model discussed in Chapter 3. Educational reform necessitates sustainability, which Beaumont defines as when "the initiative becomes embedded in practice and widespread such that it is seen as the norm and no longer an initiative" (p. 219). Despite the case studies having clear goals, they may face challenges regarding sustainability due to factors such as (a) the perceived worth of the initiative by key stakeholders, (b) continued funding, and (c) professional development for teachers and facilitators. Preliminary research on creating and implementing makerspaces indicates that maintaining one would require substantial financial, human, and material resources annually.

In the final chapter by de Vries and Klapwijk, they reflect on the insights gained from the in-depth exploration of various aspects of Maker Education, as well as the challenges it faces. One key takeaway they highlight is that the accessibility and inclusivity of Maker Education should be considered within the context of Technology Education. Collaboration between Maker Education and Technology Education could be mutually beneficial, and conclude there is a need for more research on Maker Pedagogical Content Knowledge.

Conclusions

Maker Education Meets Technology Education: Reflections on Good Practices is a book that is highly recommended for technology educators, technology and engineering educator, design and technology educators, makerspace facilitators, researchers, as well as practitioners interested in enhancing their understanding and implementation of maker education. This book offers a diverse collection of global case studies illustrating how Maker Education principles can be successfully integrated into various educational contexts, from formal classroom settings to community-based makerspaces. For educators and facilitators, it provides practical strategies and frameworks for creating and sustaining engaging, minds-on/hands-on learning environments that foster creativity, critical thinking, and problem-solving skills. Researchers will find valuable insights into the intersections between Maker Education and Technology Education, along with thematic reflections that explore fundamental pedagogical theories, social learning dynamics, and the development of spatial abilities. Practitioners will appreciate the book's honest examination of the challenges and opportunities in implementing Maker Education and its emphasis on sustainability and scalability. Overall, this book is an essential resource for anyone looking to innovate their teaching practices and advance the field of Maker Education.

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