Dailey, D., & Cotabish, A. (Eds.). (2016). *Engineering instruction for high-ability learners in K-8 classrooms.* (K. McDowall, Ed.) Waco, TX, USA: Ringgold, Inc.

Introduction

The book, Engineering Instruction for High-Ability Learners in K-8 Classrooms, edited by Debbie Dailey, Ed.D., and Alicia Cotabish, Ed.D, provides promise to the many K-8 educators and administrators that are searching for background, resources, and practical ideas to implement in their classrooms and ultimately, help close the STEM education gap. The book begins with evidence-based research supporting engineering education throughout K-8 grades. Thirteen rich and engaging chapters provide practical and descriptive examples that STEM educators will find intriguing. This book is a must read for all educators and administrators interested in STEM education. Although the title indicates a specific focus on high-ability learners, this book offers ideas, strategies, resources, and recommendations that are perfectly suited, or can be easily adapted, for all learners.

Summary of Content

It has been reported that approximately 80% of the fastest growing jobs in the U.S. currently require a strong background in STEM and this demand for highly qualified workers is only expected to grow (Dailey & Cotabish, 2016). The reasons for this demand are many and the more traditional school systems have not kept pace with the growing need for highly qualified talent demanded by STEM fields. Students today are entering the workforce and college classrooms ill prepared for the rigors of highly technical jobs and/or higher learning. What needs to be done about this growing gap between our economy and current practices for student preparation? There are no easy answers to this national trend and viable solutions can be found in many different environments. It is encouraging that many schools across the country have awakened to this challenge and are actively working to implement STEM programming. Evidence of impact can be found across all school types, including, public, private, and charter. Similarly, impact can be found across schools in varied socio-economic settings and performance levels. Despite overall progress in STEM education, few programs have successfully addressed the E in STEM, engineering. Often felt that is it too rigorous for the youngest learners, this book does an impressive job of making engineering seem not only practical, but also accessible for all learners.

Analysis and Evaluation

Grounded in Next Generation Science Standards (NGSS) expert authors do an outstanding job of providing chapters rich in practical and thoughtful ideas designed to help administrators and practitioners develop engaging classroom lessons focused on engineering content. One appealing feature of the book is how complex engineering standards are taken and broken down into more straightforward and manageable parts.

Book sections are organized in a way that groups chapters across common themes with a format that flows well and supports both easy reading and use as a reference resource. After a compelling introduction, the first section includes key components of engineering instruction and covers relevant background context and supporting evidence aligned with instructional practices and integrated curriculum. Chapters include discussion of integration with mathematics, use of robotics, innovation, inventiveness, and creativity, and integration of the arts. Section two includes examples of innovative learning practices including 3-D printing, computer science, project-based learning, and maker space concepts. Section three focuses on how to design curriculum through integration of core subjects and assessments. Finally, section four outlines important approaches to professional development for preparing teachers to engage in engineering instruction and includes the importance of engaging school leaders in the process. Beyond these comprehensive sections, two appendices are included with lists of resources and examples of engineering in formal and informal environments.

Individual chapters include a wide range of material, each with references and resources that moderate the many challenges faced by schools trying to implement rigorous STEM programming. Chapter summaries include conclusions and key considerations. In addition to background, many chapters offer practical tips and techniques for teachers as they work on implementing engineering practices into their lessons. In chapter six, Jason Trumble, shares information about using 3-D printing in the classroom. He provides a comprehensive description and history of 3-D printing before delving into practical tips and ideas about incorporating 3-D printing in the classroom using NGSS science and engineering processes. He suggests that it’s not enough to simply add new technology like digital fabrication to the classroom, instead, teachers need to actually redesign student learning. The work to achieve this goal is not an easy undertaking; it is complex and difficult. However, it is ultimately well worth the investment of time and effort because it creates deeper learning experiences and understandings in science and engineering practices for students. The author then offers classroom vignettes to illustrate how 3-D printing can be incorporated into curriculum with real-world application. Teachers can adapt these vignettes to fit their curriculum and different learning environments.

Another example from chapter nine offers a scenario from a fictional second-grade classroom. The scenario presents a second-grade teacher, Miss Smith, who having just participated in professional learning about integrating science and engineering standards into her lessons, recognizes her lesson plan on plants is inadequate. Specifically, she notices that her lesson plan does not comply with NGSS requirements. Created like a story, the reader is walked through actual steps the teacher takes to enhance her lesson plan about what plants need to grow. Working to increase the complexity and depth of the lesson, the author uses statements like “she begins with thinking about how to give her students more *voice* and *choice* with this lesson” (Dailey & Cotabish, pg 126) the chapter continues to describe, in detail, how a better lesson plan can be constructed and transformed with key elements such as essential questions, hands-on investigations, and assessment elements. Tables 9.1 and 9.2 provide the before and after lesson plans for review. This example provides a practical example that can be easily adapted to other scenarios, subject areas or grade levels.

The many examples and strategies included throughout the book make engineering and other STEM subjects appealing to a wide audience, both novice and seasoned practitioners. The authors achieve this goal, not by simplifying content or lessening the rigor and intensity of engineering, but by offering realistic, user-friendly strategies, scenarios, and engaging resources and ideas. Ultimately, the authors help to make engineering accessible to teachers and as a result, makes engineering accessible to students. As students are exposed to learning that is more integrated, rigorous, relevant, and interesting, most will embrace expectations. Instead of exclusion, it makes more sense to approach the rigorous content of STEM as inclusive and open to all students. Higher aptitude and gifted children may show more inclination towards rigorous engineering concepts and may be more likely to embrace higher learning opportunities in STEM fields, but all children will benefit and grow from these rigorous instructional practices.

Conclusion

The book guides reader’s understanding about what engineering is and what skills and competencies are critical to the successful completion of engineering curriculum. Practical examples navigate the reader through how to integrate concepts into and across curricular subjects. Engineering, the E in STEM, is often overlooked as too abstract or complex for students in grades K-8. In this book, authors take on this challenge by recognizing not only the importance of engineering in STEM curriculum but also the importance of starting with young children. Capitalizing on natural curiosities and love of play and discovery, young children are naturally equipped to embrace early engineering concepts. When these concepts are appropriately designed to support developmental needs of young children, we can expect positive outcomes in learning. The book is well written, provides a nice combination of background and practical content, and places engineering within reach for new and experienced practitioners alike.