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BOOK REVIEW Open Access

Gregory P. Thomas and Helen J. Boon: Challenges in science education: global perspectives for the future

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Abstract

Science education is one of the most important materials that students learn in their lives. Through this subject, they will learn about the phenomena that might be happening on the earth. A book by Gregory P. Thomas and Helen J. Boon with the title Challenges in Science Education: Global Perspectives for The Future delivered everything about how teachers could teach science to students in this century. This book will give the readers knowledge about how science can be taught in many ways and for different purposes. Besides that, this book also gives some ideas about the challenges that might teachers face during the learning process.

Keywords: Science, Challenges in science education, Teaching science

This book consists of 13 chapters regarding science teaching which are discussed based on research that has been carried out by several researchers which were then compiled by Gregory P-Thomas and Helen J. Boon, with great care. As a very important branch of knowledge to learn through, science students are expected to be able to solve natural phenomena and protect and appreciate everything on this earth better. This book described various studies on how to teach science and suggestions that can be used as a reference in teaching science, both for the present and for the future. This book was compiled based on research conducted on science teachers, experience, and literature studies from various sources.

The first chapter of this book described the various challenges and choices in science education. This chapter was written by Gregory P. Thomas (Professor of Science Education at the University of Alberta, Canada) and Helen J. Boon (Professor of education at James Cook University), revealed that challenges and choices in learning can become opportunities in advancing education science itself. The challenges faced in learning science such as science content, teacher pedagogy, and technological developments. The choices in teaching vary widely because the learning relates to living things and the

environment science. In this section, it was also conveyed that the lack of references about science education was a challenge in learning.

The second chapter by Tanya Doyle discussed the direction of the movement or the blueprint for science education in Australia. This was reflected in the science education curriculum that will be used by Australia. There are various considerations in determining the policy direction or blueprint for science education in Australia, such as the analysis of deliberative rhetoric, the circumstances, goals, and actions underpinning Australia's quantum age of science. The circumstances included the drive toward the quantum age; goals included economic growth and geophysical security through critical technologies; actions included the drive for impact through investment in quantum technology. These three components were mutually integrated to support the development of education. Besides that, this section also provided an overview of the next steps for science education in Australia, future challenges, and opportunities for science educators.

In the third chapter, which was written by Robyn M. Gillies, he proposed teaching science based on inquiry. This section explained in detail about inquiry-based science such as evidence of success and effectiveness in learning through inquiry. Besides that, it also described the challenges that may be faced in teaching science with inquiry-based. The interesting thing in this chapter was the explanation of the approach used for inquiry-based learning in science. This approach was the 5E model, which was one approach to teaching inquiry-based science that has a strong evidence-based 5E instructional model proposed by Bybee et al. (2015). This model consisted of five phases of learning: engage, explore, explain, elaborate, and evaluate. Not only that, it also explained about being cooperative to learn, scientific literacy, and scientific discourse, to support the implementation of science inquiry-based learning. This section emphasized the application of inquiry-based in science learning with various evidence and recommendations for its implementation.

Furthermore, chapter four discussed Educating About Mass Vaccinations in a Post-Truth Era by Subhashni Taylor, Neil Taylor, and Penelope Baker which suggested the role of science in solving social-science problems that occurred in society. The form of solving social problems presented was in the form of vaccines. This section revealed various truths about vaccines that have been in conflict and have been rejected, especially in America and Australia. This was because science was able to answer scientifically, logically, and completely. What makes this chapter special is that it could provide evidence of the importance of science in solving growing social problems which was in this case discussed the history of vaccine development, the role of the anti-vaccination movement and the media, the role of social media related to vaccine information, the role of education, and less formal approaches. In addition, science was also able to oppose various rejections and concerns of society with an innovation.

The next one is chapter five by William R. Veal, Patricia D. Morrell, Meredith A. Park Rogers, Gillian Roehrig, and Eric J. Pyle which explained their findings regarding the importance of teacher quality in teaching science, especially in developing countries. Teacher quality affects student learning outcomes. Thus, the quality of teachers needs to be improved in order to produce the quality of science learning. This chapter emphasized the findings regarding Science Teachers Preparation (STP), including matters

affecting STP, namely Neoliberal and Complex Systems Approaches, Social Justice, and its sustainability.

Chapter six explained the teacher's role in teaching science such as Everyday Science for Building Schoolchildren's Informed Agency for Action (Helen J. Boon and Donna Rigano). This section explained the urgency of the elementary school teachers' role in teaching science. The role of the elementary school teacher was important because this stage is the beginning or embryo of the formation of knowledge. The science for the next stage. This stage was also the beginning of the formation of science agents so that they were able to build a science that was close to everyday life and was indeed carried out in everyday life. Strengthening and improving the quality of teachers is a must in order to create science agents in life. So, this chapter emphasized that teachers and science were inseparable parts.

Chapter seven on Pre-service Elementary Teachers as Game Designers: Emotional Experiences from the Field written by Laura Martín-Ferrer, Elizabeth Hufnagel, Arnau Amat, Mariona Espinet, and Alberto Bellocchi. This section discussed how to teach science using games. This discussion focused on the implementation of science teaching with games by Pre-Service Teachers (PST). Despite that, it also explained how games affect the students' emotions and teachers in learning science. So, with Game-Based Learning (GBL) it can create fun learning by paying attention to PST in order to support the implementation of science learning with games.

Chapter eight on The Nature of Teacher Educators' Professional Learning: Reflections of Two Science Teacher Educators by Karen Goodnough and Saiqa Azam. This section discussed trials conducted on 2 science teachers regarding the development of knowledge, skills, and pedagogic Teacher Candidates (TCs) to create professional learning (PL) in school. Using the framework by Ping et al. (2018) which consisted of three categories: the 'what' or content of PL, the 'how' or activities of PL, and the 'reasons' or why for PL. In addition, it was also explained that in order to become a professional science teacher, preparation and coaching were needed from college to continuing teaching. Not only focusing on science contents, this chapter placed more emphasis on the pedagogy of teaching science to students. So, the learning material can be well received by students.

Then, chapters nine, ten, and eleven discussed STEM in learning. In Chapter Nine Breaking the Vicious Circle of Secondary Science Education with Twenty-First-Century Technology: Smartphone Physics Labs written by Marina Milner-Bolotin and Valery Milner. This section discussed how the role of technology and information helped in science learning. This also supported the implementation of STEM in learning. Teacher's skills in using information technology are one of the skills that have to be mastered in the application of professional learning and encourage students to be active during learning. This section emphasized the use of technology to support physics labs in learning science.

In chapter ten on Science and Technology Studies Informing STEM Education: Possibilities and Dilemmas by Majd Zouda, Sarah El Halwany, and Larry Bencze. This chapter explained the role of information technology in the implementation of STEM in learning. This section provided an illustration that STEM supported teachers in applying meaningful learning to students. In addition, STEM encouraged students to apply the knowledge gained at school to solve surrounding problems it increased

students' abilities and interest in learning. The limitations of the curriculum, infrastructure, and teachers' quality were a dilemma in its application. Thus, these limitations become opportunities for research and assessment to improve learning.

In chapter eleven on Using Animals in Education as a Means of Discovering Meaningful Contexts to Enhance Learning and Motivate Learners: Challenges and Opportunities to Integrate and Broaden STEM Education by John Cavalieri. This section discussed the role of STEM learning in supporting students' careers in the future. One of the efforts to maximize STEM learning in schools was by using animals. In this case, animals provide meaningful learning to students because they learn directly from real objects while still paying attention to ethics towards animals.

In chapter twelve, which discussed "Instruction for Metacognition in Science Classrooms: Harsh Realities and a Way Forward" written by Gregory P. Thomas. This section addressed the culmination of demands in science education, which was the metacognitive skills of the learners. This aspect was closely tied to the role of teachers in supporting students' metacognition. However, metacognition is often overlooked in the learning process. Therefore, collective efforts are needed to enhance it.

In chapter thirteen of Identifying and Challenging the Narrow Cognitive Demands of Science Textbooks by Claudia E. Johnson and Helen J. Boon. This section revealed the importance of readiness and the availability of reading materials in enhancing students' metacognition. Therefore, when writing books, curriculum, students, and STEM should be taken into consideration to realize professional learning. The reading materials should not only analyze concepts but also emphasize the utilization of that knowledge. The readiness of instructional materials became a determining factor in the achievement of learning, yet this aspect was often overlooked. In this section, the author emphasized that metacognition was crucial in meaningful science education and required special attention to improve the learning's quality.

Learning science is very important in the world of education. Various choices can be made to improve the quality of learning science. Amid the rapid development of technology and information, it becomes a challenge to improve the quality of science learning. So, it is necessary to take advantage of all available opportunities so that people be able to face the challenges of learning science in the future. This book systematically explained the opportunities and challenges of learning science in the present and the future. Thus, it helped the reader to think systemically. In addition, this book was equipped with scientific evidence such as direct research. This helped science teachers in learning because it has been tested through research. The identified weakness in this context was the inconsistency or absence of the section numbering. Furthermore, the spacing between the headings and the next section was too far apart, as in the index, contents, notes on contributors, list of figures, and list of tables. The table appearance was black and white and inconsistent in using numbers/letters as reading points. Overall, this book will be very useful for science teachers to improve the quality of their science teaching and learning experiences. Through this book, science teachers will get a clear picture of how science should be taught and future challenges that will be faced so that teachers can take appropriate action in teaching science to their students.

Abbreviations

STP	Science Teachers Preparation
PST	Pre-Service Teachers
TCs	Teacher Candidates
GBL	Game-based learning
PL	Professional learning
STEM	Science, Technology, Engineering, and Mathematics
5E	Engage, explore, explain, elaborate, and evaluate

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References

Bybee, R., Taylor, J. A., Gardner, A., Van Scotter, P., Carlson Powell, J., Westbrook, A., & Landes, N. (2015). *The BSCS 5E instructional model*. NSTA Press.
Ping, C., Schellings, G., & Beijaard, D. (2018). Teacher educators' professional learning: A literature review. *Teaching and Teacher Education, 75*, 93–104. https://doi.org/10.1016/j.tate.2018.06.003

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