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Jane Essex, *Inclusive and Accessible Secondary Science: How to Teach Science Effectively to Students with Additional or Special Needs*, Routledge, 2023; 133 pp.: ISBN: 978-1-00316-781-5

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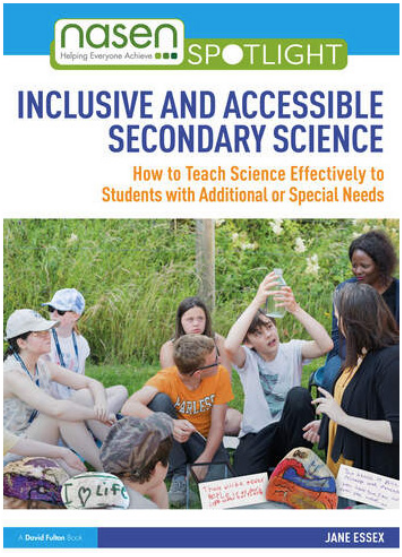

In her book *Inclusive and Accessible Secondary Science*, Jane Essex argues why science education is relevant and beneficial for all people and, therefore, should be accessible to all students, including those with specific or additional needs, even at the secondary level. She discusses the challenges students with learning difficulties encounter in secondary science education and addresses how teachers can counteract this, not only in terms of lesson planning and teaching but also regarding assessment. In so doing, Essex repeatedly refers to her experiences and teaching expertise resulting from the almost 40 years she worked as a science teacher and science teacher educator in England. The book is primarily aimed at science teachers or science teacher educators and thus repeatedly refers to specific teaching situations and instructional strategies. In addition, the readers are continually invited to reflect on their beliefs, perspectives, and teaching contexts, which is encouraged by guiding questions.

Inclusive and Accessible Secondary Science can be roughly divided into two main parts: In the theoretical part, fundamental considerations on the raison d'être of inclusive science education are explained, and the underlying concepts from the fields of pedagogy, science didactics and learning psychology are elaborated, including findings from empirical research. In the practical part, the book provides insight into specific teaching sequences on selected subject

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areas inherent to the first years of learning science in secondary schools and lists some sources recommended for support or further reading.

In her considerations, Essex tirelessly advocates the importance of and the right to access secondary science education. She emphasises the following aspects (among others) related to the perspective of individual students, secondary science teachers, the school system, and society.

Recognising that learning science has universal benefits. Learning science is not limited to preparing individuals for professional, scientific careers. Dealing with science contexts, concepts, and practices equips students with critical thinking skills, problem-solving abilities, and a deeper understanding of the world around them. These skills are universally valuable and contribute to a more informed and engaged citizenship in a society increasingly influenced by innovations in science and technology. With this in mind, Essex advocates scientific literacy for all (Roberts & Bybee, 2014) and calls on society, the educational system, and individual teachers to fulfil their obligation to allow students to acquire this literacy. First and foremost, not only because all people have the right to access quality and equal education, for legal reasons alone, but also because science for all addresses multiple challenges of today's society, such as a shortage of skilled workers while unemployment is simultaneously prevalent among people with learning difficulties or special needs. Beyond that, a considerable part of society is sceptical about science and research, resulting in uninformed consumer decisions, impeding sustainable development.

Acknowledging the potential of diversity for science education and science in general. The historical elitism and exclusionary practices associated with science have perpetuated stereotypes and hindered diversity in both the field of science and science education. By making science teaching (more) inclusive, Essex argues, teachers can challenge these entrenched norms, promoting diversity and breaking down barriers that have long limited access based on socio-economic status, gender, ethnicity, and – in particular – students' learning preconditions. In Essex's opinion, the cultural trappings embedded in scientific practices, such as exclusive language and inaccessible jargon, are not essential for acquiring scientific literacy. However, they disadvantage and categorically exclude students with lower literacy and communication skills. By embracing inclusive approaches to teaching, science education can shed these barriers, making scientific knowledge more accessible and relevant to students with diverse backgrounds and needs. In so doing, science education might contribute to broader societal goals of promoting equity and social justice. It ensures that opportunities to engage with and contribute to scientific knowledge are accessible to everyone, cultivating future generations of scientifically literate individuals who can participate in society in various capacities.

Addressing barriers to science and science education (for students with learning difficulties). The existing science curriculum and pedagogical approaches often create obstacles for students with learning difficulties. Essex states that she is 'conscious of the fact that many teachers […] will not feel able to modify *what* they teach. Despite this, they can still adapt the way in which they teach it […]' (p. 15). Accordingly, she promotes providing various learning resources, incorporating real-world examples that resonate with students from various backgrounds, and fostering a classroom environment that encourages collaboration and respect for diverse perspectives. Recognising and addressing existing barriers may contribute to ensuring that diverse learning styles and abilities are accommodated, allowing all students to participate. Following Essex, students' participation in science education is important for various reasons, for example, for students' enjoyment, personal development and empowerment, their development of science-specific and transferable skills, and their ability to participate in today's society.

After having introduced the theoretical framework regarding inclusive science education, Essex explores why students 'with learning difficulties underachieve in science' and makes suggestions on 'how […] teachers [can] mitigate this' (p. 15). Above all, two well-known theories, namely the levels of cognitive development defined by Piaget and Bloom's taxonomy of cognitive processes, are referred to as the basis for this. Even though these theories may be helpful in identifying the demands of tasks and activities when learning science, they are, unfortunately, primarily related to the cognitive domain of learning science. This analysis does not fully meet the idea of inclusive science education (as presented in previous sections) in that it neglects social, cultural, emotional, and physical factors of learning. By not only naming the other two less well-known domains of Bloom's taxonomy (affective, psychomotor) but also integrating them, a broader perspective could have been taken. Nevertheless, including additional models (e.g., SOLO taxonomy; Biggs & Collis, 1982) and findings from empirical studies, Essex clearly shows that the demands of learning science are often overwhelming not only for students with additional or special needs but also for many others. To counteract this, Essex presents the suggestions of the CASE (Cognitive Acceleration in Science Education; Shayer & Adey, 2002) project to foster students' development of formal thinking, drawing on experiences from her teaching. Further, she figures out four ways in which those with learning difficulties may differ from their peers: executive functions, functional skills, psycho-social characteristics, and experimental and investigative skills. It is described comprehensively how these four aspects – that are no longer limited to the cognitive domain – can manifest themselves

and influence students' learning on the one hand, and how teachers can create science lessons and teaching material that addresses these aspects, on the other hand. By presenting concrete examples, teachers can develop ideas, for example, reducing students' cognitive load, enhancing materials' readability, or creating learning opportunities that allow for differentiation. However, focusing on 'students' challenges' to differentiate between 'students with learning difficulties' and 'their peers' is also at risk of fostering a deficit-oriented and categorising perspective on students and their learning. This sensitive balancing act between addressing students and their individual needs and systematically attributing 'diagnoses' is supported to some extent by the reflective questions. In some of these questions, the barriers to learning are located in the system or learning object (e.g., curriculum, technical language, abstraction, mathematisation) rather than in the students, and teachers are encouraged to reflect on how these barriers could be reduced, minimised, or eliminated by adapting material and instructional strategies (cf. Stinken-Rösner et al., 2020).

One of the distinguishing features of *Inclusive and accessible secondary science* is the section on assessment, which is often disregarded in the context of inclusive education. Essex does not so much focus on specific aspects of 'inclusive assessment' but rather on how to create assessment that covers a broad range of goals aimed for in science education. By opening assessment to different aspects of learning science, the learning outcomes of students with diverse backgrounds and needs – and in particular of students with learning difficulties – can be captured. Essex argues that established assessment techniques, such as typical tests, need to be changed or at least extended by various approaches as students 'who do not do well on such tests should not be assumed not to have learnt, but rather not to have learnt the skills required to bring about success in tests' (p. 61). She advocates aligning assessment with the 'real' teaching intentions, not only those formulated by the curriculum, removing unnecessary barriers from assessment tasks and integrating open-ended questions that allow for creativity and various ways of answering.

The practical section, which forms the back part of the book, consists of concrete teaching sequences related to nine subject areas (e.g., matter, plants, earth, and space). Each of the presented sequences comprises up to eight lessons and is described in terms of learning intentions, the relevance of the topic and the addressed knowledge and skills, the applied instructional strategies, and students' activities and learning opportunities. In so doing, inclusive approaches are discussed by referring to parts of the used teaching materials in order to illustrate how teachers can increase the accessibility of their science lessons. The presented examples serve as great suggestions for teachers and

their teaching practice. Even though the sequences are clearly based on the principles set out in the theoretical section, it is not clear from the practical section whether or in what form the 'effectiveness' of the presented lessons has been investigated. It can, therefore, be assumed that the subtitle of the book, *How to Teach Science Effectively to Students with Additional or Special Needs*, refers to the theoretical framework, including findings from empirical studies in the first part of the book, whereas the practical part is primarily based on the author's own experiences from many years of professional practice.

In *Inclusive and Accessible Secondary Science,* Jane Essex provides a comprehensive argument for the importance of making science education accessible to all learners, particularly to those with specific or additional needs. Through a blend of theoretical discussion and practical insights drawn from her extensive experience, Essex highlights the universal benefits of science education, emphasising its role in fostering critical thinking, problem-solving skills, and a deeper understanding of the world. Essex addresses the challenges faced by students with learning difficulties in secondary science education, offering strategies for teachers to mitigate these challenges in lesson planning, teaching, and assessment. She advocates for inclusive teaching practices that recognise and embrace the diversity of learners, challenging traditional norms and promoting equity and social justice in science education. Overall, *Inclusive and Accessible Secondary Science* serves as a valuable resource for science teachers and science teacher educators, offering both theoretical insights and practical guidance for creating inclusive learning environments where all students can thrive in their science-specific and social pursuits.

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