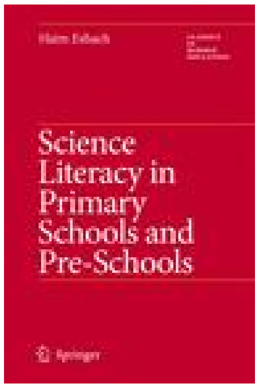
SCIENCE LITERACY IN PRIMARY SCHOOLS AND PRE-SCHOOLS

by Haim Eshach
2006
Springer, Dordrecht, The Netherlands.
xiii+174 pp.
ISBN 1-4020-4641-3 (hardcover)



Science Literacy in Primary Schools and Pre-Schools offers theoretical and practical advice on teaching science to young children. This book should appeal to researchers, policymakers, curriculum designers, college students majoring in education and teachers for designing more effective teaching and learning activities and environments in primary and pre-schools. Dr. Eshach, with his considerable experience in early science education, outlines alternative rationales and a number of approaches to do a good science education by which he means one "that will nurture scientific thinking skills and inculcate in children the desire and passion to know and learn" (p. xii). Nevertheless, he warns that bad science education can sometimes be worse than no science education at all.

Dr. Eshach has a pleasant style, asking different and challenging questions that readers may want to ask when reading the book and answering these questions lucidly. In a sense, this book has an interactive feature. The book, consisting of 5 chapters, begins with a philosophical question, which is also the heading of chapter 1, *Should Science be Taught in Early Childhood?* Chapter 1 discusses why the typical reasons given by educators are problematic and insufficient for teaching science from early childhood. In this chapter, Dr. Eshach provides an excellent overview of his rationale for why science should be taught in early childhood. He offers six justifications for exposing young children to science as follows:

1. Children naturally enjoy observing and thinking about nature: 'A child's world is fresh and new and beautiful, full of wonder and excitement' (Carson, 1984, p.42). Because of their innate curiosity, children eagerly embrace all types of science activities. What makes children particularly ready for science is this intrinsic motivation which refers to doing an activity for its inherent satisfaction rather than for some separable consequences. Some may say children just play during these science activities; however according to Vygotsky, play is the leading factor for the development of relationships between objects, meanings, and imaginations. This is one of the most important arguments for including science in pre-schools.
2. Development of attitudes toward science starts at the early stages of life. Exposing students to science in environments where they can enjoy science develops positive attitudes towards science.
3. Early exposure to scientific phenomena leads to better understanding of the scientific concepts studied later in a formal way.
4. Since teaching science involves introducing the learner to the social language of school science (Scott, 1998), the use of scientifically informed language at an early age influences the eventual development of scientific concepts.
5. Children can understand scientific concepts and reason scientifically: Though there is no consensus on whether or not small children can think scientifically or whether they are mature enough to understand (abstract) scientific concepts, some research indicates that even younger children show the ability to think scientifically and they are able to think about even complex concepts (Metz, 1995).
6. Science is an efficient means for developing scientific thinking: It is essential to encourage students to develop scientific modes of explanations and modelling (Acher et al. 2007) and to develop the science process skills from the earliest school age.

Chapter 2, *How Should Science be Taught in Early Childhood?,* presents novel and creative ways of teaching science to young children: inquiry-based teaching, learning through authentic problems; preference of the Dewey's logical vs. psychological methods, designing teaching drawing on the notion of scaffolding and on the Vygotskian notion of the zone of proximal development (Scott, 1998); situated learning; project-based teaching; and non-verbal knowledge such as the use of visual representations and concept maps. This chapter offers both the theoretical underpinning and practical guidance to create an environment where the child is an active learner (e.g. conducting investigative work, being a scientist for a day). These approaches would help teachers to move away from traditional teacher-dominated activities to student-centered practices.

In Chapter 3, Dr. Eshach argues whether science and design and technology should be integrated in a curriculum. He believes that each approach to science, and design and technology education reviewed in the literature has some limitations. Accordingly, integrating these two subjects can result in ignoring some important aspects of each. Dr. Eshach suggests that "each of the subjects should develop its own activities with regards to the other…science can develop more design and technology activities which are relevant to science lessons and, on the other hand …design and technology might develop scientific activities" (p.83). Drawing upon these ideas, Chapter 3, *When Learning Science by Doing Meets Design and Technology*, addresses the need to implement the *learning by doing* approach in science education, and discusses the learning of science via technology, especially through designing, building, evaluating, and redesigning simple artifacts. Some case studies and illustrations are presented in order to clarify this approach. Wolpert (1997, p.21) pointed out that "science is a special way of knowing and investigating and the only way appreciating the process is to do it". Nevertheless, the current state of science education in primary schools suggests that this is not the case (Harlen, 1997). There are a number of reasons for the insufficient implementation of the *learning by doing* approach in schools. On the one hand, Schank (1996) claims that educators and psychologists have not fully understood why learning by doing works, and are thus hesitant to insist on it. On the other hand, Dr. Eshach argues that teachers' lack of awareness of the effect of that *learning by doing* has on children and that teachers' lack of knowledge in order to implement such approach are the main reasons for this. In this respect, I believe this book offers a clear and helpful frame to change this situation.

Teachers' role is crucial in promoting science literacy in schools and society. Research on teachers' knowledge suggests that both teachers' subject matter knowledge and teachers' pedagogical knowledge are crucial to good science teaching and student understanding (Shulman, 1987). Unlike previous chapters, which are mainly concentrated on the children's needs in science teaching, Chapter 4, *From the Known to the Complex: The Inquiry Events Method as a Tool for K-2 Science Teaching*, focuses not only on the children's needs while designing teaching, but also on those of teachers. One such approach called the 'Inquiry Events' (IE) teaching method is presented in the first part of the chapter. The chapter then moves to a discussion of research which examined educators' changes in science teaching efficacy beliefs and science teaching outcomes after participating in a four-day workshop on IE. The participants included experienced 48 K-2 teachers, curriculum developers, and teaching-trainers from 20 different developing countries of Asia, Africa, Eastern Europe, and the Caribbean Islands. The results indicate that IE is a highly effective teaching method so as to improve science teaching efficacy beliefs of kindergarten and elementary school teachers. The research also suggests that significant changes in teachers' belief systems toward science teaching can be produced in a short period of time. The last part of the chapter continues the inquiry on the IE approach and discusses implementation and evaluation of this approach in two Israeli's kindergartens. The results showed that the IE helped two teachers in these schools to advance their both scientific knowledge and scientific reasoning.

Considering many benefits of out-of-school science learning environments such as science centers, museums and zoos, school trips to these places are not often conducted in a manner that could maximize the learning that can result from them, whether it be conceptual or affective (DeWitt & Osborne, 2007). There are some concerns that teachers do not fully understand the role of out-of-school learning and that non-formal science learning environments such as museums themselves need improvements for offering more effective learning environments. The final chapter of the book, Chapter 5, *Bridging In-School and Out-of-School Learning: Formal, Non-Formal, and Informal*, explores the nature of out-of-school learning and provides both theoretical and practical frameworks to bridge in and out-of-school learning. Dr. Eshach identifies four factors which influences out-of-school learning each containing cognitive and affective components: personal, physical, social, and instructional. This chapter makes a valuable contribution to the book in the sense that it offers numerous frameworks and examples for teachers and educators to construct bridges so that out-of-school learning is better connected to in-school learning. Research on the impacts of science fieldtrips and the effects of particular instructional practices on students' learning has resulted in a series of recommendations. As recommended by Dr. Eshach, as well as stated by DeWitt and Osborne (2007), teachers are encouraged to become familiar with the setting before the fieldtrip; to decide the purpose of the fieldtrip; to share the purpose and expectations of the visit with children, to present children the structure of visit; to plan pre-visit activities aligned with curriculum goals; to provide some tasks to be conducted in the fieldtrip, to encourage parents of kindergarten children to join the trip; to plan and conduct post-visit classroom activities to reinforce the fieldtrip experiences. It is also suggested to build a specific science center (what is called Scientific Kindergartens or Enrichment Centers) for small children in different part of a town or city. Such centers, that might even be part of science museums or schools, therefore, could offer a rich learning environment for children, parents, and teachers in the community. Most importantly, teachers' objectives for fieldtrips and effective instructional strategies used by teachers during the fieldtrip should be the focus of pre-service and in-service teacher-training courses in order to gain more benefits from out-of-school practices.

The book ends with 'matome', means 'summing up' in Japanese, in which the main points are summarized and a set of issues and questions which warrant further research attention is propounded. These questions are: why do some science activities work better than others with children? How can we prepare teachers for science education in kindergarten? How widely and in what way do teachers pass on their scientific knowledge and skills to their children? What kind of activities might advance executive control functions in children? What difficulties do children have in understanding scientific knowledge and in acquiring scientific skills? What activities are required to develop meta-cognitive operators in children? How can we analyze whether scientific activities efficiently scaffold scientific knowledge and scientific reasoning? How might educators best invest effort to build science curricula that take into account the points discussed in this book? (p.144-145).

Overall, Dr. Eshach's book offers a vigorous and reasoned argument to change the way policymakers, researchers, and teachers envision science education in early childhood. However, his research and I shall say some of his radical ideas offer interesting challenges and opportunities for further development and research. The most important requirement for this or any other approaches to science teaching is to develop and implement the teaching activity proposed, and to assess learning outcomes. In summary, justifications, approaches and methods for teaching science in early childhood offered in this book need further evaluation but are promising as effective teaching and learning approaches in primary schools and pre-schools.

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