Teaching Einsteinian Physics in Schools

Edited by: Magdalena Kersting & David Blair.

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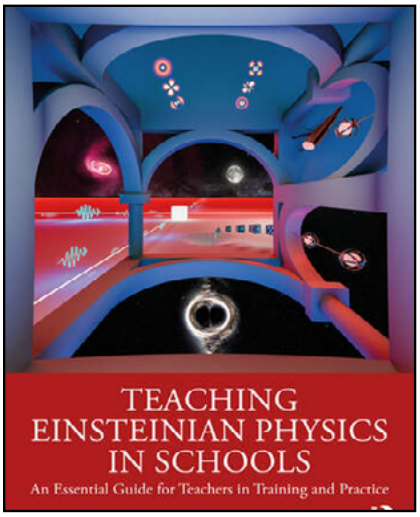
Audience: Teacher education students, primary and secondary science teachers.



Teaching Einsteinian Physics in Schools is a very large book of 416 pages (25 Chapters in 3 sections). Each chapter is presented by an author, or group of authors, with their own particular views and insights about teaching Einsteinian physics. Although there are a variety of opinions presented, there is a general sense of unity in the view that Einsteinian physics should become a part of the school curriculum.

The book is divided into three sections. The first section of the book includes a general philosophical justification for teaching Einsteinian physics; the second considers a wide variety of instructional problems whilst the final section looks at some world-wide attempts to implement the teaching of Einsteinian physics in schools. The book has been carefully edited by Magdalena Kersting and David Blair. It is illustrated with a variety of diagrams in both black and white and in colour.

The purpose of the book is to convince the reader that Einsteinian physics should be taught in schools, and that it should be taught as part of science in a spiralling curriculum from primary school onwards. This is based on Jerome Bruner's famous aphorism "Any subject can be taught effectively in some intellectually honest form to any child at any stage of development." (p. 332).

The reason that Einsteinian physics, which is our best understanding of reality, must be taught at an early age, is that its conclusions often appear to be contrary to common sense by those accepting a Newtonian paradigm. Einstein said that "common sense is the collection of prejudices acquired by the age of 18" (p. 40), so students need to develop a new common sense, which can only be achieved by obtaining familiarity with Einsteinian principles at an early age. The counterargument that Einsteinian physics is too difficult to be taught in schools is not expressed directly, but several chapters hint that this is the main reason why very few countries include Einsteinian physics in their national curricula. A few countries such as Scotland do include special relativity as a topic in Year 12 courses (p. 338).

One excellent feature of the book is that at the start of each chapter there is a brief description of what it contains and the persons for whom it will be useful. The most common project described is the 'Einstein First' project carried out by a group of science education researchers from Western Australia. These chapters are supported online via YouTube showing students carrying out experimental work, and there is also a description of the 'Einstein First' project (i.e., https://www.einsteinianphysics.com/).

A problem that the researchers have recognised is the lack of experimental work that directly relates to Einstein's theories. This is because apparatus that directly confirms his theories is both expensive and difficult to use. The researchers have devised a number of experiments based on analogies or models, which can be used by secondary students. The project used 'nerf guns' to explain photography, Heisenberg's uncertainty principle, and the photoelectric effect with the bullets fired being analogous to a stream of photons in a ray of light. The central idea of the dual nature of light is explained by the following aphorism: "Everything has bulletiness: everything has waviness. Bulletiness follows the maths of number: waves follow the maths of arrows". The 'nerf gun' experiments can be used to illustrate the bulletiness of light. Chapter 17 (p. 273) on gold illustrates the fact that there are some areas, where cooperation between teachers of chemistry and physics can provide positive links between the subjects.

The researchers have now opened several possible pathways for increasing the quantity of Einsteinian physics taught in schools and the book *Teaching Einsteinian Physics in Schools* provides future curriculum developers with ways of doing this. Chapter 2 carefully points out that change will only occur when a critical mass of researchers in this area has been reached (p. 28). Has that point has been reached? What should happen next? This is where those who would actually teach the subject should have a say. There needs to be a critical mass of physics teachers demanding such changes.

I would suggest that all secondary schools need to have a copy of this book and physics teachers need to read it. The book's main weakness was that some chapters went beyond what would be teachable in Year 12. Curriculum change is always difficult to achieve, but the contributors to this book have provided a valuable resource in making a change in the way science is taught possible.

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