[EPUB] Multiple Representations In Chemical Education Models And Modeling In Science Education

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Multiple Representations in Chemical Education-John K. Gilbert 2009-02-28 Chemistry seeks to provide qualitative and quantitative explanations for the observed behaviour of elements and their compounds. Doing so involves making use of three types of representation: the macro (the empirical properties of substances); the sub-micro (the natures of the entities giving rise to those properties); and the symbolic (the number of entities involved in any changes that take place). Although understanding this triplet relationship is a key aspect of chemical education, there is considerable evidence that students find great difficulty in achieving mastery of the ideas involved. In bringing together the work of leading chemistry educators who are researching the triplet relationship at the secondary and university levels, the book discusses the learning involved, the problems that students encounter, and successful approaches to teaching. Based on the reported research, the editors argue for a coherent model for understanding the triplet relationship in chemical education.
Multiple Representations in Chemical Education-John K. Gilbert 2010-10-28 Chemistry seeks to provide qualitative and quantitative explanations for the observed behaviour of elements and their compounds. Doing so involves making use of three types of representation: the macro (the empirical properties of substances); the sub-micro (the natures of the entities giving rise to those properties); and the symbolic (the number of entities involved in any changes that take place). Although understanding this triplet relationship is a key aspect of chemical education, there is considerable evidence that students find great difficulty in achieving mastery of the ideas involved. In bringing together the work of leading chemistry educators who are researching the triplet relationship at the secondary and university levels, the book discusses the learning involved, the problems that students encounter, and successful approaches to teaching. Based on the reported research, the editors argue for a coherent model for understanding the triplet relationship in chemical education.
Multiple Representations in Physics Education-David F. Treagust 2017-08-25 This volume is important because despite various external representations, such as analogies, metaphors, and visualizations being commonly used by physics teachers, educators and researchers, the notion of using the pedagogical functions of multiple representations to support teaching and learning is still a gap in physics education. The research presented in the three sections of the book is introduced by descriptions of various psychological theories that are applied in different ways for designing physics teaching and learning in classroom settings. The following chapters of the book illustrate teaching and learning with respect to applying specific physics multiple representations in different levels of the education system and in different physics topics using analogies and models, different modes, and in reasoning and representational competence. When multiple representations are used in physics for teaching, the expectation is that they should be successful. To ensure this is the case, the implementation of representations should consider design principles for using multiple representations. Investigations regarding their effect on classroom communication as well as on the learning results in all levels of schooling and for different topics of physics are reported. The book is intended for physics educators and their students at universities and for physics teachers in schools to apply multiple representations in physics in a productive way.
Visualization: Theory and Practice in Science Education-John K. Gilbert 2007-12-05 External representations (pictures, diagrams, graphs, concrete models) have always been valuable tools for the science teacher. This book brings together the insights of practicing scientists, science education researchers, computer specialists, and cognitive scientists, to produce a coherent overview. It links presentations about cognitive theory, its implications for science curriculum design, and for learning and teaching in classrooms and laboratories.
Multiple Representations in Biological Education-David F. Treagust 2013-02-01 This new publication in the Models and Modeling in Science Education series synthesizes a wealth of international research on using multiple representations in biology education and aims for a coherent framework in using them to improve higher-order learning. Addressing a major gap in the literature, the volume proposes a theoretical model for advancing biology educators' notions of how multiple external representations (MERs) such as analogies, metaphors and visualizations can best be harnessed for improving teaching and learning in biology at all pedagogical levels. The content tackles the conceptual and linguistic difficulties of learning biology at each level—macro, micro, sub-micro, and symbolic, illustrating how MERs can be used in teaching across these levels and in various combinations, as well as in differing contexts and topic areas. The strategies outlined will help students' reasoning and problem-solving skills, enhance their ability to construct mental models and internal representations, and, ultimately, will assist in increasing public understanding of biology-related issues, a key goal in today's world of pressing concerns over societal problems about food, environment, energy, and health. The book concludes by highlighting important aspects of research in biological education in the post-genomic, information age.
Visualization in Science Education-John K. Gilbert 2006-03-30 This book addresses key issues concerning visualization in the teaching and learning of science at any level in educational systems. It is the first book specifically on visualization in science education. The book draws on the insights from cognitive psychology, science, and education, by experts from five countries. It unites these with the practice of science education, particularly the ever-increasing use of computer-managed modelling packages.
Chemistry Education in the ICT Age-Minu Gupta Bhowon 2009-07-21 th th The 20 International Conference on Chemical Education (20 ICCE), which had rd th "Chemistry in the ICT Age" as the theme, was held from 3 to 8 August 2008 at Le Méridien Hotel, Pointe aux Piments, in Mauritius. With more than 200 participants from 40 countries, the conference featured 140 oral and 50 poster presentations. th Participants of the 20 ICCE were invited to submit full papers and the latter were subjected to peer review. The selected accepted papers are collected in this book of proceedings. This book of proceedings encloses 39 presentations covering topics ranging from fundamental to applied chemistry, such as Arts and Chemistry Education, Biochemistry and Biotechnology, Chemical Education for Development, Chemistry at Secondary Level, Chemistry at Tertiary Level, Chemistry Teacher Education, Chemistry and Society, Chemistry Olympiad, Context Oriented Chemistry, ICT and Chemistry Education, Green Chemistry, Micro Scale Chemistry, Modern Technologies in Chemistry Education, Network for Chemistry and Chemical Engineering Education, Public Understanding of Chemistry, Research in Chemistry Education and Science Education at Elementary Level. We would like to thank those who submitted the full papers and the reviewers for their timely help in assessing the papers for publication. th We would also like to pay a special tribute to all the sponsors of the 20 ICCE and, in particular, the Tertiary Education Commission (http://tec.intnet.mu/) and the Organisation for the Prohibition of Chemical Weapons (http://www.opcw.org/) for kindly agreeing to fund the publication of these proceedings.
Chemistry-Thomas R. Gilbert 2013-08-06 The authors, who have more than two decades of combined experience teaching an atoms-first course, have gone beyond reorganizing the topics. They emphasize the particulate nature of matter throughout the book in the text, art, and problems, while placing the chemistry in a biological, environmental, or geological context. The authors use a consistent problem-solving model and provide students with ample opportunities to practice.
Science Teachers' Use of Visual Representations-Billie Eilam 2014-07-11 This book examines the diverse use of visual representations by teachers in the science classroom. It contains unique pedagogies related to the use of visualization, presents original curriculum materials as well as explores future possibilities. The book begins by looking at the significance of visual representations in the teaching of science. It then goes on to detail two recent innovations in the field: simulations and slowmation, a process of explicit visualization. It also evaluates the way teachers have used different diagrams to illustrate concepts in biology and chemistry. Next, the book explores the use of visual representations in culturally diverse classrooms, including the implication of culture for teachers' use of representations, the crucial importance of language in the design and use of visualizations and visualizations in popular books about chemistry. It also shows the place of visualizations in the growing use of informal, self-directed science education. Overall, the book concludes that if the potential of visualizations in science education is to be realized in the future, the subject must be included in both pre-service and in-service teacher education. It explores ways to develop science teachers' representational competence and details the impact that this will have on their teaching. The worldwide trend towards providing science education for all, coupled with the increased availability of color printing, access to personal computers and projection facilities, has lead to a more extensive and diverse use of visual representations in the classroom. This book offers unique insights into the relationship between visual representations and science education, making it an ideal resource for educators as well as researchers in science education, visualization and pedagogy.
Discipline-Based Education Research-National Research Council 2012-08-27 The National Science Foundation funded a synthesis study on the status, contributions, and future direction of discipline-based education research (DBER) in physics, biological sciences, geosciences, and chemistry. DBER combines knowledge of teaching and learning with deep knowledge of discipline-specific science content. It describes the discipline-specific difficulties learners face and the specialized intellectual and instructional resources that can facilitate student understanding. Discipline-Based Education Research is based on a 30-month study built on two workshops held in 2008 to explore evidence on promising practices in undergraduate science, technology, engineering, and mathematics (STEM) education. This book asks questions that are essential to advancing DBER and broadening its impact on undergraduate science teaching and learning. The book provides empirical research on undergraduate teaching and learning in the sciences, explores the extent to which this research currently influences undergraduate instruction, and identifies the intellectual and material resources required to further develop DBER. Discipline-Based Education Research provides guidance for future DBER research. In addition, the findings and recommendations of this report may invite, if not assist, post-secondary institutions to increase interest and research activity in DBER and improve its quality and usefulness across all natural science disciples, as well as guide instruction and assessment across natural science courses to improve student learning. The book brings greater focus to issues of student attrition in the natural sciences that are related to the quality of instruction. Discipline-Based Education Research will be of interest to educators, policy makers, researchers, scholars, decision makers in universities, government agencies, curriculum developers, research sponsors, and education advocacy groups.
Research and Practice in Chemistry Education-Madeleine Schultz 2019-04-06 This book brings together fifteen contributions from presenters at the 25th IUPAC International Conference on Chemistry Education 2018, held in Sydney. Written by a highly diverse group of chemistry educators working within different national and institutional contexts with the common goal of improving student learning, the book presents research in multiple facets of the cutting edge of chemistry education, offering insights into the application of learning theories in chemistry combined with practical experience in implementing teaching strategies. The chapters are arranged according to the themes novel pedagogies, dynamic teaching environments, new approaches in assessment and professional skills – each of which is of substantial current interest to the science education communities. Providing an overview of contemporary practice, this book helps improve student learning outcomes. Many of the teaching strategies presented are transferable to other disciplines and are of great interest to the global community of tertiary chemistry educators as well as readers in the areas of secondary STEM education and other disciplines.
Multiple Representations in Biological Education-David F. Treagust 2013-02-01 This new publication in the Models and Modeling in Science Education series synthesizes a wealth of international research on using multiple representations in biology education and aims for a coherent framework in using them to improve higher-order learning. Addressing a major gap in the literature, the volume proposes a theoretical model for advancing biology educators' notions of how multiple external representations (MERs) such as analogies, metaphors and visualizations can best be harnessed for improving teaching and learning in biology at all pedagogical levels. The content tackles the conceptual and linguistic difficulties of learning biology at each level—macro, micro, sub-micro, and symbolic, illustrating how MERs can be used in teaching across these levels and in various combinations, as well as in differing contexts and topic areas. The strategies outlined will help students' reasoning and problem-solving skills, enhance their ability to construct mental models and internal representations, and, ultimately, will assist in increasing public understanding of biology-related issues, a key goal in today's world of pressing concerns over societal problems about food, environment, energy, and health. The book concludes by highlighting important aspects of research in biological education in the post-genomic, information age.
Tools of Chemistry Education Research-Diane M. Bunce 2015-02-05 Tools of Chemistry Education Research meets the current need for information on more in-depth resources for those interested in doing chemistry education research. Renowned chemists Diane M. Bunce and Renée S. Cole present this volume as a continuation of the dialogue started in their previous work, Nuts and Bolts of Chemical Education Research. With both volumes, new and experienced researchers will now have a place to start as they consider new research projects in chemistry education. Tools of Chemistry Education Research brings together a group of talented researchers to share their insights and expertise with the broader community. The volume features the contributions of both early career and more established chemistry education researchers, so as to promote the growth and expansion of chemistry education. Drawing on the expertise and insights of junior faculty and more experienced researchers, each author offers unique insights that promise to benefit other practitioners in chemistry education research.
Creative Chemists-Simon Rees 2020-06-29 Creative thinking, be it that of the teacher or the student, has tended to be overlooked in science, but exercising it is important. This book shows how it can be done in chemistry, both in the context of creative chemistry teaching and in learning chemistry. Going beyond principles and ideology, readers will find practical strategies, tools, examples, and case studies in a variety of contexts to bring creative thinking theory into practice. Beginning with a discussion on the nature of creativity, the authors' debunk misconceptions and address the relationship between creativity and problem solving. Delving into opportunities for practising creative thinking in science, for instance, hypothesis generation and experiment design, the authors' then move on to discussions around assessing and evaluating creative thinking. Further areas covered include: multisensory chemistry, language and literacy, practical work and story-telling. As a resource, this book points the way to fostering exploration and the development of creative thinking in chemistry for the benefit of the student, and for the benefit of the teacher in offering a source of satisfaction and achievement in the work they do.
Chemical Education: Towards Research-based Practice-J.K. Gilbert 2006-04-11 Chemical education is essential to everybody because it deals with ideas that play major roles in personal, social, and economic decisions. This book is based on three principles: that all aspects of chemical education should be associated with research; that the development of opportunities for chemical education should be both a continuous process and be linked to research; and that the professional development of all those associated with chemical education should make extensive and diverse use of that research. It is intended for: pre-service and practising chemistry teachers and lecturers; chemistry teacher educators; chemical education researchers; the designers and managers of formal chemical curricula; informal chemical educators; authors of textbooks and curriculum support materials; practising chemists and chemical technologists. It addresses: the relation between chemistry and chemical education; curricula for chemical education; teaching and learning about chemical compounds and chemical change; the development of teachers; the development of chemical education as a field of enquiry. This is mainly done in respect of the full range of formal education contexts (schools, universities, vocational colleges) but also in respect of informal education contexts (books, science centres and museums).
Chemical Misconceptions-Keith Taber 2002 Part 1 deals with the theory of misconceptions, by including information on some of the key alternative conceptions that have been uncovered by research.
Chemistry-Thomas R. Gilbert 2020 "A research-based text and assessment package that helps students visualize chemistry as they solve problems. The exciting NEW Sixth Edition expands on the visualization pedagogy from coauthor Stacey Lowery Bretz and makes it even easier to implement in the classroom. Based on her chemistry education research on how students construct and interpret multiple representations, art in the book and media has been revised to be more pedagogically effective and to address student misconceptions. NEW projected visualization questions help instructors assess students' conceptual understanding in lecture or during exams. A NEW Interactive Instructor's Guide provides innovative ways to incorporate research-based active learning pedagogy into the classroom"--
Towards a Framework for Representational Competence in Science Education-Kristy L. Daniel 2018-07-25 This book covers the current state of thinking and what it means to have a framework of representational competence and how such theory can be used to shape our understanding of the use of representations in science education, assessment, and instruction. Currently, there is not a consensus in science education regarding representational competence as a unified theoretical framework. There are multiple theories of representational competence in the literature that use differing perspectives on what competence means and entails. Furthermore, dependent largely on the discipline, language discrepancies cause a potential barrier for merging ideas and pushing forward in this area. While a single unified theory may not be a realistic goal, there needs to be strides taken toward working as a unified research community to better investigate and interpret representational competence. An objective of this book is to initiate thinking about a representational competence theoretical framework across science educators, learning scientists, practitioners and scientists. As such, we have divided the chapters into three major themes to help push our thinking forward: presenting current thinking about representational competence in science education, assessing representational competence within learners, and using our understandings to structure instruction.
Chemistry Education-Javier García-Martínez 2015-02-17 Winner of the CHOICE Outstanding Academic Title 2017 Award This comprehensive collection of top-level contributions provides a thorough review of the vibrant field of chemistry education. Highly-experienced chemistry professors and education experts cover the latest developments in chemistry learning and teaching, as well as the pivotal role of chemistry for shaping a more sustainable future. Adopting a practice-oriented approach, the current challenges and opportunities posed by chemistry education are critically discussed, highlighting the pitfalls that can occur in teaching chemistry and how to circumvent them. The main topics discussed include best practices, project-based education, blended learning and the role of technology, including e-learning, and science visualization. Hands-on recommendations on how to optimally implement innovative

strategies of teaching chemistry at university and high-school levels make this book an essential resource for anybody interested in either teaching or learning chemistry more effectively, from experience chemistry professors to secondary school teachers, from educators with no formal training in didactics to frustrated chemistry students.

Concepts of Matter in Science Education-Georgios Tsaparlis 2013-07-09 Bringing together a wide collection of ideas, reviews, analyses and new research on particulate and structural concepts of matter, Concepts of Matter in Science Education informs practice from pre-school through graduate school learning and teaching and aims to inspire progress in science education. The expert contributors offer a range of reviews and critical analyses of related literature and in-depth analysis of specific issues, as well as new research. Among the themes covered are learning progressions for teaching a particle model of matter, the mental models of both students and teachers of the particulate nature of matter, educational technology, chemical reactions and chemical phenomena, chemical structure and bonding, quantum chemistry and the history and philosophy of science relating to the particulate nature of matter. The book will benefit a wide audience including classroom practitioners and student teachers at every educational level, teacher educators and researchers in science education. "If gaining the precise meaning in particulate terms of what is solid, what is liquid, and that air is a gas, were that simple, we would not be confronted with another book which, while suggesting new approaches to teaching these topics, confirms they are still very difficult for students to learn". Peter Fensham, Emeritus Professor Monash University, Adjunct Professor QUT (from the foreword to this book)

Towards a Competence-Based View on Models and Modeling in Science Education-Annette Upmeier zu Belzen 2020-01-01 The book takes a closer look at the theoretical and empirical basis for a competence-based view of models and modeling in science learning and science education research. Current thinking about models and modeling is reflected. The focus lies on the development of modeling competence in science education, and on philosophical aspects, including perspectives on nature of science. The book explores, interprets, and discusses models and modeling from the perspective of different theoretical frameworks and empirical results. The extent to which these frameworks can be integrated into a competence-based approach for science education is discussed. In addition, the book provides practical guidance by outlining evidence-based approaches to diagnosing and promoting modeling competence. The aim is to convey a strong understanding of models and modeling for professions such as teacher educators, science education researchers, teachers, and scientists. Different methods for the diagnosis and assessment of modeling competence are presented and discussed with regard to their potential and limitations. The book provides evidence-based ideas about how teachers can be supported in teaching with models and modeling implementing a competence-based approach and, thus, how students can develop their modeling competence. Based on the findings, research challenges for the future are identified.

International Perspectives on Chemistry Education, Research, and Practice-Charlie Cox 2019-08 Strategies for improving teaching and student success in secondary and post-secondary chemistry classrooms is widely researched nationally and internationally. The development of high quality instruction is key to retaining students in STEM fields, as well as, developing standards for deeper learning and application of course content. The latter is particularly important given the central nature of chemistry to STEM fields which is reflected by the number of majors that require a minimal exposure to chemistry theory and practice. The idea of gathering international perspectives emerged from our participation in the ACS Chemical Education international committee and from hosting ACS symposia focusing upon international relations and research. To broaden perspectives of chemical education through an international lens, researchers in Australia, Turkey, Romania, Costa Rica, Singapore, the Netherlands, Greece, Slovenia, and Canada contributed chapters with a focus upon topics ranging from assessment, safety, pedagogy, metacognition, to outreach. In addition to symposium presenters, other contributors were invited based upon their knowledge of chemical education theory and practice.

Learning with Multiple Representations-Maarten W. van Someren 1998 Aims to collect papers on learning declarative knowledge and problem solving skills that involve multiple representations such as graphical and mathematical representations, knowledge at different levels of abstraction. This book covers approaches to this topic from different perspectives: educational, cognitive modelling and machine learning.

Positive Learning in the Age of Information-Olga Zlatkin-Troitschanskaia 2017-12-15 While information and communication technology has a vast influence on our lives, little is understood about its effects on the way we learn. In the Age of Information, students – consciously or not – are learning in diverse formal and informal environments from a broad variety of sources, with scientific knowledge competing against unfounded assertions, and misinformation and biased data spreading through social and mass media. The Positive Learning in the Age of Information (PLATO) program illustrated by the contributions in this book unites outstanding and highly innovative expertise on the fundamentals of information processing and human learning to investigate a new paradigm of positive learning as a vital, morally and ethically oriented approach, which is of existential importance to maintaining the civilization standards of a modern society in the digital age.

Pericyclic Chemistry-Dipak Kumar Mandal 2018-03-26 Pericyclic Chemistry: Orbital Mechanisms and Stereochemistry is a complete guide to the topic that is ideal for graduate students, advanced undergraduate students and researchers in organic chemistry. An introduction to molecular orbital theory and relevant stereochemical concepts is provided as background, with all four classes of pericyclic reactions discussed and illustrated with orbital picture representations. Also included are chapters on cycloadditions, the most versatile class, and electrocyclic reactions, sigmatropic rearrangements and group transfer reactions. A separate chapter on the construction of correlation diagrams is also included, emphasizing a practical, hands on approach. Author Dipak Kumar Mandal brings over 30 years of teaching experience to the topic and illuminates pericyclic chemistry with a clear and fresh perspective. Comprehensive guide featuring unifying mechanistic approaches, stereochemical details and novel rules and mnemonics to delineate product stereochemistry Includes two background chapters on molecular orbitals and stereochemical concepts Emphasizes a theoretical understanding using perturbation theory (Salem-Klopman equation) and physical insights from orbital and state correlation analyses

We Have Never Been Modern-Bruno Latour 2012-11-01 With the rise of science, we moderns believe, the world changed irrevocably, separating us forever from our primitive, premodern ancestors. But if we were to let go of this fond conviction, Bruno Latour asks, what would the world look like? His book, an anthropology of science, shows us how much of modernity is actually a matter of faith. What does it mean to be modern? What difference does the scientific method make? The difference, Latour explains, is in our careful distinctions between nature and society, between human and thing, distinctions that our benighted ancestors, in their world of alchemy, astrology, and phrenology, never made. But alongside this purifying practice that defines modernity, there exists another seemingly contrary one: the construction of systems that mix politics, science, technology, and nature. The ozone debate is such a hybrid, in Latour’s analysis, as are global warming, deforestation, even the idea of black holes. As these hybrids proliferate, the prospect of keeping nature and culture in their separate mental chambers becomes overwhelming—and rather than try, Latour suggests, we should rethink our distinctions, rethink the definition and constitution of modernity itself. His book offers a new explanation of science that finally recognizes the connections between nature and culture—and so, between our culture and others, past and present. Nothing short of a reworking of our mental landscape. We Have Never Been Modern blurs the boundaries among science, the humanities, and the social sciences to enhance understanding on all sides. A summation of the work of one of the most influential and provocative interpreters of science, it aims at saving what is good and valuable in modernity and replacing the rest with a broader, fairer, and finer sense of possibility.

Handbook of Research on Science Education-Norman G. Lederman 2014-07-11 Building on the foundation set in Volume I—a landmark synthesis of research in the field—Volume II is a comprehensive, state-of-the-art new volume highlighting new and emerging research perspectives. The contributors, all experts in their research areas, represent the international and gender diversity in the science education research community. The volume is organized around six themes: theory and methods of science education research; science learning; culture, gender, and society and science learning; science teaching; curriculum and assessment in science; science teacher education. Each chapter presents an integrative review of the research on the topic it addresses—pulling together the existing research, working to understand the historical trends and patterns in that body of scholarship, describing how the issue is conceptualized within the literature, how methods and theories have shaped the outcomes of the research, and where the strengths, weaknesses, and gaps are in the literature. Providing guidance to science education faculty and graduate students and leading to new insights and directions for future research, the Handbook of Research on Science Education, Volume II is an essential resource for the entire science education community.

Teaching Science in Elementary and Middle School-Joseph S. Krajcik 2014-01-23 Teaching Science in Elementary and Middle School offers in-depth information about the fundamental features of project-based science and strategies for implementing the approach. In project-based science classrooms students investigate, use technology, develop artifacts, collaborate, and make products to show what they have learned. Paralleling what scientists do, project-based science represents the essence of inquiry and the nature of science. Because project-based science is a method aligned with what is known about how to help all children learn science, it not only helps students learn science more thoroughly and deeply, it also helps them experience the joy of doing science. Project-based science embodies the principles in A Framework for K-12 Science Education and the Next Generation Science Standards. Blending principles of learning and motivation with practical teaching ideas, this text shows how project-based learning is related to ideas in the Framework and provides concrete strategies for meeting its goals. Features include long-term, interdisciplinary, student-centered lessons; scenarios; learning activities, and "Connecting to Framework for K–12 Science Education" textboxes. More concise than previous editions, the Fourth Edition offers a wealth of supplementary material on a new Companion Website, including many videos showing a teacher and class in a project environment.

Misconceptions in Chemistry-Hans-Dieter Barke 2008-11-18 Over the last decades several researchers discovered that children, pupils and even young adults develop their own understanding of "how nature really works". These pre-concepts concerning combustion, gases or conservation of mass are brought into lectures and teachers have to diagnose and to reflect on them for better instruction. In addition, there are ‘school-made misconceptions’ concerning equilibrium, acid-base or redox reactions which originate from inappropriate curriculum and instruction materials. The primary goal of this monograph is to help teachers at universities, colleges and schools to diagnose and ‘cure’ the pre-concepts. In case of the school-made misconceptions it will help to prevent them from the very beginning through reflective teaching. The volume includes detailed descriptions of class-room experiments and structural models to cure and to prevent these misconceptions.

Women In Their Element: Selected Women's Contributions To The Periodic System-Lykknes Annette 2019-08-05 This year we celebrate the 150th anniversary of Mendeleev's first publication of the Periodic Table of Elements. This book offers an original viewpoint on the history of the Periodic Table: a collective volume with short illustrated papers on women and their contribution to the building and the understanding of the Periodic Table and of the elements themselves.Few existing texts deal with women's contributions to the Periodic Table. A book on women's work will help make historical women chemists more visible, as well as shed light on the multifaceted character of the work on the chemical elements and their periodic relationships. Stories of female input, the editors believe, will contribute to the understanding of the nature of science, of collaboration as opposed to the traditional depiction of the lone genius.While the discovery of elements will be a natural part of this collective work, the editors aim to go beyond discovery histories. Stories of women contributors to the chemistry of the elements will also include understanding the concept of element, identifying properties, developing analytical methods, mapping the radioactive series, finding applications of elements, and the participation of women as audiences when new elements were presented at lectures.As for the selection of women, the chapters include pre-periodic table contributions as well as recent discoveries, unknown stories as well as more famous ones. The main emphasis will be on work conducted in the late 19th century and early 20th century. Furthermore, the book includes elements from different groups in the periodic table, so as to represent a variety of chemical contexts.'As with the discoveries themselves, bringing these tales of female scientists to light has taken much teamwork, including by contributors Gisela Boeck, John Hudson, Claire Murray, Jessica Wade, Mary Mark Ockerbloom, Marelene Rayner-Canham, Geoffrey Rayner-Canham, Xavier Roqué, Matt Shindell and Ignacio Suay-Matallana.Tracing women in the history of chemistry unveils a fuller picture of all the people working on scientific discoveries, from unpaid assistants and technicians to leaders of great labs. In this celebratory year of the periodic table, it is crucial to recognize how it has been built — and continues to be shaped — by these individual efforts and broad collaborations.'Nature 565, 559-561 (2019)

Chemistry Education and Contributions from History and Philosophy of Science-Mansoor Niaz 2015-12-23 This book explores the relationship between the content of chemistry education and the history and philosophy of science (HPS) framework that underlies such education. It discusses the need to present an image that reflects how chemistry developed and progresses. It proposes that chemistry should be taught the way it is practiced by chemists: as a human enterprise, at the interface of scientific practice and HPS. Finally, it sets out to convince teachers to go beyond the traditional classroom practice and explore new teaching strategies. The importance of HPS has been recognized for the science curriculum since the middle of the 20th century. The need for teaching chemistry within a historical context is not difficult to understand as HPS is not far below the surface in any science classroom. A review of the literature shows that the traditional chemistry classroom, curricula, and textbooks while dealing with concepts such as law, theory, model, explanation, hypothesis, observation, evidence and idealization, generally ignore elements of the history and philosophy of science. This book proposes that the conceptual understanding of chemistry requires knowledge and understanding of the history and philosophy of science. “Professor Niaz’s book is most welcome, coming at a time when there is an urgently felt need to upgrade the teaching of science. The book is a huge aid for adding to the usual way - presenting science as a series of mere facts - also the necessary mandate: to show how science is done, and how science, through its history and philosophy, is part of the cultural development of humanity.” Gerald Holton, Mallinckrodt Professor of Physics & Professor of History of Science, Harvard University “In this stimulating and sophisticated blend of history of chemistry, philosophy of science, and science pedagogy, Professor Mansoor Niaz has succeeded in offering a promising new approach to the teaching of fundamental ideas in chemistry. Historians and philosophers of chemistry --- and above all, chemistry teachers --- will find this book full of valuable and highly usable new ideas” Alan Rocke, Case Western Reserve University “This book artfully connects chemistry and chemistry education to the human context in which chemical science is practiced and the historical and philosophical background that illuminates that practice. Mansoor Niaz deftly weaves together historical episodes in the quest for scientific knowledge with the psychology of learning and philosophical reflections on the nature of scientific knowledge and method. The result is a compelling case for historically and philosophically informed science education. Highly recommended!” Harvey Siegel, University of Miami “Books that analyze the philosophy and history of science in Chemistry are quite rare. ‘Chemistry Education and Contributions from History and Philosophy of Science’ by Mansoor Niaz is one of the rare books on the history and philosophy of chemistry and their importance in teaching this science. The book goes through all the main concepts of chemistry, and analyzes the historical and philosophical developments as well as their reflections in textbooks. Closest to my heart is Chapter 6, which is devoted to the chemical bond, the glue that holds together all matter in our earth. The chapter emphasizes the revolutionary impact of the concept of the ‘covalent bond’ on the chemical community and the great novelty of the idea that was conceived 11 years before quantum mechanics was able to offer the mechanism of electron pairing and covalent bonding. The author goes then to describe the emergence of two rival theories that explained the nature of the chemical bond in terms of quantum mechanics; these are valence bond (VB) and molecular orbital (MO) theories. He emphasizes the importance of having rival theories and interpretations in science and its advancement. He further argues that this VB-MO rivalry is still alive and together the two conceptual frames serve as the tool kit for thinking and doing chemistry in creative manners. The author surveys chemistry textbooks in the light of the how the books preserve or not the balance between the two theories in describing various chemical phenomena. This Talmudic approach of conceptual tension is a universal characteristic of any branch of evolving wisdom. As such, Mansoor’s book would be of great utility for chemistry teachers to examine how can they become more effective teachers by recognizing the importance of conceptual tension”. Sason Shaik Saeree K. and Louis P. Fiedler Chair in Chemistry Director, The Lise Meitner-Minerva Center for Computational Quantum Chemistry, The Hebrew University of Jerusalem, ISRAEL

Towards a Framework for Representational Competence in Science Education-Kristy L. Daniel 2018-07-25 This book covers the current state of thinking and what it means to have a framework of representational competence and how such theory can be used to shape our understanding of the use of representations in science education, assessment, and instruction. Currently, there is not a consensus in science education regarding representational competence as a unified theoretical framework. There are multiple theories of representational competence in the literature that use differing perspectives on what competence means and entails. Furthermore, dependent largely on the discipline, language discrepancies cause a potential barrier for merging ideas and pushing forward in this area. While a single unified theory may not be a realistic goal, there needs to be strides taken toward working as a unified research community to better investigate and interpret representational competence. An objective of this book is to initiate thinking about a representational competence theoretical framework across science educators, learning scientists, practitioners and scientists. As such, we have divided the chapters into three major themes to help push our thinking forward: presenting current thinking about representational competence in science education, assessing representational competence within learners, and using our understandings to structure instruction.

Overcoming Students' Misconceptions in Science-Mageswary Karpudewan 2017-02-28 This book discusses the importance of identifying and addressing misconceptions for the successful teaching and learning of science across all levels of science education from elementary school to high school. It suggests teaching approaches based on research data to address students’ common misconceptions. Detailed descriptions of how these instructional approaches can be incorporated into teaching and learning science are also included. The science education literature extensively documents the findings of studies about students’ misconceptions or alternative conceptions about various science concepts. Furthermore, some of the studies involve systematic approaches to not only creating but also implementing instructional programs to reduce the incidence of these misconceptions among high school science students. These studies, however, are largely unavailable to classroom practitioners, partly because they are usually found in various science education journals that teachers have no time to refer to or are not readily available to them. In response, this book offers an essential and easily accessible guide.

Transforming Teacher Education Through the Epistemic Core of Chemistry-Sibel Erduran 2019-06-10 This book synthesizes theoretical perspectives, empirical evidence and practical strategies for improving teacher education in chemistry. Many chemistry lessons involve mindless “cookbook” activities where students and teachers follow recipes, memorise formulae and recall facts without understanding how and why knowledge in chemistry works. Capitalising on traditionally disparate areas of research, the book investigates how to make chemistry education more meaningful for both students and teachers. It provides an example of how theory and practice in chemistry education can be bridged. It reflects on the nature of knowledge in chemistry by referring to theoretical perspectives from philosophy of chemistry. It draws on empirical evidence from research on teacher education, and illustrates concrete strategies and resources that can be used by teacher educators. The book describes the design and implementation of an innovative teacher education project to show the impact of an intervention on pre-service teachers. The book shows how, by making use of visual representations and analogies, the project makes some fairly abstract and complex ideas accessible to pre-service teachers.

Discipline-Based Education Research-National Research Council 2012-08-27 The National Science Foundation funded a synthesis study on the status, contributions, and future direction of discipline-based education research (DBER) in physics, biological sciences, geosciences, and chemistry. DBER combines knowledge of teaching and learning with deep knowledge of discipline-specific science content. It describes the discipline-specific difficulties learners face and the specialized intellectual and instructional resources that can facilitate student understanding. Discipline-Based Education Research is based on a 30-month study built on two workshops held in 2008 to explore evidence on promising practices in undergraduate science, technology, engineering, and mathematics (STEM) education. This book asks questions that are essential to advancing DBER and broadening its impact on undergraduate science teaching and learning. The book provides empirical research on undergraduate teaching and learning in the sciences, explores the extent to which this research currently influences undergraduate instruction, and identifies the intellectual and material resources required to further develop DBER. Discipline-Based Education Research provides guidance for future DBER research. In addition, the findings and recommendations of this report may invite, if not assist, post-secondary institutions to increase interest and research activity in DBER and improve its quality and usefulness across all natural science disciples, as well as guide instruction and assessment across natural science courses to improve

student learning. The book brings greater focus to issues of student attrition in the natural sciences that are related to the quality of instruction. Discipline-Based Education Research will be of interest to educators, policy makers, researchers, scholars, decision makers in universities, government agencies, curriculum developers, research sponsors, and education advocacy groups.
Modelling-based Teaching in Science Education-John K. Gilbert 2016-05-30 This book argues that modelling should be a component of all school curricula that aspire to provide ‘authentic science education for all’. The literature on modelling is reviewed and a ‘model of modelling’ is proposed. The conditions for the successful implementation of the ‘model of modelling’ in classrooms are explored and illustrated from practical experience. The roles of argumentation, visualisation, and analogical reasoning, in successful modelling-based teaching are reviewed. The contribution of such teaching to both the learning of key scientific concepts and an understanding of the nature of science are established. Approaches to the design of curricula that facilitate the progressive grasp of the knowledge and skills entailed in modelling are outlined. Recognising that the approach will both represent a substantial change from the ‘content-transmission’ approach to science teaching and be in accordance with current best-practice in science education, the design of suitable approaches to teacher education are discussed. Finally, the challenges that modelling-based education pose to science education researchers, advanced students of science education and curriculum design, teacher educators, public examiners, and textbook designers, are all outlined.
Models and Modeling-Myint Swe Khine 2011-03-01 The process of developing models, known as modeling, allows scientists to visualize difficult concepts, explain complex phenomena and clarify intricate theories. In recent years, science educators have greatly increased their use of modeling in teaching, especially real-time dynamic modeling, which is central to a scientific investigation. Modeling in science teaching is being used in an array of fields, everything from primary sciences to tertiary chemistry to college physics, and it is sure to play an increasing role in the future of education. Models and Modeling: Cognitive Tools for Scientific Enquiry is a comprehensive introduction to the use of models and modeling in science education. It identifies and describes many different modeling tools and presents recent applications of modeling as a cognitive tool for scientific enquiry.
Cognitive and Affective Aspects in Science Education Research-Kaisa Hahl 2017-08-08 This edited volume brings forth intriguing, novel and innovative research in the field of science education. The chapters in the book deal with a wide variety of topics and research approaches, conducted in various contexts and settings, all adding a strong contribution to knowledge on science teaching and learning. The book is comprised of selected high-quality studies that were presented at the 11th European Science Education Research Association (ESERA) Conference, held in Helsinki, Finland from 31 August to 4 September, 2015. The ESERA science education research community consists of professionals with diverse disciplinary backgrounds from natural sciences to social sciences. This diversity provides a rich understanding of cognitive and affective aspects of science teaching and learning in this volume. The studies in this book will invoke discussion and ignite further interest in finding new ways of doing and researching science education for the future and looking for international partners for both science education and science education research. The twenty-five chapters showcase current orientations of research in science education and are of interest to science teachers, teacher educators and science education researchers around the world with a commitment to evidence-based and forward-looking science teaching and learning.
Topics and Trends in Current Science Education-Catherine Bruguière 2013-11-19 This book features 35 of best papers from the 9th European Science Education Research Association Conference, ESERA 2011, held in Lyon, France, September 5th-9th 2011. The ESERA international conference featured some 1,200 participants from Africa, Asia, Australia, Europe as well as North and South America offering insight into the field at the end of the first decade of the 21st century. This book presents studies that represent the current orientations of research in science education and includes studies in different educational traditions from around the world. It is organized into six parts around the three poles (content, students, teachers) and their interrelations of science education: after a general presentation of the volume (first part), the second part concerns SSI (Socio-Scientific Issues) dealing with new types of content, the third the teachers, the fourth the students, the fifth the relationships between teaching and learning, and the sixth the teaching resources and the curricula.
Introduction to Chemistry-Pamela Marks 2015-01-09 Introduction to Chemistry, 4e by Bauer/Birk/Marks offers today's student a fresh perspective to the introduction of chemistry. This textbook offers a conceptual approach to chemistry by starting first with macroscopic phenomena, and then presenting the underlying microscopic detail. Each chapter opens with a real-life scenario that helps students connect abstract chemical concepts to their own lives. The math found in Introduction to Chemistry, 4e is introduced on a need-to-know basis, with "Math Toolboxes" in select chapters to help support the math skills required in that chapter.

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