

## Sources of students' difficulties in learning Chemistry

David Treagust,<sup>1</sup> Reinders Duit,<sup>2</sup> and Martina Nieswandt<sup>3</sup>

### Abstract

Chemistry is a difficult subject to teach and to learn at both secondary and tertiary levels. Major learning difficulties are due to the particular views of chemistry phenomena that in many ways contradict intuitive and everyday views of the learners. As a result, major misunderstandings occur when students try to comprehend chemical explanations within the framework of their pre-instructional conceptions. This paper describes research findings on students' pre-instructional conceptions in the domain of chemistry and on attempts to guide students from their conceptions to the core ideas of chemistry. Rather than providing an overview of students' conceptions in various topics, we review learning difficulties from the perspectives of the challenge of multiple representations and the relation of chemistry to everyday experiences, including understanding the special language of chemistry. We believe that these perspectives contribute substantially to the limited success of teaching and learning chemistry.

### Studies on understanding and learning chemistry

Understanding and learning core science concepts and principles, including those in chemistry, are difficult; many research studies have revealed major learning difficulties and identified key causes of these difficulties. A large number of intervention studies have attempted to address these difficulties by examining the role of students' preinstructional conceptions in the learning process. Further readings in this area are the bibliography by Pfandt and Duit (1998), general reviews of studies on learning science by Treagust, Duit and Fraser (1996) and by Duit and Treagust (1998), and a review on conceptual change approaches in science by Hewson, Beeth, & Thorley (1998).

There is overwhelming empirical evidence in the literature that what students already know is the key factor in learning. Usually students' preinstructional conceptions provide frameworks that are not in accordance with the science conceptions to be learned. From a constructivist perspective, which is the predominating contemporary view of learning in science education, every observation and every sensual input of any other kind has to be interpreted by the receiver (Steffe & Gale, 1995; Tobin, 1993). Students construct their own meanings of observations that they make when experiments are presented, pictures are shown, and explanations are given by the teacher or the textbook. The only interpretive frameworks that students possess are the conceptions gained in daily life or in science classes. As a result, in making sense of what is presented in science classes and in textbooks, sometimes students construct meanings that are in contrast to the expected chemistry view. Within this constructivist perspective, learning is not seen as the intake of knowledge that is delivered by the teacher and teaching is not viewed as transfer of knowledge from teacher or textbook to the head of the students. Rather, learning is viewed as an active construction process of the learner and teaching is designed to support and nurture this construction process. Accordingly, learning science can be a painstaking process of a sequence of gradual changes of students' preinstructional conceptions towards science conceptions (Vosniadou & Ioannides, 1998). The term conceptual change is usually employed to point to this process because it denotes that major changes of the initial conceptual frameworks are necessary when science concepts and principles are learned.

Most of the 3000 or so studies on learning difficulties in science reported by Pfandt and Duit (1998) have been carried out in the domain of physics (70%), with much less in biology (20%) and even less in chemistry (10%). Consequently, most general results on the role of preinstructional conceptions in the learning process and on the effect of conceptual change approaches to learning draw on findings from physics, although studies in biology and chemistry do contribute to these insights.

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# Difficulties Of Student In Learning Chemistry

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Mahfuzah Mohamad**



## **Difficulties Of Student In Learning Chemistry:**

### **Proceedings of the International Conference on Education, Humanities, Social Science (ICEHoS 2022)**

Prasetyo Hartanto, Joko Suprapmanto, 2023-07-31 This is an open access book The International Conference on Education Humanities and Social Science ICEHoS is an activity in the form of an international conference by presenting new studies and research results in the fields of Education Humanities and Social Sciences The Elementary School Teacher Education Study Program is the organizer of this international conference ICEHoS is the second conference held by us and will be held virtually due to the COVID 19 Pandemic which has not shown a better situation The 2nd ICEHoS 2022 conference is expected to be able to bring together national and international scale researchers academics practitioners students and community and industry activists in our chosen fields Considering the COVID 19 pandemic which has impacted various lines especially research in this field the 2nd ICEHoS 2022 international conference has the main theme The future education in society 5.0 to build a strong learning connection *Teaching Chemistry in Higher Education* Michael Seery, Claire Mc

Donnell, 2019-07-01 Teaching Chemistry in Higher Education celebrates the contributions of Professor Tina Overton to the scholarship and practice of teaching and learning in chemistry education Leading educators in United Kingdom Ireland and Australia three countries where Tina has had enormous impact and influence have contributed chapters on innovative approaches that are well established in their own practice Each chapter introduces the key education literature underpinning the approach being described Rationales are discussed in the context of attributes and learning outcomes desirable in modern chemistry curricula True to Tina's personal philosophy chapters offer pragmatic and useful guidance on the implementation of innovative teaching approaches drawing from the authors experience of their own practice and evaluations of their implementation Each chapter also offers key guidance points for implementation in readers own settings so as to maximise their adaptability Chapters are supplemented with further reading and supplementary materials on the book's website [overtonfestschrift.wordpress.com](https://overtonfestschrift.wordpress.com) Chapter topics include innovative approaches in facilitating group work problem solving context and problem based learning embedding transferable skills and laboratory education all themes relating to the scholarly interests of Professor Tina Overton About the Editors Michael Seery is Professor of Chemistry Education at the University of Edinburgh and is Editor of Chemistry Education Research and Practice Claire Mc Donnell is Assistant Head of School of Chemical and Pharmaceutical Sciences at Technological University Dublin Cover Art Christopher Armstrong University of Hull

### **Learning Difficulties Encountered by Students Studying the CHEM Study Program**

Ilene Joyce Swartney, 1968 *Handbook of Research on Science Education, Volume II* Norman G. Lederman, Sandra K. Abell, 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

**ICES 2021** Sunarto Sunarto,Ronny Gunawan,Erni Murniarti,Taat Guswantoro,Dwi Fajar Saputra,Robbi Rahim,2022-06-28 We are delighted to introduce the proceedings of the third edition of the International Conference on of Education and Science The 3rd International Conference of Education and Science ICES Universitas Kristen Indonesia will be an annual event hosted by Education and Teacher Training Faculty Universitas Kristen Indonesia This year 2021 will be the third ICES UKI will be held on 17 18 November 2021 at Education and Teacher Training Faculty Universitas Kristen Indonesia Indonesia This conference has brought researchers developers and practitioners around the world The theme of ICES 2021 was Research and Education Sustainability Post COVID 19 in Asian Context The 3rd International Conference of Education and Science ICES 2021 consisted of 46 full papers The conference tracks were teaching and learning education technology educational psychology and christian education Research and Education Sustainability Post COVID 19 in Asian Context has been chosen at the main theme for the conference Science and education underlie all human life especially in the face of the Industrial Revolution 4 0 which is clearly stated in RIRN Thus science and education will become a special field of study in the 3rd ICES 2021 Through this activity it is expected to increase the number of international publications by Indonesian academics in the fields of natural science social science and education The conference invites delegates from across Indonesian and Asian region and beyond and is usually attended by more than 1000 participants from university academics researchers practitioners and professionals across a wide range of industries We strongly believe that The 3rd International Conference of Education and Science ICES 2021 provides a good forum for all researcher developers and practitioners to discuss all science and education aspects that are relevant to The 3rd ICES 2021 We also expect that the future The 4rd ICES 2022 will be as successful and stimulating as indicated by the contributions presented in this volume

*Conference Proceedings. New Perspectives in Science Education* Pixel,2017 Teaching and Learning in Higher Education Elizabeth Cleaver,Maxine Lintern,Mike McLinden,2014-03-31 In today s higher education climate academic staff are encouraged to focus not only on the up to date content of their teaching but also to identify the most effective ways to engage students in learning often alongside other key transferrable skills This had led to a growing requirement for staff to adopt a scholarly approach to learning and teaching

practice and to undertake scholarship of learning and teaching as part of ongoing professional development This text explores broad best practice approaches to undertaking enquiry into learning and teaching in higher education It provides an introduction for staff who have been educated within a range of academic disciplines often with high level but very focused knowledge about and understandings of research processes to the potentially new world of educational enquiry This is complemented by chapters exploring what educational enquiry means in the context of different academic disciplines including physical sciences mathematics engineering the life sciences the arts the humanities the health professions and law It also includes An overview of research methodology including data collection literature reviews good ethical practice and research dissemination Case studies of actual research projects to support understanding of how to carry out educational enquiry in practice Lecturers why waste time waiting for the post arrive Request and receive your e inspection copy today

*Improving Assessment and Evaluation Strategies on Online Learning* Surjani Wonorahardjo, Sari

Karmina, Habiddin, 2022-06-10 ICLI is an annual International Conference on Learning Innovation ICLI hosted by Universitas Negeri Malang Indonesia in collaboration with the Islamic Development Bank IsDB and Indonesian Consortium for Learning Innovation Research ICLIR as well as Univerisiti Teknologi MARA Cawangan Perlis Malaysia serving as co organizer this year The conference aims to gather researchers practitioners students experts consultants teachers and lecturers to share their insights and experiences on research not only in constructing innovations in learning but also the knowledge of learner s capability The learners who are characterized as creative and competent by having the ability to understand what they have learned and capable of taking initiative and thinking critically In addition ICLI is organized on the basis of the trend in the 21st century categorized by the increasing complexity of technology and the emergence of a corporate restructuring movement This book is the proceeding of ICLI 2021 containing a selection of articles presented at this conference as the output of the activity Various topics around education are covered in this book and some literature studies around specific topics on learning and education are covered as well This proceeding book will be beneficial to students scholars and practitioners who have a deep concern in education It is also futuristic with a lot of practical insights for students faculty and practitioners and also a description of the Indonesian educational system in today s era **Action Research, Innovation and Change** Thomas Stern, Andrew Townsend, Franz Rauch, Angela Schuster, 2013-12-17

Action research continues to see a growth in interest both internationally and across disciplines This book demonstrates the diversity in settings and focus for action research and provides a guide to its core aspiration to achieve principled change Written by authors from a range of countries and range of disciplines including education health care palliative care social work and community development this book answers these key questions How can action research be used to achieve principled change How has action research been applied in various disciplines and in different countries What can be learnt about the conduct of action research from these diverse settings By means of detailed case studies of successful projects and discussions that challenge

and raise theoretical questions this book explores some of the contemporary cutting edge applications and conceptualisations of action research Action research paves the way for the empowerment of people involved in social action and the examples of successful change processes that are the core of this book will prove inspirational and provide practical advice Written by a range of leading international researchers in the field this book will define the future for action research for years to come

**ICONSEIR 2021** Yusnadi Yusnadi ,Nani Barorah Nasution ,Shofia Mawaddah,Sriadhi Sriadhi ,Emily Danvers,2022-05-23 The 3rd International Conference on Science Education in Industrial Revolution 4.0 ICONSEIR 4.0 is a forum of scientists academics researchers teachers and observers of education and students of post graduate who care of education This event was held by the Faculty of Education Universitas Negeri Medan Indonesia on December 21st 2021 **New Teaching and Teacher Issues** Mary B. Klein,2006 Teaching is a profession which is so enormous and so packed with significance that the issues related to it have a consistently high ranking with members of society in virtually every public opinion poll These issues include multicultural education teacher training and accreditation burn out teaching under conditions particular to a world wide certain country student behaviour and preparation computers in the classroom parental influence on the teaching process the changing curriculum and its meaning for teaching budgetary problems and a multitude of similar issues This book presents issues current to the field from educators and researchers from around the globe *Handbook of Research on Critical Issues in Special Education for School Rehabilitation Practices* Singh, Ajay,Yeh, Chia Jung,Blanchard, Sheresa,Anunciação, Luis,2021-04-23 Rehabilitation professionals working with students with disabilities and the families of those students face unique challenges in providing inclusive services to special education student populations There needs to be a focus on adaptive teaching methods that provide quality experience for students with varying disabilities to promote student success and inclusivity Critical issues within these practices span autism diverse students gifted education learning disabilities behavioral and emotional disorders and more With having many different types of students with vastly different situations it is important for rehabilitation professionals to understand the best practices and learning systems for special education students who have a wide range of needs and challenges The Handbook of Research on Critical Issues in Special Education for School Rehabilitation Practices focuses on the issues and challenges rehabilitation professionals face in special education and how they can provide inclusive and effective services to diverse student populations This book highlights topics such as culturally responsive teacher preparation artificial intelligence in the classroom universal design inclusive development and school rehabilitation and explores the effects these newfound practices in education have on various types of students with disabilities This book is essential for special education teachers administrators counselors practitioners researchers academicians and students interested in the new methods theories and solutions for the best practices in inclusive and effective special education *Research Based Undergraduate Science Teaching* Dennis W. Sunal,Cynthia S Sunal,Emmett L. Wright,Cheryl L. Mason,Dean Zollman,2014-07-01 Research in Science Education RISE Volume 6 Research

Based Undergraduate Science Teaching examines research theory and practice concerning issues of teaching science with undergraduates This RISE volume addresses higher education faculty and all who teach entry level science The focus is on helping undergraduates develop a basic science literacy leading to scientific expertise RISE Volume 6 focuses on research based reforms leading to best practices in teaching undergraduates in science and engineering The goal of this volume is to provide a research foundation for the professional development of faculty teaching undergraduate science Such science instruction should have short and longterm impacts on student outcomes The goal was carried out through a series of events over several years The website at <http://nseus.org> documents materials from these events The international call for manuscripts for this volume requested the inclusion of major priorities and critical research areas methodological concerns and results of implementation of faculty professional development programs and reform in teaching in undergraduate science classrooms In developing research manuscripts to be reviewed for RISE Volume 6 researchers were asked to consider the status and effectiveness of current and experimental practices for reforming undergraduate science courses involving all undergraduates including groups of students who are not always well represented in STEM education To influence practice it is important to understand how researchbased practice is made and how it is implemented The volume should be considered as a first step in thinking through what reform in undergraduate science teaching might look like and how we help faculty to implement such reform

#### **Science Education**

Keith S. Taber, Ben Akpan, 2016-12-27 This book comprises a wide range of scholarly essays introducing readers to key topics and issues in science education Science education has become a well established field in its own right with a vast literature and many active areas of scholarship Science Education An International Course Companion offers an entry point for students seeking a sound but introductory understanding of the key perspectives and areas of thinking in science education Each account is self contained and offers a scholarly and research informed introduction to a particular topic theme or perspective with both citations to key literature and recommendations for more advanced reading Science Education An International Course Companion allows readers such as those preparing for school science teaching or seeking more advanced specialist qualifications to obtain a broad familiarity with key issues across the field as well as guiding wider reading about particular topics of interest The book therefore acts as a reader to support learning across courses in science education internationally The broad coverage of topics is such that that the book will support students following a diverse range of courses and qualifications The comprehensive nature of the book will allow course leaders and departments to nominate the book as the key reader to support students their core course companion in science education

#### **Multiple Representations in Chemical Education**

John K. Gilbert, David Treagust, 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

**The Journal of Education** ,1911      Instructional Explanations in the Disciplines Mary Kay Stein,Linda Kucan,2009-11-27 In today s climate of accountability and standards increasing attention is focused on teacher quality with less emphasis on what teachers actually do to interest and engage students in learning This path breaking volume addresses this research problem with a clear definition and a content specific analysis of the most essential teaching moment the instructional explanation for vital new perspectives on educational method and process Rich in examples from science mathematics and the humanities Instructional Explanations in the Disciplines explores a variety of interactive contexts for teaching and learning which may be collaborative between teachers students and others performed in non classroom settings or assisted by technology The book s subject matter specific framework reveals key elements in the process such as carefully examining the question to be answered making connections with what is already known and developing examples conducive to further understanding Instructional Explanations in the Disciplines is a valuable addition to the education library giving researchers new methods of unpacking educational process as few books before it      Proceedings of the 3rd International Conference on Intelligent and Interactive Computing 2021 (UTeM Press) Sarni Suhaila Rahim,Siti Nurul Mahfuzah Mohamad,2021-09-01 The 3rd International Conference on Intelligent and Interactive Computing 2021 IIC 2021 was held virtually at Universiti Teknikal Malaysia Melaka UTeM Melaka Malaysia on 9 September 2021 The event was jointly organized by the Department of Interactive Media and Department of Intelligent Computing and Analytics Faculty of Information and Communication Technology Universiti Teknikal Malaysia Melaka UTeM with the theme Empowering the World with Intelligent and Immersive Computing towards Smart Solutions This open access e proceedings contains a compilation of 38 selected papers from the IIC 2021 The technical committees received a great response for submissions from various area including computational intelligence data analytics robotics and automation multimedia and immersive technologies education 4 0 and others We hope that this proceeding will serve as a valuable reference for researchers The event has achieved its aim which is to gather academic scholars and industry practitioners to share valuable knowledge and expertise in related disciplines Moreover it is hoped that this conference has opened up opportunities to explore recent advancements and challenges on selected research discipline As the editors in chief we are grateful and would like to convey our sincerest gratitude to the fellow review members for their effort in reviewing the submitted papers for this proceeding We are thankful to all the authors for revising their papers according to the proceeding requirements Also we would like to



express our thoughtful appreciation to the organizer of the IIC 2021      **AISTSSE 2018** Martina Restuati ,Herbert Sipahutar,Juniastel Rajagukguk,2019-10-04 This book contains the proceedings of the The 5th Annual International Seminar on Trends in Science and Science Education AISTSSE and The 2nd International Conference on Innovation in Education Science and Culture ICIESC where held on 18 October 2018 and 25 September 2018 in same city Medan North Sumatera Both of conferences were organized respectively by Faculty of Mathematics and Natural Sciences and Research Institute Universitas Negeri Medan The papers from these conferences collected in a proceedings book entitled Proceedings of 5th AISTSSE In publishing process AISTSSE and ICIESC were collaboration conference presents six plenary and invited speakers from Australia Japan Thailand and from Indonesia Besides speaker around 162 researchers covering lecturers teachers participants and students have attended in this conference The researchers come from Jakarta Yogyakarta Bandung Palembang Jambi Batam Pekanbaru Padang Aceh Medan and several from Malaysia and Thailand The AISTSSE meeting is expected to yield fruitful result from discussion on various issues dealing with challenges we face in this Industrial Revolution RI 4 0 The purpose of AISTSSE is to bring together professionals academics and students who are interested in the advancement of research and practical applications of innovation in education science and culture The presentation of such conference covering multi disciplines will contribute a lot of inspiring inputs and new knowledge on current trending about Mathematical Sciences Mathematics Education Physical Sciences Physics Education Biological Sciences Biology Education Chemical Sciences Chemistry Education and Computer Sciences Thus this will contribute to the next young generation researches to produce innovative research findings Hopely that the scientific attitude and skills through research will promote Unimed to be a well known university which persist to be developed and excelled Finally we would like to express greatest thankful to all colleagues in the steering committee for cooperation in administering and arranging the conference Hopefully these seminar and conference will be continued in the coming years with many more insight articles from inspiring research We would also like to thank the invited speakers for their invaluable contribution and for sharing their vision in their talks We hope to meet you again for the next conference of AISTSSE

**Proceedings of the 7th Annual International Seminar on Transformative Education and Educational Leadership, AISTEEL 2022, 20 September 2022, Medan, North Sumatera Province, Indonesia**

Bornok Sinaga,Rahmad Husein,Juniastel Rajagukguk,2022-12-06 Proceedings of the 7th Annual International Seminar on Transformative Education and Educational Leadership AISTEEL 2022 contains several papers that have presented at the seminar with theme Technology and Innovation in Educational Transformation This seminar was held on 20 September 2022 and organized by Postgraduate School Univesitas Negeri Medan and become a routine agenda annually The 7th AISTEEL was realized this year with various presenters lecturers researchers and students from universities both in and out of Indonesia The 7th AISTEEL presents 4 distinguished keynote speakers from Universitas Negeri Medan Indonesia Murdoch University Australia Curtin University

Perth Australia University Malaya Malaysia Monash University Australia and Tampere University of Applied Sciences Finland In addition presenters of parallel sessions come from various Government and Private Universities Institutions Academy and Schools Some of them are those who have sat and will sit in the oral defence examination The plenary speakers have been present topics covering multi disciplines They have contributed many inspiring inputs on current trending educational research topics all over the world The expectation is that all potential lecturers and students have shared their research findings for improving their teaching process and quality and leadership There are 162 papers passed through rigorous reviews process and accepted by the committee All of papers reflect the conference scopes by follow Teachers Education Model in Future Education and Research Global Issue Transformative Learning and Educational Leadership Mathematics Science and Nursing Education Social Language and Cultural Education Vocational Education and Educational Technology Economics Business and Management Education Curriculum Research and Development Innovative Educational Practices and Effective Technology in the Classroom Educational Policy and Administration Education

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