

Metacognition In Science Education Trends In Current Research Contemporary Trends And Issues In Science Education

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POGIL - Shawn R. Simonson 2019-04-16
Process Oriented Guided Inquiry Learning (POGIL) is a pedagogy that is based on research on how people learn and has been shown to lead to better student outcomes in many contexts and in a variety of academic disciplines. Beyond facilitating students' mastery of a discipline, it promotes vital educational outcomes such as communication skills and critical thinking. Its active international community of practitioners provides accessible educational development and support for anyone developing related courses. Having started as a process developed by a group of chemistry professors focused on helping their students better grasp the concepts of general chemistry, The POGIL Project has grown into a dynamic organization of committed instructors who help each other transform classrooms and improve student success, develop curricular materials to assist this process, conduct research expanding what is known about learning and teaching, and provide professional development and collegiality from elementary teachers to college professors. As a pedagogy it has been shown to be effective in a variety of content areas and at different educational levels. This is an introduction to the process and the community. Every POGIL classroom is different and is a reflection of the uniqueness of the particular context - the institution, department, physical space, student body, and instructor - but follows a common

structure in which students work cooperatively in self-managed small groups of three or four. The group work is focused on activities that are carefully designed and scaffolded to enable students to develop important concepts or to deepen and refine their understanding of those ideas or concepts for themselves, based entirely on data provided in class, not on prior reading of the textbook or other introduction to the topic. The learning environment is structured to support the development of process skills -- such as teamwork, effective communication, information processing, problem solving, and critical thinking. The instructor's role is to facilitate the development of student concepts and process skills, not to simply deliver content to the students. The first part of this book introduces the theoretical and philosophical foundations of POGIL pedagogy and summarizes the literature demonstrating its efficacy. The second part of the book focusses on implementing POGIL, covering the formation and effective management of student teams, offering guidance on the selection and writing of POGIL activities, as well as on facilitation, teaching large classes, and assessment. The book concludes with examples of implementation in STEM and non-STEM disciplines as well as guidance on how to get started. Appendices provide additional resources and information about The POGIL Project.

Successful Remembering and Successful

Forgetting - Aaron S. Benjamin 2011-01-07

The chapters in this volume are testament to the many ways in which Robert Bjork's ideas have shaped the course of research on human memory over four decades. It showcases the theoretical advances and recent findings by researchers whose work and careers have been influenced by Bjork. The first group of chapters explore the idea that forgetting is an adaptive response to the demands of a retrieval system fraught with competition - an idea that has helped recalibrate conceptualizations of memory away from one in which the computer is the dominant metaphor. Several chapters then review the application of research on learning and memory to enhancing human performance, reflecting Bjork's staunch commitment to translating his findings and theories to real-world settings. Later chapters address topics that are relevant to the translation of cognitive psychology to human performance, and in particular recognize the critical role of metacognition in such problems. The final chapters cover a variety of issues related to how remembering can be enhanced, and how research on remembering can be profitably guided by the use of mathematical modeling. This volume will appeal to researchers and graduate students of human learning, memory, and forgetting, and will also benefit an audience working in applied domains, such as training and education.

Trends and Prospects in Metacognition Research - Anastasia Efklides 2010-09-08

Trends and Prospects in Metacognition presents a collection of chapters dealing principally with independent areas of empirical Metacognition research. These research foci, such as animal metacognition, neuropsychology of metacognition, implicit learning, metacognitive experiences, metamemory, young children's Metacognition, theory of mind, metacognitive knowledge, decision making, and interventions for the enhancement of metacognition, have all emerged as trends in the field of metacognition. Yet, the resulting research has not converged, precluding an integration of concepts and findings. Presenting a new theoretical framework, *Trends and Prospects in Metacognition* extends the classical definitions offered by Flavell and Nelson to carry the

prospect of more integrated work into the future. By opening the possibility to cross the boundaries posed by traditionally independent research areas, this volume provides a foundation for the integration of research paradigms and concepts and builds on the relationship between metacognition and consciousness, while integrating basic with applied research.

Metacognition in Science Education - Anat Zohar 2011-10-20

Why is metacognition gaining recognition, both in education generally and in science learning in particular? What does metacognition contribute to the theory and practice of science learning? *Metacognition in Science Education* discusses emerging topics at the intersection of metacognition with the teaching and learning of science concepts, and with higher order thinking more generally. The book provides readers with a background on metacognition and analyses the latest developments in the field. It also gives an account of best-practice methodology.

Expanding on the theoretical underpinnings of metacognition, and written by world leaders in metacognitive research, the chapters present cutting-edge studies on how various forms of metacognitive instruction enhance understanding and thinking in science classrooms. The editors strive for conceptual coherency in the various definitions of metacognition that appear in the book, and show that the study of metacognition is not an end in itself. Rather, it is integral to other important constructs, such as self-regulation, literacy, the teaching of thinking strategies, motivation, meta-strategies, conceptual understanding, reflection, and critical thinking. The book testifies to a growing recognition of the potential value of metacognition to science learning. It will motivate science educators in different educational contexts to incorporate this topic into their ongoing research and practice.

How People Learn - National Research Council 2000-08-11

First released in the Spring of 1999, *How People Learn* has been expanded to show how the theories and insights from the original book can translate into actions and practice, now making a real connection between classroom activities and learning behavior. This edition includes far-

reaching suggestions for research that could increase the impact that classroom teaching has on actual learning. Like the original edition, this book offers exciting new research about the mind and the brain that provides answers to a number of compelling questions. When do infants begin to learn? How do experts learn and how is this different from non-experts? What can teachers and schools do—with curricula, classroom settings, and teaching methods—to help children learn most effectively? New evidence from many branches of science has significantly added to our understanding of what it means to know, from the neural processes that occur during learning to the influence of culture on what people see and absorb. How People Learn examines these findings and their implications for what we teach, how we teach it, and how we assess what our children learn. The book uses exemplary teaching to illustrate how approaches based on what we now know result in in-depth learning. This new knowledge calls into question concepts and practices firmly entrenched in our current education system. Topics include: How learning actually changes the physical structure of the brain. How existing knowledge affects what people notice and how they learn. What the thought processes of experts tell us about how to teach. The amazing learning potential of infants. The relationship of classroom learning and everyday settings of community and workplace. Learning needs and opportunities for teachers. A realistic look at the role of technology in education.

Adapted Primary Literature - Anat Yarden
2015-03-16

This book specifies the foundation for Adapted Primary Literature (APL), a novel text genre that enables the learning and teaching of science using research articles that were adapted to the knowledge level of high-school students. More than 50 years ago, J.J. Schwab suggested that Primary Scientific Articles “afford the most authentic, unretouched specimens of enquiry that we can obtain” and raised for the first time the idea that such articles can be used for “enquiry into enquiry”. This book, the first to be published on this topic, presents the realization of this vision and shows how the reading and writing of scientific articles can be used for inquiry learning and teaching. It provides the

origins and theory of APL and examines the concept and its importance. It outlines a detailed description of creating and using APL and provides examples for the use of the enactment of APL in classes, as well as descriptions of possible future prospects for the implementation of APL. Altogether, the book lays the foundations for the use of this authentic text genre for the learning and teaching of science in secondary schools.

Handbook of Research on Science Education - Sandra K. Abell 2007

This state-of-the art research handbook provides a comprehensive, coherent, current synthesis of the empirical and theoretical research concerning teaching and learning in science and lays down a foundation upon which future research can be built. Structured to highlight recent trends in the field, the volume is organized around five themes: *Science Learning; *Culture, Gender, and Society and Science Learning; *Science Teaching; *Curriculum and Assessment in Science; and *Science Teacher Education The contributors, all leading experts in their research areas, represent the international and gender diversity that exists in the science education research community. 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. Chapters conclude with implications for practice and proposed agendas for future research. As a whole, the Handbook of Research on Science Education demonstrates that science education is alive and well and illustrates its vitality. It is an essential resource for the entire science education community, including veteran and emerging researchers, university faculty, graduate students, practitioners in the schools, and science education professionals outside of universities.

Handbook of Research on Reading Comprehension, Second Edition - Susan E. Israel
2016-11-29

This esteemed reference work and professional

resource, now substantially revised, integrates classic and cutting-edge research on how children and adolescents make meaning from text. The comprehension tasks and challenges facing students at different grade levels are explored, with attention to multiple text types and reading purposes. Preeminent researchers offer a range of perspectives--cognitive, neuroscientific, sociocultural, pedagogical, and technological--on key aspects of comprehension. Effective approaches to assessment, instruction, and intervention are reviewed. The volume also addresses issues in teaching specific populations, including struggling readers and English language learners. New to This Edition

- *A decade's worth of significant research advances are reflected in 10 entirely new chapters.
- *Revised throughout to incorporate new studies and timely topics: the expanding role of technology, changing school populations, the Common Core standards, international research, and more.
- *Chapters on graphic, scientific, and multiple digital texts.
- *Chapters on fluency, professional learning, and literacy coaching.

Teaching Chemistry - A Studybook - Ingo Eilks 2013-04-20

This book focuses on developing and updating prospective and practicing chemistry teachers' pedagogical content knowledge. The 11 chapters of the book discuss the most essential theories from general and science education, and in the second part of each of the chapters apply the theory to examples from the chemistry classroom. Key sentences, tasks for self-assessment, and suggestions for further reading are also included. The book is focused on many different issues a teacher of chemistry is concerned with. The chapters provide contemporary discussions of the chemistry curriculum, objectives and assessment, motivation, learning difficulties, linguistic issues, practical work, student active pedagogies, ICT, informal learning, continuous professional development, and teaching chemistry in developing environments. This book, with contributions from many of the world's top experts in chemistry education, is a major publication offering something that has not previously been available. Within this single volume, chemistry teachers, teacher educators,

and prospective teachers will find information and advice relating to key issues in teaching (such as the curriculum, assessment and so forth), but contextualised in terms of the specifics of teaching and learning of chemistry, and drawing upon the extensive research in the field. Moreover, the book is written in a scholarly style with extensive citations to the literature, thus providing an excellent starting point for teachers and research students undertaking scholarly studies in chemistry education; whilst, at the same time, offering insight and practical advice to support the planning of effective chemistry teaching. This book should be considered essential reading for those preparing for chemistry teaching, and will be an important addition to the libraries of all concerned with chemical education. Dr Keith S. Taber (University of Cambridge; Editor: Chemistry Education Research and Practice) The highly regarded collection of authors in this book fills a critical void by providing an essential resource for teachers of chemistry to enhance pedagogical content knowledge for teaching modern chemistry. Through clever orchestration of examples and theory, and with carefully framed guiding questions, the book equips teachers to act on the relevance of essential chemistry knowledge to navigate such challenges as context, motivation to learn, thinking, activity, language, assessment, and maintaining professional expertise. If you are a secondary or post-secondary teacher of chemistry, this book will quickly become a favorite well-thumbed resource! Professor Hannah Sevian (University of Massachusetts Boston)

Digital Teaching Platforms - Chris Dede 2012

The Digital Teaching Platform (DTP) brings the power of interactive technology to teaching and learning in classrooms. In this authoritative book, top researchers in the field of learning science and educational technology examine the current state of design and research on DTPs, the principles for evaluating them, and their likely evolution as a dominant medium for educational improvement. The authors examine DTPs in light of contemporary classroom requirements, as well as current initiatives such as the Common Core State Standards, Race to the Top, and the 2010 National Educational

Technology Plan.

Issues and Challenges in Science Education Research - Kim Chwee Daniel Tan 2012-04-27

In contemporary society, science constitutes a significant part of human life in that it impacts on how people experience and understand the world and themselves. The rapid advances in science and technology, newly established societal and cultural norms and values, and changes in the climate and environment, as well as, the depletion of natural resources all greatly impact the lives of children and youths, and hence their ways of learning, viewing the world, experiencing phenomena around them and interacting with others. These changes challenge science educators to rethink the epistemology and pedagogy in science classrooms today as the practice of science education needs to be proactive and relevant to students and prepare them for life in the present and in the future. Featuring contributions from highly experienced and celebrated science educators, as well as research perspectives from Europe, the USA, Asia and Australia, this book addresses theoretical and practical examples in science education that, on the one hand, plays a key role in our understanding of the world, and yet, paradoxically, now acknowledges a growing number of uncertainties of knowledge about the world. The material is in four sections that cover the learning and teaching of science from science literacy to multiple representations; science teacher education; the use of innovations and new technologies in science teaching and learning; and science learning in informal settings including outdoor environmental learning activities.

Acknowledging the issues and challenges in science education, this book hopes to generate collaborative discussions among scholars, researchers, and educators to develop critical and creative ways of science teaching to improve and enrich the lives of our children and youths.

Make It Stick - Peter C. Brown 2014-04-14

Discusses the best methods of learning, describing how rereading and rote repetition are counterproductive and how such techniques as self-testing, spaced retrieval, and finding additional layers of information in new material can enhance learning.

International Perspectives on the Teaching

and Learning of Geometry in Secondary Schools - Patricio Herbst 2018-04-27

This book presents current perspectives on theoretical and empirical issues related to the teaching and learning of geometry at secondary schools. It contains chapters contributing to three main areas. A first set of chapters examines mathematical, epistemological, and curricular perspectives. A second set of chapters presents studies on geometry instruction and teacher knowledge, and a third set of chapters offers studies on geometry thinking and learning. Specific research topics addressed also include teaching practice, learning trajectories, learning difficulties, technological resources, instructional design, assessments, textbook analyses, and teacher education in geometry. Geometry remains an essential and critical topic in school mathematics. As they learn geometry, students develop essential mathematical thinking and visualization skills and learn a language that helps them relate to and interact with the physical world. Geometry has traditionally been included as a subject of study in secondary mathematics curricula, but it has also featured as a resource in out-of-school problem solving, and has been connected to various human activities such as sports, games, and artwork. Furthermore, geometry often plays a role in teacher preparation, undergraduate mathematics, and at the workplace. New technologies, including dynamic geometry software, computer-assisted design software, and geometric positioning systems, have provided more resources for teachers to design environments and tasks in which students can learn and use geometry. In this context, research on the teaching and learning of geometry will continue to be a key element on the research agendas of mathematics educators, as researchers continue to look for ways to enhance student learning and to understand student thinking and teachers' decision making. *Current Research in Biology Education* - Konstantinos Korfiatis 2022

This book is a collection of full papers based on the peer-reviewed submissions accepted for the ERIDOB 2020 conference (which was cancelled due to COVID-19). ERIDOB brings together researchers in Biology Education from around the world to share and discuss their research

work and results. It is the only major international conference on biology education research, and all the papers therefore are written by international researchers from across Europe (and beyond), which present the findings from a range of contemporary biology education research projects. They are all entirely new papers describing new research in the field. The papers are peer-reviewed by experienced international researchers selected by the ERIDOB Academic Committee. The papers reflect the ERIDOB conference strands by covering topics on: Socioscientific issues, Nature of Science and scientific thinking Teaching and learning in biology Perceptions of biology and biology education Textbook analysis Outdoor and environmental education By providing a collection of new research findings from many countries, this book is a great resource for researchers and practitioners such as school, college and university biology teachers' around the world. It is useful for training biology teachers and therefore valuable to teacher training institutions.

Proceedings of the 3rd Annual Generalized Intelligent Framework for Tutoring (GIFT) Users Symposium (GIFTSym3) - Robert A. Sottolare
2015-08-01

GIFT, the Generalized Intelligent Framework for Tutoring, is a modular, service-oriented architecture developed to lower the skills and time needed to author effective adaptive instruction. Design goals for GIFT also include capturing best instructional practices, promoting standardization and reuse for adaptive instructional content and methods, and methods for evaluating the effectiveness of tutoring technologies. Truly adaptive systems make intelligent (optimal) decisions about tailoring instruction in real-time and make these decisions based on information about the learner and conditions in the instructional environment. The GIFT Users Symposia were started in 2013 to capture successful implementations of GIFT from the user community and to share recommendations leading to more useful capabilities for GIFT authors, researchers, and learners.

Metacognition: Fundamentals, Applications, and Trends - Alejandro Peña-Ayala 2014-10-30

This book is devoted to the Metacognition arena.

It highlights works that show relevant analysis, reviews, theoretical, and methodological proposals, as well as studies, approaches, applications, and tools that shape current state, define trends and inspire future research. As a result of the revision process fourteen manuscripts were accepted and organized into five parts as follows:

- **Conceptual:** contains conceptual works oriented to: (1) review models of strategy instruction and tailor a hybrid strategy; (2) unveil second-order judgments and define a method to assess metacognitive judgments; (3) introduces a conceptual model to describe the metacognitive activity as an autopoietic system.
- **Framework:** offers three works concerned with: (4) stimulate metacognitive skills and self-regulatory functions; (5) evaluate metacognitive skills and self-regulated learning at problem solving; (6) deal with executive management metacognition and strategic knowledge metacognition.
- **Studies:** reports research related to: (7) uncover how metacognitive awareness of listening strategies bias listening proficiency; (8) unveil how metacognitive skills and motivation are achieved in science informal learning; (9) tackle stress at learning by means of coping strategies.
- **Approaches:** focus on the following targets: (10) social metacognition to support collaborative problem solving; (11) metacognitive skills to be stimulated in computer supported collaborative learning; (12) metacognitive knowledge and metacognitive experiences are essential for teaching practices.
- **Tools:** promotes the use of intelligent tutoring systems such as: (13) BioWorld allows learners to practice medical diagnostic by providing virtual patient cases; (14) MetaHistoReasoning provides examples to learners and inquiries about the causes of historical events. This volume will be a source of interest for researchers, practitioners, professors, and postgraduate students aimed at updating their knowledge and finding targets for future work in the metacognition arena.

Handbook of Research on Science Teacher Education - Julie A. Luft 2022-04-27

This groundbreaking handbook offers a contemporary and thorough review of research relating directly to the preparation, induction, and career long professional learning of K-12

science teachers. Through critical and concise chapters, this volume provides essential insights into science teacher education that range from their learning as individuals to the programs that cultivate their knowledge and practices. Each chapter is a current review of research that depicts the area, and then points to empirically based conclusions or suggestions for science teacher educators or educational researchers. Issues associated with equity are embedded within each chapter. Drawing on the work of over one hundred contributors from across the globe, this handbook has 35 chapters that cover established, emergent, diverse, and pioneering areas of research, including: Research methods and methodologies in science teacher education, including discussions of the purpose of science teacher education research and equitable perspectives; Formal and informal teacher education programs that span from early childhood educators to the complexity of preparation, to the role of informal settings such as museums; Continuous professional learning of science teachers that supports building cultural responsiveness and teacher leadership; Core topics in science teacher education that focus on teacher knowledge, educative curricula, and working with all students; and Emerging areas in science teacher education such as STEM education, global education, and identity development. This comprehensive, in-depth text will be central to the work of science teacher educators, researchers in the field of science education, and all those who work closely with science teachers.

Cognitive and Metacognitive Problem-Solving Strategies in Post-16 Physics -

Ronald Mazorodze 2019-09-20

This book reports on a study on physics problem solving in real classrooms situations. Problem solving plays a pivotal role in the physics curriculum at all levels. However, physics students' performance in problem solving all too often remains limited to basic routine problems, with evidence of poor performance in solving problems that go beyond equation retrieval and substitution. Adopting an action research methodology, the study bridges the 'research-practical divide' by explicitly teaching physics problem-solving strategies through collaborative group problem-solving sessions embedded

within the curriculum. Data were collected using external assessments and video recordings of individual and collaborative group problem-solving sessions by 16-18 year-olds. The analysis revealed a positive shift in the students' problem-solving patterns, both at group and individual level. Students demonstrated a deliberate, well-planned deployment of the taught strategies. The marked positive shifts in collaborative competences, cognitive competences, metacognitive processing and increased self-efficacy are positively correlated with attainment in problem solving in physics. However, this shift proved to be due to different mechanisms triggered in the different students.

Science Learning and Instruction - Marcia C. Linn 2011-05-20

Science Learning and Instruction describes advances in understanding the nature of science learning and their implications for the design of science instruction. The authors show how design patterns, design principles, and professional development opportunities coalesce to create and sustain effective instruction in each primary scientific domain: earth science, life science, and physical science. Calling for more in depth and less fleeting coverage of science topics in order to accomplish knowledge integration, the book highlights the importance of designing the instructional materials, the examples that are introduced in each scientific domain, and the professional development that accompanies these materials. It argues that unless all these efforts are made simultaneously, educators cannot hope to improve science learning outcomes. The book also addresses how many policies, including curriculum, standards, guidelines, and standardized tests, work against the goal of integrative understanding, and discusses opportunities to rethink science education policies based on research findings from instruction that emphasizes such understanding.

Deeper Learning, Dialogic Learning, and Critical Thinking - Emmanuel Manalo 2019-09-30

Deeper learning, dialogic learning, and critical thinking are essential capabilities in the 21st-century environments we now operate. Apart from being important in themselves, they are also crucial in enabling the acquisition of many other 21st-century skills/capabilities such as

problem solving, collaborative learning, innovation, information and media literacy, and so on. However, the majority of teachers in schools and instructors in higher education are inadequately prepared for the task of promoting deeper learning, dialogic learning, and critical thinking in their students. This is despite the fact that there are educational researchers who are developing and evaluating strategies for such promotion. The problem is bridging the gap between the educational researchers' work and what gets conveyed to teachers and instructors as evidence-based, usable strategies. This book addresses that gap: in it, leading scholars from around the world describe strategies they have developed for successfully cultivating students' capabilities for deeper learning and transfer of what they learn, dialogic learning and effective communication, and critical thought. They explore connections in the promotion of these capabilities, and they provide, in accessible form, research evidence demonstrating the efficacy of the strategies. They also discuss answers to the questions of how and why the strategies work. A seminal resource, this book creates tangible links between innovative educational research and classroom teaching practices to address the all-important question of how we can realize our ideals for education in the 21st century. It is a must read for pre-service and in-service teachers, teacher educators and professional developers, and educational researchers who truly care that we deliver education that will prepare and serve students for life.

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.

The Routledge International Handbook of Young Children's Thinking and Understanding - Sue Robson 2014-11-13

This ground-breaking handbook provides a much-needed, contemporary and authoritative reference text on young children's thinking. The different perspectives represented in the thirty-nine chapters contribute to a vibrant picture of young children, their ways of thinking and their efforts at understanding, constructing and navigating the world. The Routledge International Handbook of Young Children's Thinking and Understanding brings together commissioned pieces by a range of hand-picked influential, international authors from a variety of disciplines who share a high public profile for their specific developments in the theories of children's thinking, learning and understanding. The handbook is organised into four complementary parts: • How can we think about young children's thinking?: Concepts and contexts • Knowing about the brain and knowing about the mind • Making sense of the world • Documenting and developing children's thinking Supported throughout with relevant research and case studies, this handbook is an international insight into the many ways there are to understand children and childhood paired with the knowledge that young children have a strong, vital, and creative ability to think and to understand, and to create and contend with the world around them.

Assessing for Learning - Peggy L. Maki 2012-02-27

While there is consensus that institutions need to represent their educational effectiveness through documentation of student learning, the

higher education community is divided between those who support national standardized tests to compare institutions' educational effectiveness, and those who believe that valid assessment of student achievement is based on assessing the work that students produce along and at the end of their educational journeys. This book espouses the latter philosophy—what Peggy Maki sees as an integrated and authentic approach to providing evidence of student learning based on the work that students produce along the chronology of their learning. She believes that assessment needs to be humanized, as opposed to standardized, to take into account the demographics of institutions, as students do not all start at the same place in their learning. Students also need the tools to assess their own progress. In addition to updating and expanding the contents of her first edition to reflect changes in assessment practices and developments over the last seven years, such as the development of technology-enabled assessment methods and the national need for institutions to demonstrate that they are using results to improve student learning, Maki focuses on ways to deepen program and institution-level assessment within the context of collective inquiry about student learning. Recognizing that assessment is not initially a linear start-up process or even necessarily sequential, and recognizing that institutions develop processes appropriate for their mission and culture, this book does not take a prescriptive or formulaic approach to building this commitment. What it does present is a framework, with examples of processes and strategies, to assist faculty, staff, administrators, and campus leaders to develop a sustainable and shared core institutional process that deepens inquiry into what and how students learn to identify and improve patterns of weakness that inhibit learning. This book is designed to assist colleges and universities build a sustainable commitment to assessing student learning at both the institution and program levels. It provides the tools for collective inquiry among faculty, staff, administrators and students to develop evidence of students' abilities to integrate, apply and transfer learning, as well as to construct their own meaning. Each chapter also concludes with (1) an Additional Resources

section that includes references to meta-sites with further resources, so users can pursue particular issues in greater depth and detail and (2) worksheets, guides, and exercises designed to build collaborative ownership of assessment. The second edition now covers: * Strategies to connect students to an institution's or a program's assessment commitment * Description of the components of a comprehensive institutional commitment that engages the institution, educators, and students--all as learners * Expanded coverage of direct and indirect assessment methods, including technology-enabled methods that engage students in the process * New case studies and campus examples covering undergraduate, graduate education, and the co-curriculum * New chapter with case studies that presents a framework for a backward designed problem-based assessment process, anchored in answering open-ended research or study questions that lead to improving pedagogy and educational practices * Integration of developments across professional, scholarly, and accrediting bodies, and disciplinary organizations * Descriptions and illustrations of assessment management systems * Additional examples, exercises, guides and worksheets that align with new content

Perspectives on Scientific Argumentation - Myint Swe Khine 2011-09-30

Argumentation—arriving at conclusions on a topic through a process of logical reasoning that includes debate and persuasion—has in recent years emerged as a central topic of discussion among science educators and researchers. There is now a firm and general belief that fostering argumentation in learning activities can develop students' critical thinking and reasoning skills, and that dialogic and collaborative inquiries are key precursors to an engagement in scientific argumentation. It is also reckoned that argumentation helps students assimilate knowledge and generate complex meaning. The consensus among educators is that involving students in scientific argumentation must play a critical role in the education process itself. Recent analysis of research trends in science education indicates that argumentation is now the most prevalent research topic in the literature. This book attempts to consolidate

contemporary thinking and research on the role of scientific argumentation in education. *Perspectives on Scientific Argumentation* brings together prominent scholars in the field to share the sum of their knowledge about the place of scientific argumentation in teaching and learning. Chapters explore scientific argumentation as a means of addressing and solving problems in conceptual change, reasoning, knowledge-building and the promotion of scientific literacy. Others interrogate topics such as the importance of language, discursive practice, social interactions and culture in the classroom. The material in this book, which features intervention studies, discourse analyses, classroom-based experiments, anthropological observations, and design-based research, will inform theoretical frameworks and changing pedagogical practices as well as encourage new avenues of research. *Teaching and Measuring Cognitive Readiness* - Harold F. O'Neil 2013-07-18

Teaching and Measuring Cognitive Readiness presents theoretical and empirical findings regarding cognitive readiness and assessments of their impact on adult learning. The term readiness is used in assessing student preparation for K-12 schools, while in the military and in industry, "readiness" denotes preparation to be effective in performing a mission or a job. Cognitive Readiness is viewed through a Knowledge, Skills, and Attributes (KSA) lens. *Teaching and Measuring Cognitive Readiness* deals with (a) the primacy of cognitive readiness as attributes or individual difference variables; (b) the need for cognitive readiness instructional and assessment strategies; (c) the need to integrate assessment into cognitive readiness training; (d) the need for theory-driven evaluation studies to increase knowledge and efficacy in teaching cognitive readiness; and (e) the need for a solid psychometric approach to the use of cognitive readiness assessments.

Quality Research in Literacy and Science Education - Mack C. Shelley 2008-12-30

Statistical models attempt to describe and quantify relationships between variables. In the models presented in this chapter, there is a response variable (sometimes called dependent variable) and at least one predictor variable (sometimes called independent or explanatory

variable). When investigating a possible cause-and-effect type of relationship, the response variable is the putative effect and the predictors are the hypothesized causes. Typically, there is a main predictor variable of interest; other predictors in the model are called covariates. Unknown covariates or other independent variables not controlled in an experiment or analysis can affect the dependent or outcome variable and mislead the conclusions made from the inquiry (Bock, Velleman, & De Veaux, 2009). A p value (p) measures the statistical significance of the observed relationship; given the model, p is the probability that a relationship is seen by mere chance. The smaller the p value, the more confident we can be that the pattern seen in the data is not random. In the type of models examined here, the R measures the proportion of the variation in the response variable that is explained by the predictors specified in the model; if R is close to 1, then almost all the variation in the response variable has been explained. This measure is also known as the multiple correlation coefficient. Statistical studies can be grouped into two types: experimental and observational.

International Handbook of Research in History, Philosophy and Science Teaching - Michael R. Matthews 2014-07-03

This inaugural handbook documents the distinctive research field that utilizes history and philosophy in investigation of theoretical, curricular and pedagogical issues in the teaching of science and mathematics. It is contributed to by 130 researchers from 30 countries; it provides a logically structured, fully referenced guide to the ways in which science and mathematics education is, informed by the history and philosophy of these disciplines, as well as by the philosophy of education more generally. The first handbook to cover the field, it lays down a much-needed marker of progress to date and provides a platform for informed and coherent future analysis and research of the subject. The publication comes at a time of heightened worldwide concern over the standard of science and mathematics education, attended by fierce debate over how best to reform curricula and enliven student engagement in the subjects. There is a growing recognition among educators and policy makers

that the learning of science must dovetail with learning about science; this handbook is uniquely positioned as a locus for the discussion. The handbook features sections on pedagogical, theoretical, national, and biographical research, setting the literature of each tradition in its historical context. It reminds readers at a crucial juncture that there has been a long and rich tradition of historical and philosophical engagements with science and mathematics teaching, and that lessons can be learnt from these engagements for the resolution of current theoretical, curricular and pedagogical questions that face teachers and administrators. Science educators will be grateful for this unique, encyclopaedic handbook, Gerald Holton, Physics Department, Harvard University This handbook gathers the fruits of over thirty years' research by a growing international and cosmopolitan community Fabio Bevilacqua, Physics Department, University of Pavia Handbook of Research on Reading Comprehension, Second Edition - Susan E. Israel 2016-12-30

"This edition provides a transformative snapshot of reading comprehension as a field of study at a seminal moment. It maintains the same high level of standards with respect to (1) historical perspectives useful for laying the foundation of study on reading comprehension; (2) theoretical perspectives that allow the reader to consider different views on how specific areas have evolved since the first edition; (3) excellent chapters on various elements of reading comprehension, including major research studies in assessment, cultural impacts of reading comprehension, issues affecting English language learners, and consideration of international populations; and (4) identification of future research needs to help raise important questions and stimulate possible hypotheses for future research"--

Higher Order Thinking in Science Classrooms: Students' Learning and Teachers' Professional Development - Anat Zohar 2004-01-31

How can educators bridge the gap between "big" ideas about teaching students to think and educational practice? This book addresses this question by a unique combination of theory, field experience and elaborate educational research.

Its basic idea is to look at science instruction with regard to two sets of explicit goals: one set refers to teaching science concepts and the second set refers to teaching higher order thinking. This book tells about how thinking can be taught not only in the rare and unique conditions that are so typical of affluent experimental educational projects but also in the less privileged but much more common conditions of educational practice that most schools have to endure. It provides empirical evidence showing that students from all academic levels actually improve their thinking and their scientific knowledge following the thinking curricula, and discusses specific means for teaching higher order thinking to students with low academic achievements. The second part of the book addresses issues that pertain to teachers' professional development and to their knowledge and beliefs regarding the teaching of higher order thinking. This book is intended for a very large audience: researchers (including graduate students), curricular designers, practicing and pre-service teachers, college students, teacher educators and those interested in educational reform. Although the book is primarily about the development of thinking in science classrooms, most of its chapters may be of interest to educators from all disciplines. *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.

Special issue on research - Colette Dufresne-Tassé 2016-01-05

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Reconceptualizing the Nature of Science for Science Education - Sibel Erduran 2014-08-20 Prompted by the ongoing debate among science educators over 'nature of science', and its importance in school and university curricula,

this book is a clarion call for a broad re-conceptualizing of nature of science in science education. The authors draw on the 'family resemblance' approach popularized by Wittgenstein, defining science as a cognitive-epistemic and social-institutional system whose heterogeneous characteristics and influences should be more thoroughly reflected in science education. They seek wherever possible to clarify their developing thesis with visual tools that illustrate how their ideas can be practically applied in science education. The volume's holistic representation of science, which includes the aims and values, knowledge, practices, techniques, and methodological rules (as well as science's social and institutional contexts), mirrors its core aim to synthesize perspectives from the fields of philosophy of science and science education. The authors believe that this more integrated conception of nature of science in science education is both innovative and beneficial. They discuss in detail the implications for curriculum content, pedagogy, and learning outcomes, deploy numerous real-life examples, and detail the links between their ideas and curriculum policy more generally.

The Routledge International Handbook of Research on Teaching Thinking - Rupert Wegerif 2015-05-22

The Routledge International Handbook of Research on Teaching Thinking is a comprehensive guide to research on teaching thinking. Teaching thinking is key to growing a more successful economy, is needed for increased democratic engagement and is vital for the well-being of individuals faced with the complexity of a globalised world. However, there are questions about what we mean by 'thinking', how best to teach it and how best to assess it, and it is these questions that this handbook explores and addresses. Containing surveys and summaries of international, cutting-edge research on every aspect of teaching thinking in a range of contexts, the handbook is thorough in its delivery, examining many different approaches and methods to help readers understand what teaching thinking is and how we can best take this movement forward. Key topics include: • Theoretical perspectives on teaching thinking • Approaches for teaching

thinking • Developing creative thinking • Developing critical thinking and metacognition • The assessment of thinking • Teaching thinking in the context of STEM • Collaborative thinking and new technology • Neuro-educational research on teaching thinking This book is an essential guide for policy-makers, teachers and researchers who are interested in teaching thinking

Science Education in East Asia - Myint Swe Khine 2015-09-03

This book presents innovations in teaching and learning science, novel approaches to science curriculum, cultural and contextual factors in promoting science education and improving the standard and achievement of students in East Asian countries. The authors in this book discuss education reform and science curriculum changes and promotion of science and STEM education, parental roles and involvement in children's education, teacher preparation and professional development and research in science education in the context of international benchmarking tests to measure the knowledge of mathematics and science such as the Trends in Mathematics and Science Study (TIMSS) and achievement in science, mathematics and reading like Programme for International Student Assessment (PISA). Among the high achieving countries, the performance of the students in East Asian countries such as Singapore, Taiwan, Korea, Japan, Hong Kong and China (Shanghai) are notable. This book investigates the reasons why students from East Asian countries consistently claim the top places in each and every cycle of those study. It brings together prominent science educators and researchers from East Asia to share their experience and findings, reflection and vision on emerging trends, pedagogical innovations and research-informed practices in science education in the region. It provides insights into effective educational strategies and development of science education to international readers.

Emerging Technologies for the Classroom - Chrystalla Mouza 2012-11-07

This book provides contemporary examples of the ways in which educators can use digital technologies to create effective learning environments that support improved learning and instruction. These examples are guided by

multiple conceptual and methodological traditions evolving from the learning sciences and instructional technology communities as well as other communities doing important work on learning technologies. In particular, the book provides examples of technology innovations and the ways in which educators can use them to foster deep understanding, collaboration, creativity, invention, and reflection. Additional examples demonstrate the ways in which emerging mobile and networked technologies can help extend student learning beyond the confines of the classroom wall and support student-directed learning and new media literacies.

How Science Works - Rob Toplis 2010-12-02

How Science Works provides student and practising teachers with a comprehensive introduction to one of the most dramatic changes to the secondary science curriculum. Underpinned by the latest research in the field, it explores the emergence and meaning of How Science Works and reviews major developments in pedagogy and practice. With chapters structured around three key themes - why How Science Works, what it is and how to teach it - expert contributors explore issues including the need for curriculum change, arguments for scientific literacy for all, school students' views about science, what we understand about scientific methods, types of scientific enquiry, and, importantly, effective pedagogies and their implications for practice. Aiming to promote discussion and reflection on the ways forward for this new and emerging area of the school science curriculum, it considers: teaching controversial issues in science argumentation and questioning for effective teaching enhancing investigative science and developing reasoned scientific judgments the role of ICT in exploring How Science Works teaching science outside the classroom. How Science Works is a source of guidance for all student, new and experienced teachers of secondary science, interested in investigating how the curriculum can provide creativity and engagement for all school students.

Learning Causality in a Complex World -

Tina A. Grotzer 2012-06-28

What do children's interactions on the playground have to do with foreign policy? How

does science understanding in middle school relate to environmental disasters in third world countries? The causal patterns that we detect and how we act upon them pervade every aspect of our lives. These skills will only become more important in the future as our world becomes more global and more interconnected. Yet we aren't very skilled at thinking about causality. Research shows that instead we rely on limiting default assumptions that can lead to poor choices in a complex world. What can we do about it? This book offers ways to become aware of these patterns and to reframe our thinking to become more effective learners and citizens of the world. Through examples and accessible explanations, it offers a causal curriculum to enable more effective learning so that we can put the power of better causal understanding to work for ourselves and the next generation— for today and tomorrow.

New Science of Learning - Myint Swe Khine
2010-06-16

The earliest educational software simply transferred print material from the page to the monitor. Since then, the Internet and other digital media have brought students an ever-expanding, low-cost knowledge base and the opportunity to interact with minds around the globe—while running the risk of shortening their attention spans, isolating them from interpersonal contact, and subjecting them to information overload. The *New Science of Learning: Cognition, Computers and Collaboration in Education* deftly explores the multiple relationships found among these critical elements in students' increasingly complex and multi-paced educational experience. Starting with instructors' insights into the cognitive effects of digital media—a diverse range of viewpoints with little consensus—this cutting-edge resource acknowledges the double-edged potential inherent in computer-based education and its role in shaping students' thinking capabilities. Accordingly, the emphasis is on strategies that maximize the strengths and compensate for the negative aspects of digital learning, including: Group cognition as a foundation for learning Metacognitive control of learning and remembering Higher education course development using open education resources Designing a technology-oriented

teacher professional development model Supporting student collaboration with digital video tools Teaching and learning through social annotation practices The *New Science of Learning: Cognition, Computers and Collaboration in Education* brings emerging challenges and innovative ideas into sharp focus for researchers in educational psychology, instructional design, education technologies, and the learning sciences.

The Precarious Future of Education - Jan Jagodzinski
2016-11-30

This volume examines the challenges weighing on the future of education in the face of globalization in the twenty-first century. Bringing together eleven authors who explore the paradox of an "after" to the future of education, each chapter in this book targets three important areas: ecology as understood in the broader framework of globalization and pedagogy; curriculum concerns which impact learning; and the pervasiveness of technology in education today.

Cognition, Metacognition, and Culture in STEM Education - Yehudit Judy Dori
2017-12-01

This book addresses the point of intersection between cognition, metacognition, and culture in learning and teaching Science, Technology, Engineering, and Mathematics (STEM). We explore theoretical background and cutting-edge research about how various forms of cognitive and metacognitive instruction may enhance learning and thinking in STEM classrooms from K-12 to university and in different cultures and countries. Over the past several years, STEM education research has witnessed rapid growth, attracting considerable interest among scholars and educators. The book provides an updated collection of studies about cognition, metacognition and culture in the four STEM domains. The field of research, cognition and metacognition in STEM education still suffers from ambiguity in meanings of key concepts that various researchers use. This book is organized according to a unique manner: Each chapter features one of the four STEM domains and one of the three themes—cognition, metacognition, and culture—and defines key concepts. This matrix-type organization opens a new path to knowledge in STEM education and facilitates its understanding. The discussion at the end of the

book integrates these definitions for analyzing and mapping the STEM education research.

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