



IMPROVING UNDERGRADUATE INSTRUCTION IN SCIENCE, TECHNOLOGY, ENGINEERING, AND MATHEMATICS

REPORT OF A WORKSHOP

**NATIONAL RESEARCH COUNCIL
OF THE NATIONAL ACADEMIES**

Improving Undergraduate Instruction In Science Technology Engineering And Mathematics Report Of A Workshop

**National Research Council, Division on
Earth and Life Studies, Board on Life
Sciences, Committee on Education on
Dual Use Issues in the Life Sciences**

Improving Undergraduate Instruction In Science Technology Engineering And Mathematics Report Of A Workshop:

Improving Undergraduate Instruction in Science, Technology, Engineering, and Mathematics National Research Council, Division of Behavioral and Social Sciences and Education, Center for Education, Committee on Undergraduate Science Education, Steering Committee on Criteria and Benchmarks for Increased Learning from Undergraduate STEM Instruction, 2003-06-28 Participants in this workshop were asked to explore three related questions 1 how to create measures of undergraduate learning in STEM courses 2 how such measures might be organized into a framework of criteria and benchmarks to assess instruction and 3 how such a framework might be used at the institutional level to assess STEM courses and curricula to promote ongoing improvements The following issues were highlighted Effective science instruction identifies explicit measurable learning objectives Effective teaching assists students in reconciling their incomplete or erroneous preconceptions with new knowledge Instruction that is limited to passive delivery of information requiring memorization of lecture and text contents is likely to be unsuccessful in eliciting desired learning outcomes Models of effective instruction that promote conceptual understanding in students and the ability of the learner to apply knowledge in new situations are available Institutions need better assessment tools for evaluating course design and effective instruction Deans and department chairs often fail to recognize measures they have at their disposal to enhance incentives for improving education Much is still to be learned from research into how to improve instruction in ways that enhance student learning

Evaluating and Improving Undergraduate Teaching in Science, Technology, Engineering, and Mathematics

National Research Council, Division of Behavioral and Social Sciences and Education, Center for Education, Committee on Recognizing, Evaluating, Rewarding, and Developing Excellence in Teaching of Undergraduate Science, Mathematics, Engineering, and Technology, 2003-01-19 Economic academic and social forces are causing undergraduate schools to start a fresh examination of teaching effectiveness Administrators face the complex task of developing equitable predictable ways to evaluate encourage and reward good teaching in science math engineering and technology Evaluating and Improving Undergraduate Teaching in Science Technology Engineering and Mathematics offers a vision for systematic evaluation of teaching practices and academic programs with recommendations to the various stakeholders in higher education about how to achieve change What is good undergraduate teaching This book discusses how to evaluate undergraduate teaching of science mathematics engineering and technology and what characterizes effective teaching in these fields Why has it been difficult for colleges and universities to address the question of teaching effectiveness The committee explores the implications of differences between the research and teaching cultures and how practices in rewarding researchers could be transferred to the teaching enterprise How should administrators approach the evaluation of individual faculty members And how should evaluation results be used The committee discusses methodologies offers practical guidelines and points out

pitfalls Evaluating and Improving Undergraduate Teaching in Science Technology Engineering and Mathematics provides a blueprint for institutions ready to build effective evaluation programs for teaching in science fields *Integrating the Sciences and Society* Harriet Hartman,2008-10-01 Many people think of social problems as involving poor and powerless individuals in society This work seeks to improve the balance by adding a focus on important and powerful institutions It discusses policy sciences public policy analysis and public management It addresses operations and design issues for government organizations **Transforming Insitutions** Gabriela C. Weaver,Wilella D. Burgess,Amy L. Childress,Linda Slakey,2016 Higher education is coming under increasing scrutiny both publically and within academia with respect to its ability to appropriately prepare students for the careers that will make them competitive in the 21st century workplace At the same time there is a growing awareness that many global issues will require creative and critical thinking deeply rooted in the technical STEM science technology engineering and mathematics disciplines Transforming Institutions brings together chapters from the scholars and leaders who were part of the 2011 and 2014 conferences It provides an overview of the context and challenges in STEM higher education contributed chapters describing programs and research in this area and a reflection and summary of the lessons from the many authors viewpoints leading to suggested next steps in the path toward transformation *Inquiry-Based Learning for Science, Technology, Engineering, and Math (STEM) Programs* Patrick Blessinger,John M. Carfora,2015-10-20 This volume covers the many issues and concepts of how IBL can be applied to STEM programs and serves as a conceptual and practical resource and guide for educators and offers practical examples of IBL in action and diverse strategies on how to implement IBL in different contexts To Improve the Academy Douglas Reimondo Robertson,Linda B. Nilson,2007-10-12 An annual publication of the Professional and Organizational Development Network in Higher Education POD To Improve the Academy offers a resource for improvement in higher education to faculty and instructional development staff department chairs faculty deans student services staff chief academic officers and educational consultants *Talking about Leaving Revisited* Elaine Seymour,Anne-Barrie Hunter,2019-12-10 Talking about Leaving Revisited discusses findings from a five year study that explores the extent nature and contributory causes of field switching both from and among STEM majors and what enables persistence to graduation The book reflects on what has and has not changed since publication of Talking about Leaving Why Undergraduates Leave the Sciences Elaine Seymour Nancy M Hewitt Westview Press 1997 With the editors guidance the authors of each chapter collaborate to address key questions drawing on findings from each related study source national and institutional data interviews with faculty and students structured observations and student assessments of teaching methods in STEM gateway courses Pitched to a wide audience engaging in style and richly illustrated in the interviewees own words this book affords the most comprehensive explanatory account to date of persistence relocation and loss in undergraduate sciences Comprehensively addresses the causes of loss from undergraduate STEM majors an issue of ongoing national concern Presents critical research relevant for nationwide

STEM education reform efforts Explores the reasons why talented undergraduates abandon STEM majors Dispels popular causal myths about why students choose to leave STEM majors This volume is based upon work supported by the Alfred P Sloan Foundation Award No 2012 6 05 and the National Science Foundation Award No DUE 1224637 Improving Teaching, Learning, Equity, and Success in Gateway Courses Andrew K. Koch, 2018-01-22 As long as there have been U S colleges and universities there have been entry courses that pose difficulties for students courses that have served more as weeding out rather than gearing up experiences for undergraduates This volume makes the case that the weed out dynamic is no longer acceptable if it ever was Contemporary postsecondary education is characterized by vastly expanded access for historically underserved populations of students and this new level of access is coupled with increased scrutiny of retention and graduation outcomes Chapters in this volume define and explore issues in gateway courses and provide various examples of how to improve teaching learning and outcomes in these foundational components of the undergraduate experience This is the 180th volume of the Jossey Bass quarterly report series New Directions for Higher Education Addressed to presidents vice presidents deans and other higher education decision makers on all kinds of campuses it provides timely information and authoritative advice about major issues and administrative problems confronting every institution *Transforming Agricultural Education for a Changing World* National Research Council, Division on Earth and Life Studies, Board on Life Sciences, Board on Agriculture and Natural Resources, Committee on a Leadership Summit to Effect Change in Teaching and Learning, 2009-11-16 During the next ten years colleges of agriculture will be challenged to transform their role in higher education and their relationship to the evolving global food and agricultural enterprise If successful agriculture colleges will emerge as an important venue for scholars and stakeholders to address some of the most complex and urgent problems facing society Such a transformation could reestablish and sustain the historical position of the college of agriculture as a cornerstone institution in academe but for that to occur a rapid and concerted effort by our higher education system is needed to shape their academic focus around the reality of issues that define the world's systems of food and agriculture and to refashion the way in which they foster knowledge of those complex systems in their students Although there is no single approach to transforming agricultural education a commitment to change is imperative A Practice-based Model of STEM Teaching Alpaslan Sahin, 2015-07-21 The STEM Students on the Stage SOS™ model was developed by Harmony Public Schools with the goal of teaching rigorous content in an engaging fun and effective way In this book you will learn that the STEM SOS model is not only helping students learn STEM content and develop 21st century skills but also helping teachers improve their classroom climate through increased student teacher communication and a reduction in classroom management issues There are at least two ways in which this book is innovative First you will find student videos and websites associated with QR codes readers can use their QR readers to watch student videos related to the content in the chapter and see student e portfolio samples at their Google sites This provides the opportunity to see that what is discussed

in the book actually happened Second the book is not about a theory it is an actual implemented model that has evolved through the years and has been used in more than 25 schools since 2012 Every year the model continues to be improved to increase its rigor and ease of implementation for both teachers and students In addition to using the book as a classroom teacher resource and guide it can also be used as a textbook in advanced graduate level curriculum and instruction educational leadership and STEM education programs Therefore STEM educators leaders pre service and in service teachers and graduate students will all benefit from reading this book Appendices will be one of the favorite aspects of this book for teachers who are constantly looking for ready to use student and teacher handouts and activities Full handouts including formative and summative assessments materials and grading rubrics will provide an opportunity for teachers and curriculum directors to understand the ideas and secrets behind the STEM SOS model Lastly STEM directors will find this to be one of the best STEM teaching model examples on the market because the model has fully accessible student and teacher handouts assessment materials rubrics and hundreds of student products e portfolios including video presentations and project brochures online

Science Teachers' Learning National Academies of Sciences, Engineering, and Medicine, Division of Behavioral and Social Sciences and Education, Teacher Advisory Council, Board on Science Education, Committee on Strengthening Science Education through a Teacher Learning Continuum, 2016-01-15 Currently many states are adopting the Next Generation Science Standards NGSS or are revising their own state standards in ways that reflect the NGSS For students and schools the implementation of any science standards rests with teachers For those teachers an evolving understanding about how best to teach science represents a significant transition in the way science is currently taught in most classrooms and it will require most science teachers to change how they teach That change will require learning opportunities for teachers that reinforce and expand their knowledge of the major ideas and concepts in science their familiarity with a range of instructional strategies and the skills to implement those strategies in the classroom Providing these kinds of learning opportunities in turn will require profound changes to current approaches to supporting teachers learning across their careers from their initial training to continuing professional development A teacher's capability to improve students scientific understanding is heavily influenced by the school and district in which they work the community in which the school is located and the larger professional communities to which they belong Science Teachers Learning provides guidance for schools and districts on how best to support teachers learning and how to implement successful programs for professional development This report makes actionable recommendations for science teachers learning that take a broad view of what is known about science education how and when teachers learn and education policies that directly and indirectly shape what teachers are able to learn and teach The challenge of developing the expertise teachers need to implement the NGSS presents an opportunity to rethink professional learning for science teachers Science Teachers Learning will be a valuable resource for classrooms departments schools districts and professional organizations as they

move to new ways to teach science

Information Systems Development Olegas Vasilecas,Albertas Caplinskas,Gregory Wojtkowski,Wita Wojtkowski,Jože Zupancic,Stanislaw Wrycza,2006-02-08 This volume is comprised of the proceedings of the 13th International Conference on Information Systems Development held August 26th 28th 2004 at Vilnius Gediminas Technical University Vilnius Lithuania The aim of this volume is to provide a forum for the research and practices addressing current issues associated with Information Systems Development ISD Every day new technologies applications and methods raise the standards for the quality of systems expected by organizations as well as end users All are becoming dependent on systems reliability scalability and performance Thus it is crucial to exchange ideas and experiences and to stimulate exploration of new solutions This proceedings provides a forum for both technical and organizational issues

Meeting the Challenges to Measurement in an Era of Accountability Henry Braun,2016-01-29 Under pressure and support from the federal government states have increasingly turned to indicators based on student test scores to evaluate teachers and schools as well as students themselves The focus thus far has been on test scores in those subject areas where there is a sequence of consecutive tests such as in mathematics or English language arts with a focus on grades 4 8 Teachers in these subject areas however constitute less than thirty percent of the teacher workforce in a district Comparatively little has been written about the measurement of achievement in the other grades and subjects This volume seeks to remedy this imbalance by focusing on the assessment of student achievement in a broad range of grade levels and subject areas with particular attention to their use in the evaluation of teachers and schools in all It addresses traditional end of course tests as well as alternative measures such as portfolios exhibitions and student learning objectives In each case issues related to design and development psychometric considerations and validity challenges are covered from both a generic and a content specific perspective The NCME Applications of Educational Measurement and Assessment series includes edited volumes designed to inform research based applications of educational measurement and assessment Edited by leading experts these books are comprehensive and practical resources on the latest developments in the field The Open Access version of this book available at <http://www.taylorfrancis.com> has been made available under a Creative Commons Attribution Non Commercial No

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Impact of Water Pollution on Human Health and Environmental Sustainability McKeown, A. Elaine,2015-10-27 Water is at the core of all life on Earth and exists as one of the main components of the human body Because water is essential to life addressing water pollution and sustainability issues is of great concern to environmentalists and public health specialists alike Impact of Water Pollution on Human Health and Environmental Sustainability highlights several important water related issues and explores a number of potential solutions to the problem of water sustainability Focusing on research based perspectives on water availability industrial and agricultural pollution water contamination and their impacts on the human population as well as the environment this crucial publication is a necessary addition to academic and government libraries serving graduate level students environmental scientists public health workers policy makers and

legislators seeking the latest information on sustainable and contaminant free water resources

Challenges and Opportunities for Education About Dual Use Issues in the Life Sciences National Research Council, Division on Earth and Life Studies, Board on Life Sciences, Committee on Education on Dual Use Issues in the Life Sciences, 2011-01-16 The Challenges and Opportunities for Education About Dual Use Issues in the Life Sciences workshop was held to engage the life sciences community on the particular security issues related to research with dual use potential More than 60 participants from almost 30 countries took part and included practicing life scientists bioethics and biosecurity practitioners and experts in the design of educational programs The workshop sought to identify a baseline about 1 the extent to which dual use issues are currently being included in postsecondary education undergraduate and postgraduate in the life sciences 2 in what contexts that education is occurring e g in formal coursework informal settings as stand alone subjects or part of more general training and in what fields and 3 what online educational materials addressing research in the life sciences with dual use potential already exist

Promising Practices in Undergraduate Science, Technology, Engineering, and Mathematics Education National Research Council, Division of Behavioral and Social Sciences and Education, Board on Science Education, Planning Committee on Evidence on Selected Innovations in Undergraduate STEM Education, 2011-04-19 Numerous teaching learning assessment and institutional innovations in undergraduate science technology engineering and mathematics STEM education have emerged in the past decade Because virtually all of these innovations have been developed independently of one another their goals and purposes vary widely Some focus on making science accessible and meaningful to the vast majority of students who will not pursue STEM majors or careers others aim to increase the diversity of students who enroll and succeed in STEM courses and programs still other efforts focus on reforming the overall curriculum in specific disciplines In addition to this variation in focus these innovations have been implemented at scales that range from individual classrooms to entire departments or institutions By 2008 partly because of this wide variability it was apparent that little was known about the feasibility of replicating individual innovations or about their potential for broader impact beyond the specific contexts in which they were created The research base on innovations in undergraduate STEM education was expanding rapidly but the process of synthesizing that knowledge base had not yet begun If future investments were to be informed by the past then the field clearly needed a retrospective look at the ways in which earlier innovations had influenced undergraduate STEM education To address this need the National Research Council NRC convened two public workshops to examine the impact and effectiveness of selected STEM undergraduate education innovations This volume summarizes the workshops which addressed such topics as the link between learning goals and evidence promising practices at the individual faculty and institutional levels classroom based promising practices and professional development for graduate students new faculty and veteran faculty The workshops concluded with a broader examination of the barriers and opportunities associated with systemic change

Transitions and Transformations in

Learning and Education Paivi Tynjala, Marja-Leena Stenström, Marjatta Saarnivaara, 2012-03-30 The breakneck speed of change in today's societies creates enormous challenges for educational institutions at all levels This volume explores ways how to manage change in educational processes and contexts focusing in particular on the concepts of transition and transformation How do we educate a skilled workforce sensitive professionals and responsive citizens who are able not only to cope with change but also to adopt required roles as agents of change How do we prepare students and employees to cope adequately with changes and transitions in their careers and personal lives The first of this book's three sections deals with the conceptual and theoretical aspects of transition transformational processes and human development It defines these concepts and examines the ways in which educational theory and praxis understand concepts of change and development The second section presents empirical studies that offer differing perspectives on educational transitions covering the lifespan from early years education to lifelong learning The third part of the volume focuses on issues of learning and pedagogy and argues that educational practices should change with the changing world With numerous concrete examples included in the analysis and with studies taking a range of forms from personal histories to large scale surveys this new book is a major addition to the literature in a field that has key implications for our future The first of this book's three sections deals with the conceptual and theoretical aspects of transition transformational processes and human development It defines these concepts and examines the ways in which educational theory and praxis understand concepts of change and development The second section presents empirical studies that offer differing perspectives on educational transitions covering the lifespan from early years education to lifelong learning The third part of the volume focuses on issues of learning and pedagogy and argues that educational practices should change with the changing world With numerous concrete examples included in the analysis and with studies taking a range of forms from personal histories to large scale surveys this new book is a major addition to the literature in a field that has key implications for our future

Making Scientists Gregory Light, Marina Micari, 2013-03-05 Gregory Light and Marina Micari reject the view that science technology engineering and mathematics are elite disciplines restricted to a small number with innate talent Rich in concrete advice Making Scientists offers a new paradigm of how scientific subjects can be taught at the college level

Computer Science and Engineering Education for Pre-collegiate Students and Teachers Andrea Burrows, 2019-06-11 Now more than ever as a worldwide STEM community we need to know what pre collegiate teachers and students explore learn and implement in relation to computer science and engineering education As computer science and engineering education are not always stand alone courses in pre collegiate schools how are pre collegiate teachers and students learning about these topics How can these subjects be integrated Explore six articles in this book that directly relate to the currently hot topics of computer science and engineering education as they tie into pre collegiate science technology and mathematics realms There is a systematic review article to set the stage of the problem Following this overview are two teacher focused articles on

professional development in computer science and entrepreneurship venture training The final three articles focus on varying levels of student work including pre collegiate secondary students exploration of engineering design technology future science teachers collegiate students perceptions of engineering and pre collegiate future engineers exploration of environmental radioactivity All six articles speak to computer science and engineering education in pre collegiate forums but blend into the collegiate world for a look at what all audiences can bring to the conversation about these topics The Routledge International Handbook of Student-Centered Learning and Teaching in Higher Education Sabine Hoidn, Manja Klemenčič, 2020-07-28 The movement away from teacher centered toward student centered learning and teaching SCLT in higher education has intensified in recent decades Yet in spite of its widespread use in literature and policy documents SCLT remains somewhat poorly defined under researched and often misinterpreted Against this backdrop The Routledge International Handbook of Student Centered Learning and Teaching in Higher Education offers an original comprehensive and up to date overview of the fundamentals of SCLT and its discussion and applications in policy and practice Bringing together 71 scholars from around the world the volume offers a most comprehensive and up to date overview of the fundamentals of SCLT and its applications in policy and practice provides beacons of good practice that display how instructional expertise manifests itself in the quality of classroom learning and teaching and in the institutional environment and critically discusses challenges new directions and developments in pedagogy course and study program design classroom practice assessment and institutional policy An essential resource this book uniquely offers researchers educators and students in higher education new insights into the roots latest thinking practices and evidence surrounding SCLT in higher education

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