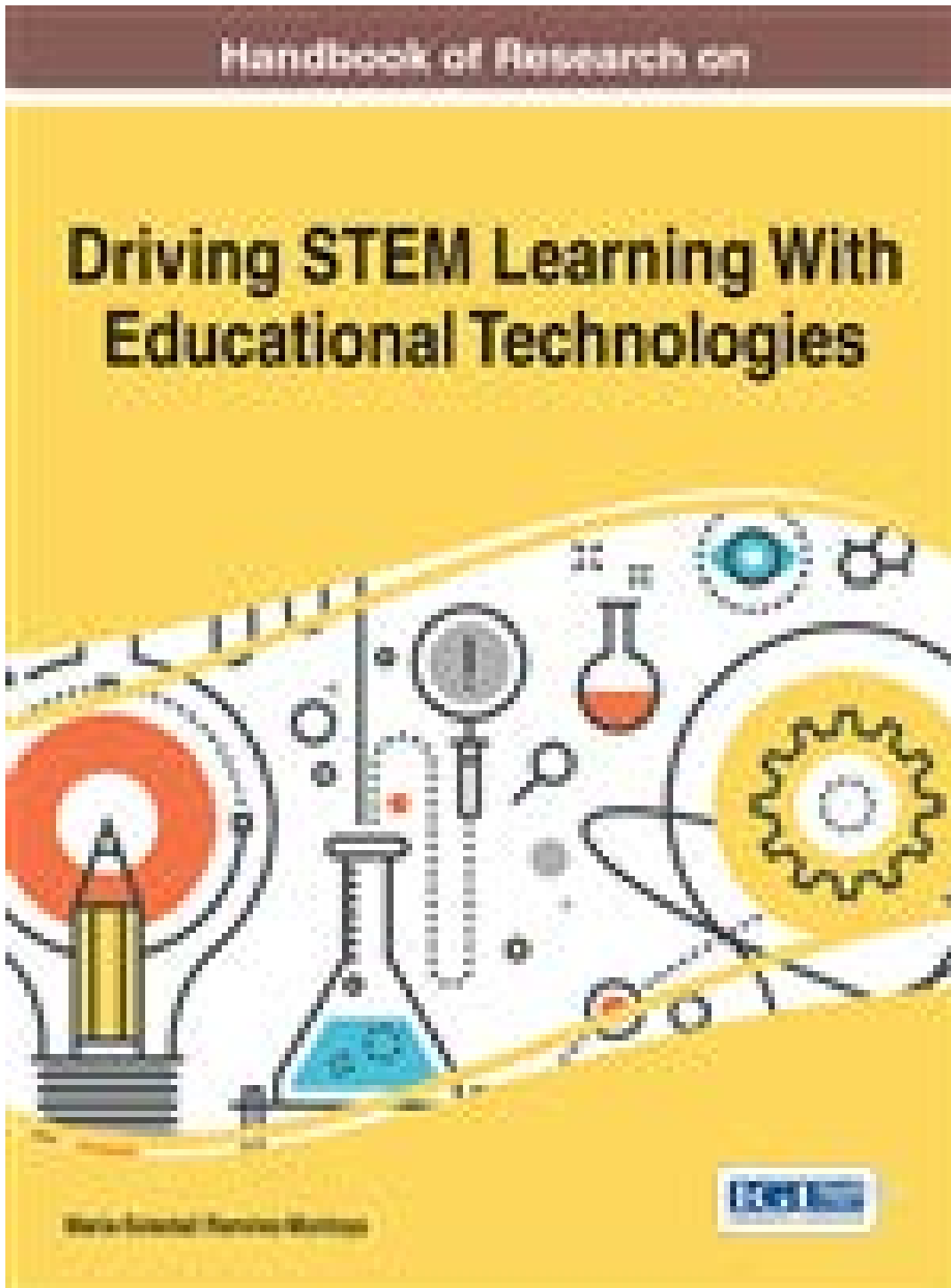


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Handbook of Research on Driving STEM Learning With Educational Technologies

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Tecnologico de Monterrey, Mexico

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Preface

The education of young people in science is at least as important, maybe more so, than the research itself. (Glenn Theodore Seaborg)

The training of researchers is the motivation engine to keep growing scientifically. In this framework it was where, through the support of Researcher Link Programme, promoted by the Fund for International Cooperation in Science and Technology (FONCICYT) of the National Council of Science and Technology (CONACYT), in collaboration with the British Council, articulated the project “Training directed to Researchers with Interest in Science and Mathematics Education” (No. 8/II-E/2014). The project aimed to develop research skills for mathematics and science education through research exchange between participants from Mexico and the United Kingdom. In the concretion of the program, it focused on the training of doctoral students and linking academic communities in Mexico and the United Kingdom to develop proposals aimed at developing skills for STEM.

This book introduces the reader to one of the currently most important areas, known as STEM (science, technology, engineering, and mathematics) disciplines, linked to the training of researchers. Through a combination of theoretical support, to a detailed description of research reports, the reader gets an overview of specific applications the authors of each chapter made on topics within STEM education. In this document, the reader, not only will delve into specific examples of problems encountered in the classroom during the exercise of the teaching-learning content such as mathematics, biology, economics and engineering, but will also find cases related to other educational aspects of sciences, such as the sociological reviews of curriculums and educational measurement and evaluation. Although each section of this document relates to the STEM area, the reader will find that it is written in a friendly language, free of complicated technicalities; where the technical terms are found, these are addressed within a specific context that allows them to be fully understood.

The authors address clearly identified educational situations, for example, cases where the higher education teachers face challenges from their daily activities as science teachers. Moreover, the chapters on educational research reports, allow observing with simple descriptions how the scientific methodology is applied directly to examine situations that students face every day during their learning process. Finally, the content where curriculum and assessment aspects are addressed reflects on current areas of improvement to improve the quality of science education. In this content, for example, the reader can find reflections on how the role of the culture and customs of ethnic groups can improve the development of science programs which include local elements to better the learning of the contents. Similarly,

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there are sections where the development of measuring instruments is reported to assess attitudes and motivational aspects that allow students to increase their interest in STEM areas.

There is no doubt that the economic development of a nation goes hand in hand with scientific and technological developments, to act on local or global problems (optimization of natural resources, preservation of the environment, increase the quality of life and sustainable productive development, among others). In this context, it is imperative to understand how the individual acquires the skills and knowledge derived from the STEM disciplines to potentiate their personal and professional development. Under this concern and demand for STEM knowledge, national institutions such as National Council of Science and Technology (CONACYT / Mexico), National Science Foundation (NSF, USA) and United Nations Educational Organization (UNESCO), have created or promoted programs that monitor and evaluate the overall educational progress in these areas (Trends in Mathematics and Science, TIMMS).

However, despite these standardized tools and policies, it is still necessary to learn from each particular environment the factors that allow the development of skills and scientific knowledge on individuals. The contents of this book, by presenting educational applied cases, respond to the current need to understand and stimulate students in their learning processes within the STEM disciplines. Therefore, the aimed book audience are not only those interested in issues related to the applied STEM disciplines; the content addressed is information of interest to STEM-trained teachers who are directly involved in teaching science in secondary and higher education levels (for example teachers of mathematics, engineering, biology, medicine). Also, other education stakeholders (program and educational policies managers, educational psychologists, vocational counselors, educational researchers, etc.) can benefit from the readings contained in this document.

Regarding content, this book has 25 chapters written by authors with teaching or educational research experience in science teaching and learning. Each chapter, in a self-contained manner, addresses a reflection, investigation or case directly applied to secondary or higher education. The readers can read this book chapter by chapter, or from the section that they find more interest according to the following thematic description:

CHAPTER 1: TRAINING EDUCATIONAL RESEARCHERS IN SCIENCE AND MATHEMATICS – A CASE STUDY THROUGH A BINATIONAL WORKSHOP MEXICO-UK

This chapter places the great contextual framework in which this book was developed through the project “Training directed to Researchers with Interest in Science and Mathematics Education.” Specifically, this chapter presents the case study of the construction of knowledge that was generated through the project where participating students had the experience of building knowledge creating a research paper. The case presents theoretical conceptualizations of the construction of knowledge in students from doctoral programs, contextual description of participants and the project, the process of construction of knowledge of participating students through the workshop experience, the processes by participating teachers and networking opportunities that open from the project.

CHAPTER 2: USING MODELING AND SIMULATION TO LEARN MATHEMATICS

This chapter presents a study to show the importance for future engineers and students in a class of mathematics at a university level that expanding their vision of the use of mathematical concepts in everyday life situations has. For several years, the community of Mathematics Education has reported that the advantages of learning mathematics are linked with the reality of students; this chapter is a contribution in that direction to emphasize the importance of not only to mathematically model a social reality but to simulate it through the specific use of certain technology. Introducing a more holistic approach to learning science and mathematics is one of the points of interest in this chapter. A highlight is the dynamic modeling of social systems, where the human being is a fundamental part, which can be introduced to future engineers from a perspective that brings into play not only the development of their mathematical skills but other equally important skills, such as systemic thinking, communication, teamwork and critical thinking.

CHAPTER 3: TEACHERS AND MATHEMATICAL MODELING – WHAT ARE THE CHALLENGES?

Mathematical modeling had been an important topic in Mathematics Education. Evidence from research all over the world had shown the mathematical modeling benefits in the learning of mathematics applications in different educative levels. Studies now try to understand how mathematical modeling can be incorporated in the teachers' daily practices. The aim of this chapter is to propose an innovative methodology that helps teachers learn about mathematical modeling and put it into practice in their classrooms. The chapter analyzes the teachers' conceptions and their changes during a collaborative work with the researcher.

CHAPTER 4: DATA LITERACY AND CITIZENSHIP – UNDERSTANDING “BIG DATA” TO BOOST TEACHING AND LEARNING IN SCIENCE AND MATHEMATICS

STEM education cannot be detached from the set of broader developments occurring in contemporary society. With this premise in mind, this chapter explores the ways in which educators can embrace a sociological approach to Big Data to complement their teaching methods in disciplines such as Science and Mathematics. Big Data is deemed to be a rather abstract and complex concept, but despite this, it appears to be solidly ingrained in practices, logics, cultures, and institutions related to business, finance, information, government, or health. Within these spheres, computational data becomes essential to generating the insight that subsequently informs decision-making at different levels of society. As modern education seeks to empower pupils through insight that can be turned into actionable knowledge, data literacy is highly valued by employers in various sectors. It appears, therefore, that to improve the current rates of data literacy amongst Science and Mathematics students, educators should use a blend of instrumental approaches and critical thinking when teaching their subjects. This chapter intends to provide some guidelines and highlights a series of challenges that emerge from a narrow understanding of the principles underpinning Big Data in the teaching of STEM disciplines.

CHAPTER 5: FINANCIAL LITERACY – GAPS FOUND BETWEEN MEXICAN PUBLIC AND PRIVATE, MIDDLE, AND HIGH-SCHOOL STUDENTS

This chapter addresses the use of mathematics in real-world contexts; specifically, in the solution of financial problems. The lack of financial literacy is a matter of concern since it has been identified as one of the main reasons behind debt accumulation, saving and investment shortages, as well as other financial pitfalls. The study is set in Mexico; however, a lack of financial literacy is not an issue only in emerging economies; consumers in developed economies also fail to demonstrate a strong financial competence. Financial literacy is the confluence of financial knowledge, attitudes, and behaviors required to make financially responsible decisions and to solve financial problems; it has an impact on the daily decisions of an individual, from balancing a budget to saving for retirement and, in consequence, affects the individual's financial well-being. Results from the research study presented in this chapter describe the financial literacy found on a group of Mexican students from two educational levels (middle school and high school) and two educational systems (public and private). Results offer a description and analysis of the needs and gaps found on participants' financial literacy.

CHAPTER 6: A PROJECT-BASED LEARNING APPROACH – DEVELOPING MATHEMATICAL COMPETENCES IN ENGINEERING STUDENTS

The scope and style of teaching mathematics change as the technology changes. The multiplicity of teaching strategies, beyond the classroom and away from the teacher, opens up new territories for education. The trend toward increasing the technology component in engineering curricula is part of an effort to better prepare graduates for engineering practice. Project-based learning (PBL) is an instructional method in which students learn a range of skills and subject matter in the process of creating their own projects. Sometimes, these projects are solutions to real-world problems. Students can accomplish a hands-on project in a single environment, and they can use these skills when they move to the industry. It is false that technology has changed human beings' fundamental capacities to learn if learning is understood in purely cognitivist terms. But there has been a profound change on how ideas and practices are communicated, and what it means to be a knowledgeable or capable person. In this way, the use of teaching-learning strategies using technologies tools is support for students when they are raised to generate their knowledge and develop independent learning strategies.

CHAPTER 7: DIDACTIC SEQUENCES TEACHING MATHEMATICS FOR ENGINEERS WITH FOCUS ON DIFFERENTIAL EQUATIONS

In this chapter, the authors design a didactical activity that helps to answer some questions that engineering students ask: how can we use mathematics in our engineering training?, where can we apply them? The didactical activity is based on mathematical modeling, analyzing specialty training courses focusing on circuits and differential equations. Considering the Anthropological Theory of Didactics (ATD) and implementing a methodology within it, the authors analyzed the mathematical models of an RC circuit merged in the subject of differential equations. Thus, a link with the course of circuits was formed, showing to the engineering trainees that mathematics can solve problems in a non-mathematical

context, thus answering the initial questions the students have on the application of mathematics in engineering. These activities help the students to understand that mathematics is a tool that they can wield to solve different types of engineering applications. In this manner, when they reach the industry they can identify mathematics in their workspace, providing a better understanding of engineering problems and being able to propose innovative solutions using mathematics.

CHAPTER 8: MAKING LINKS BETWEEN SOLUTIONS TO AN UNSTRUCTURED PROBLEM – THE ROLE OF PRE-WRITTEN, DESIGNED STUDENT RESPONSES

Developing students' metacognitive strategies and understandings of concepts underlying problems is key to students' success in solving unstructured problems. Studies suggest that encouraging students to make judgments about various solution strategies can improve their capacity to monitor and regulate their solution. Moreover, by making connections between distinctly different approaches, students may deepen their understanding of underlying concepts. However, studies also indicate that within one class, the range of methods produced by students may be narrow and not include more sophisticated approaches. Inevitably this will restrict both the extent of their evaluation of strategies and also opportunities to notice how distinct strategies may be linked by invariant properties as one moves, for example, between a graph, a table, and an algebraic expression. The materials in this study attempt to mitigate this issue.

CHAPTER 9: ASSESSING AUTHENTIC INTELLECTUAL WORK IN MATHEMATICS TASKS

This chapter deals with one of the most important tools for teaching: textbooks. It analyses the authentic intellectual work that tasks represent: the construction of knowledge, disciplined inquiry, and value beyond school promoted by them. The sixth-grade Mexican mathematics textbook was analyzed, which is a free and widely distributed book in Mexico. Findings reveal challenges in the way in which tasks are connected to students' lives according to the context they come from. This could nurture teachers' decisions in selecting and adapting textbooks' tasks, and the development of future materials.

CHAPTER 10: THE IMPORTANCE OF THE DISCIPLINARY PERSPECTIVE IN EDUCATIONAL RESEARCH

In this chapter, the authors explore some aspects of education as influenced by particular disciplinary perspectives. In the first part, the viewpoint of Physics to examine the linkage between general educational research and discipline-based educational research is used. The authors investigate how findings can be translated between the two spheres, why some transfers are successful, and others are not, and highlight the importance of the disciplinary context. In the second part, the authors continue to use a disciplinary context, this time in the field of Mathematics, to examine the role played by mathematical modeling within the general pedagogy of the discipline. The authors find that in both cases, the wider themes of transfer, context, and disciplinary identity have a powerful influence on the success, or oth-

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erwise, of educational innovation. The authors give some recommendations for how such innovations can be effectively developed.

CHAPTER 11: LEARNING BIOLOGY WITH SITUATED LEARNING IN MEXICAN ZAPOTECA TELE-SECONDARY SCHOOLS

In this chapter, the author explores an alternative to traditional science education for indigenous communities. Situated learning is a recent pedagogical alternative that affords the possibility of integrating the pupils' culture and ways of interpreting the world within the curricular aims. The chapter exemplifies how situated learning can be applied in Mexican indigenous classrooms and analyses how it helps students learn, be motivated while they learn, and see the importance of what they are learning. The chapter can serve as a guide for adapting curricular contents in different contexts to make them culturally responsive and to help indigenous students understand the importance of the obtained learning.

CHAPTER 12: TRANSFORMATIONS OF THE CONCEPT OF LINEAR FUNCTION IN TECHNOLOGICAL HIGH SCHOOLS

Recent curriculum studies in the educational mathematics area have evolved and broadened the scope of action. This chapter explores the changes brought about by the implementation of teaching linear functions in the Functions and Algebraic Thinking course; participants were three mathematics teachers who work in Mexican Technological High Schools, an educational modality that affords the students a bivalent training. The main reasons that led to the development of this research are: 1) the fact that most of the curriculum studies are not usually focused on one object of knowledge; 2) the fact that the theoretical review showed few studies coming from this modality; and, 3) that most of the research developed on linear function are of cognitive or historical type. This chapter presents the results found in the research, as well as posing the possibility of strengthening it with further research about the curriculum in the educational mathematics area.

CHAPTER 13: MEASUREMENT INSTRUMENTS TO MOTIVATE SCIENTIFIC LEARNING BY CONCEPTUAL CHANGE

The chapter is concerned with how to measure scientific reasoning, motivation, and interest of students toward learning science, a very important subject in STEM education. Teachers need to know how motivation affects the achievement of their students, and if this motivation has an influence on scientific reasoning, to improve and provide new science teaching techniques. This investigation attempts to find out if students can discern if they have misconceptions or non-scientific ideas about science topics to make a conceptual change of those ideas, how motivation influences this change, and if the student can make this change when presented with high scientific reasoning.

CHAPTER 14: TEST DESIGN TO ASSESS THE QUALITIES OF SCIENCE STUDENTS' PRIOR KNOWLEDGE

STEM Education involves processes like learning, which includes a complex multifactorial relation among variables, which can be social, cultural and individual. The prior knowledge that a student has before a learning task is one of the most important individual variables recognized in many studies. This chapter presents the design of an instrument that measures the inherent qualities of declarative prior knowledge: correct, incomplete and incorrect knowledge. This instrument would help to evaluate the separate effect of the inherent qualities of the learning process. The contents of knowledge to be evaluated are related to the subject of electricity and magnetism for the domains of electrostatics to cover part of the syllabi for engineering students.

CHAPTER 15: ARGUMENTATION SCHEMA TO ANALYZE HIGH SCHOOL STUDENTS' SCIENTIFIC REASONING

A key objective of the science teacher is to contribute to the task of motivating students to develop their scientific thinking to understand and interpret different natural phenomena with the intention of solving specific problems. This chapter introduces the reader to the study of developing argumentation schemas in a classroom situation, contributing to the generation of student's scientific reasoning. It provides teachers in the area of physical sciences, and researchers in the area of teaching physics with a theoretical framework they can use to describe, analyze and model student's reasoning in a specific class environment. The disciplinary context in which this research is done is the kinematic theory.

CHAPTER 16: ACCURATE ITEMS FOR INACCURATE CONCEPTIONS IN UNDERGRADUATE PHYSICS STUDENTS

The psychometric analysis of conceptual tests, surveys, and inventories provides relevant information about their structure and usefulness. Nevertheless, it is also necessary to bear in mind that the student sample which is taking these tests might not always be in the same academic situations, not to mention social or cultural environments as well. Therefore, it is reasonable to consider that a psychometric analysis is needed depending on the student population in which a certain set of items is applied. In this chapter, the authors study the statistical characteristics of 14 questions of the Conceptual Survey of Electricity and Magnetism (CSEM), based on the administrations that have been done during the past years to 5397 students at the end of their semester taking the undergraduate course of Electricity and Magnetism at a private university in the north of Mexico. This allows the authors to propose modifications to certain items, if necessary, to ensure that they fit the academic requirements for the type of course the test was designed for and have an inventory as independent of the sample as possible.

CHAPTER 17: A LOOK INTO STUDENTS' INTERPRETATION OF ELECTRIC FIELD LINES

In this chapter, the authors aim to identify how students interpret electric field line diagrams and the effect their interpretations may have on the conceptual understanding of the electric field. This is essential in teaching science since many students who pursue undergraduate degrees in STEM take a course of electricity and magnetism in their second year of university. In this course, students face the challenge of understanding some abstract concepts, including the electric field, one of the most fundamental concepts in the study of electrodynamics at the undergraduate level. By identifying how students interpret the different representations of the electric field, instructors can make informed decisions about how to teach the content of this topic and how to address students' difficulties in learning the concept.

CHAPTER 18: RESEARCH-BASED STRATEGIES IN AN ELECTRIC CIRCUITS LAB – TUTORIALS AND REALTIME PHYSICS APPROACHES

The importance of the use of technology in education has been increasing exponentially in the last decades. Literature related to the study of STEM education concludes that the integration of technology in education on an everyday basis helps students stay engaged, gives students the opportunity to interact with their classmates by encouraging collaboration, and is a great way to reach an adequate understanding of the concepts. The engineering students who learn how to manipulate technology and work in teams are more prepared for the challenges in their professional practice. Technology helps students take more control over their learning, to learn to make their decisions and to be more reflective of their practice. Incorporating technology in a physics laboratory for engineering students is beneficial in several ways: to improve conceptual learning, to develop technology skills and, to develop collaborative skills. This research presents evidence that when students, guided by research-based strategies, use different types of technology such as computers and calculators with probes to collect data of different phenomena in the physics laboratory, they achieve better conceptual learning, technology, and collaboration skills.

CHAPTER 19: INTEGRATION OF DIGITAL TECHNOLOGIES – COLLABORATIVE PRACTICES IN TEACHING MATHEMATICS

Promoting collaborative practices among elementary school teachers by cultivating a community of practice in the area of teacher professional development and from classroom contexts, affects their thinking on how to integrate digital technologies (DT) to their practice of teaching mathematics. The chapter explains how a community of practice improves institutional practices and influences the learning process of students and how the teacher modifies and adapts existing digital resources to contextualize the needs of their students. It also shows the ways the teacher uses DT as a replacement for non-digital technologies and sometimes amplifies their potential without a substantial modification of teaching resources and teaching practices, and how the teacher cares about acquiring specialized knowledge to understand and construct mathematical knowledge for teaching. The author argues that it is necessary for teachers to know the criteria to select relevant digital learning resources and make adjustments depending on the constraints in three dimensions: technological, pedagogical and content. There is scarce research to fol-

low up the elementary school teacher in a cycle of improving their teaching practice from design-based research, from a foundation with primary sources constructed from a group frame with teachers and through a device that nourishes the conceptualization while technological innovation occurs.

CHAPTER 20: THE EFFECTIVENESS OF COMPUTER-AIDED ASSESSMENT FOR THE PURPOSES OF A MATHEMATICAL SCIENCES LECTURER

Judging whether an assessment tool is effective or not is a difficult task. While the literature offers examples of assessments that are formative, for example, the outcomes are presented as absolute. That is, such studies imply that an assessment tool is formative or not formative. In practice, whether an assessment is effective or not depends on the context in which it is used, how it is used, and what the teacher wishes to achieve. The effectiveness of computer-aided assessment for the purposes of a mathematical sciences lecturer details the process by which a model for effective assessment was used to determine how effective an assessment tool had been for six lecturers testing their mathematics and engineering students. It exemplifies the need to consider context and aims when judging the extent to which an assessment tool has been effective. By presenting the model for effective assessment and examples from the computer-aided assessment study, the chapter provides a blueprint for practitioners to reflect upon and develop their assessment practices and needs.

CHAPTER 21: CONSTRUCTION OF THE DEFINITE INTEGRAL CONCEPT USING OPEN SOURCE SOFTWARE

This chapter provides a learning activity for the construction of the definite integral concept. The problem to be solved is an everyday situation that involves three different moments of a cyclist who travels in a mountainous area. The Geogebra software is used to provide graphical visualization, fast calculations and student interaction with the learning activity. The GeoGebra file is designed with buttons to trigger actions and move between views. The immediate display of actions implemented in the software allows the students focus on the assimilation of concepts.

CHAPTER 22: CONTEXT AS ACTION IN THE TEACHING OF STATISTICAL CONCEPTS – AN ACTIVITY THEORY PERSPECTIVE

This chapter considers the concept of ‘context’ in the case of teaching statistics at university level. The study uses observations of lectures and takes a Cultural-Historical Activity Theory (CHAT) perspective to situate the teaching of statistics within the activity of learning. ‘Context’ in the educational literature may refer to the background or situation that is represented in an example or task and also to the educational setting, pedagogical or learning environment (e.g. curriculum). Further, in statistics, the purpose of investigations is to learn more about a real situation or context. Finally, ‘context’ has also been conceptualized more broadly as a collection of factors that frame the structure and meaning of human actions. This chapter, therefore, uses CHAT to characterize the ‘context’ of statistics lecturers’ teaching practices, e.g. in lecture theaters, institutional practices, and society as well as the role of ‘context’ in the

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teaching of statistics at university. This chapter seeks to show how ‘context’ in these lectures included individual, social experiences, historical conceptions, artifacts and human interactions to support learning through actualizing statistical concepts, achieved through contextualized representations and also abstract generalizations.

CHAPTER 23: STATISTICS IN JOURNALISM PRACTICE AND HIGHER EDUCATION

Science communication is nowadays at the center of science and technology research. It no longer can be considered, as it was in the past, an auxiliary element of the process of investigation and research. The complexity of the emerging new media ecology and the embeddedness of science into the public sphere where is now constantly being scrutinized by the media, politicians and the public at large, presents serious challenges for Science, Technology, Engineering and Mathematics as knowledge areas. In this context, statistics are prominently featured in most news stories about STEM, yet most citizens and many news reporters do not have the knowledge required to read them critically or analyze and use them in a meaningful manner in their work or their lives. The result is that the public is often ill-informed about the statistics that underpin scientific and technological narratives as it is the case of GM food and global warming. The chapter explores the reasons for these gaps and discusses pedagogical and strategic approaches to fill those gaps. In so doing, it looks at the role of the news media in general and in particular that of journalism education in addressing these issues to build bridges between STEM and the public at large.

CHAPTER 24: UNDERSTANDING QUALITY OF STATISTICS IN NEWS STORIES – A THEORETICAL APPROACH FROM THE AUDIENCE’S PERSPECTIVE

This chapter provides theoretical insight about the importance of improving audience research in the understanding of statistics as vehiculated in the media. There is a lack of research on how numbers, quantified information, and statistics are understood by a wide audience. Such urgency is not only relevant for Media and Communication scholars, but also for those involved in Education with a particular focus on mathematics and technology. The chapter also addresses the notion of “quality” and reviews the most updated literature in the field, with particular emphasis on how the concept of “quality” can be successfully applied to statistics. “Quality” is historically considered a key concept both for the well-functioning of society and in the information exchange between readers and information producers, such as the journalists or, as in the case of this book, teachers, and educators. The chapter raises awareness on the topic and provides a critical analysis with the aim of helping researchers to foster their analytical skills in the area of mathematics and sciences education.

CHAPTER 25: THE USES OF SCIENCE STATISTICS IN THE NEWS MEDIA AND ON DAILY LIFE

In 2009 an Expert Group on Science and the Media was created as part of the UK's Science and Society Strategy. One of the major findings of their report was that scientist should better communicate their research and science among citizens. In this research, the author reflects on one key factor within the process of science communication: data. It questions the use of statistical data as an objectifying tool while writing about science. The understanding of science, statistics, and media interplay is crucial to make rational decisions, to gain awareness of the significance of spreading scientific knowledge and information as to ensure that science adequately influence on daily life. Within this framework, this chapter proves the importance to communicate science statistics as it is essential to the public understanding of science and therefore to the decision-making processes. Science has a significant impact on society and daily life and therefore it is imperative to understand its fundamentals and how its information is mediated. Undeniably, scientific knowledge is valuable to humanity. Therefore, when communicating and disseminating science information, journalists are contributing to the scientific literacy of citizens. This chapter questions this contribution in the news media and on daily life.

CONCLUSION

The diversity of themes (research, essays, learning models) in both content and disciplines (mathematics, science education, educational assessment, etc.) addressed in this book allow the reader to have a body of knowledge and applicable tools for everyday teaching. These contributions, ranging from the development of educational projects in the classroom applicable to industry to the exemplification of how to integrate educational research to specific problems, make this document an enriching reading for reference of all educational stakeholders. The contents of this book not only help to disseminate practical work in the educational area of the STEM disciplines but their approach from a different perspective -offering specific content to each school case but general to the area of teaching and learning- allows an overview that brings the reader, even if not specialized one in a particular discipline, closer to a deeper understanding of the importance of the preparation of human resources in the STEM disciplines. This book, because of its friendly language, is an easy transit channel for effective communication between teachers practitioners, educational researchers and highly skilled professionals interested in working in STEM education.

In accordance with the words of Glenn Theodore Seaborg: “The education of young people in science is at least as important, maybe more so, than the research itself” (<http://www2.lbl.gov/Science-Articles/Archive/seaborg-quotes-own.html>), it is with this book we leave an invitation to continue growing scientifically in promoting skills in researchers with critical analysis, proactive and with international vision and supporting research and innovation networks to work together on intellectual growth and to seek opportunities in an integrated research and publications.

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