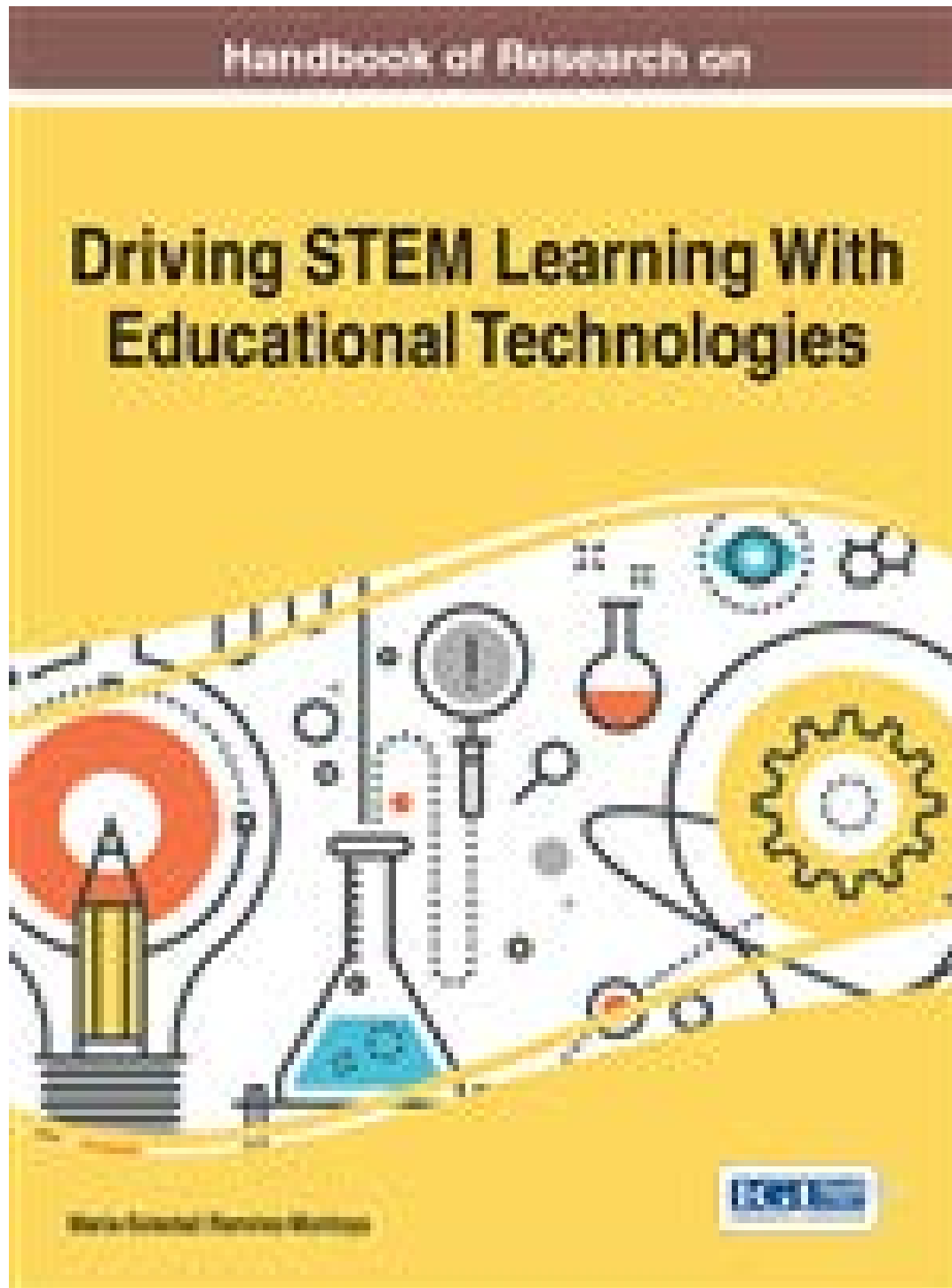


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# Handbook of Research on Driving STEM Learning With Educational Technologies

María-Soledad Ramírez-Montoya  
*Tecnologico de Monterrey, Mexico*

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# Table of Contents

|              |    |
|--------------|----|
| Preface..... | XX |
|--------------|----|

## Section 1 Introduction

### Chapter 1

|   |   |
|---|---|
| Training Educational Researchers in Science and Mathematics: A Case Study Through a Binational Workshop Mexico-UK ..... | 1 |
| <i>María-Soledad Ramírez-Montoya, Tecnológico de Monterrey, Mexico</i>  |   |

## Section 2 Research in Mathematics Education

### Chapter 2

|  |    |
|--|----|
| Using Modeling and Simulation to Learn Mathematics .....         | 23 |
| <i>Ruth Rodríguez Gallegos, Tecnológico de Monterrey, Mexico</i> |    |

### Chapter 3

|  |    |
|--|----|
| Teachers and Mathematical Modeling: What Are the Challenges?.....      | 45 |
| <i>Samantha Analuz Quiroz Rivera, Tecnológico de Monterrey, Mexico</i> |    |
| <i>Ruth Rodríguez Gallegos, Tecnológico de Monterrey, Mexico</i>       |    |

### Chapter 4

|  |    |
|--|----|
| Data Literacy and Citizenship: Understanding ‘Big Data’ to Boost Teaching and Learning in Science and Mathematics..... | 65 |
| <i>Eddy L. Borges-Rey, University of Stirling, UK</i>  |    |

### Chapter 5

|  |    |
|--|----|
| Financial Literacy: Gaps Found Between Mexican Public and Private, Middle, and High-School Students..... | 80 |
| <i>Adriana Berenice Valencia Álvarez, Tecnológico de Monterrey, Mexico</i>                               |    |
| <i>Jaime Ricardo Valenzuela González, Tecnológico de Monterrey, Mexico</i>                               |    |

## **Chapter 6**

- A Project-Based Learning Approach: Developing Mathematical Competences in Engineering Students ..... 107  
*Ismael Osuna Galan, Universidad Politécnica de Chiapas, Mexico*  
*Alejandro Miguel Rosas-Mendoza, Instituto Politécnico Nacional-CICATA, Mexico*

## **Chapter 7**

- Didactic Sequences Teaching Mathematics for Engineers With Focus on Differential Equations .... 129  
*Luis Ramón Siero González, Instituto Politécnico Nacional, Mexico & Universidad Autónoma de Baja California, Mexico*  
*Avenilde Romo Vázquez, Instituto Politécnico Nacional, Mexico*

## **Chapter 8**

- Making Links Between Solutions to an Unstructured Problem: The Role of Pre-Written, Designed Student Responses..... 152  
*Sheila Evans, University of Nottingham, UK*

## **Chapter 9**

- Assessing Authentic Intellectual Work in Mathematics Tasks ..... 176  
*Lesly Yahaira Rodríguez Martínez, Universidad Autónoma de Aguascalientes, Mexico*  
*María Guadalupe Pérez Martínez, Universidad Autónoma de Aguascalientes, Mexico*  
*Adriana Mercado Salas, Universidad Autónoma de Aguascalientes, Mexico*

### **Section 3**

### **Research in Science Education**

## **Chapter 10**

- The Importance of the Disciplinary Perspective in Educational Research..... 198  
*Ross Kerr Galloway, University of Edinburgh, UK*  
*Paul Hernandez-Martinez, Loughborough University, UK*

## **Chapter 11**

- Learning Biology With Situated Learning in Mexican Zapoteca Tele-Secondary Schools ..... 214  
*Paulina Guerrero-Gutiérrez, King's College London, UK*

## **Chapter 12**

- Transformations of the Concept of Linear Function in Technological High Schools ..... 238  
*Rebeca Flores Garcia, Instituto Politecnico Nacional, Mexico*

## **Chapter 13**

- Measurement Instruments to Motivate Scientific Learning by Conceptual Change ..... 260  
*Ana Marcela Monjardín Gopar, Universidad Politécnica de Chihuahua, Mexico & Universidad Pedagógica Nacional del Estado de Chihuahua, Mexico*  
*Gerónimo Mendoza Meraz, Universidad Autónoma de Chihuahua, Mexico*

|  |     |
|--|-----|
| <b>Chapter 14</b>  |     |
| Test Design to Assess the Qualities of Science Students' Prior Knowledge .....       | 278 |
| <i>Luis Hernán Arellano Ulloa, Instituto Tecnológico de Chihuahua, Mexico</i>        |     |
| <i>Gerónimo Mendoza Meraz, Universidad Autónoma de Chihuahua, Mexico</i>             |     |
| <i>Ana Cecilia Villarreal Ballesteros, Universidad Autónoma de Chihuahua, Mexico</i> |     |

|  |     |
|--|-----|
| <b>Chapter 15</b>  |     |
| Argumentation Schema to Analyze High School Students' Scientific Reasoning .....             | 297 |
| <i>Ricardo Lorenzo De la Garza, Tecnológico de Monterrey, Mexico</i>                         |     |
| <i>Genaro Zavala, Tecnológico de Monterrey, Mexico &amp; Universidad Andres Bello, Chile</i> |     |
| <i>Alma Adrianna Gómez Galindo, CINVESTAV Unidad Monterrey, Mexico</i>                       |     |

|  |     |
|--|-----|
| <b>Chapter 16</b>  |     |
| Accurate Items for Inaccurate Conceptions in Undergraduate Physics Students .....            | 315 |
| <i>Eder Hernandez, Tecnológico de Monterrey, Mexico</i>                                      |     |
| <i>Genaro Zavala, Tecnológico de Monterrey, Mexico &amp; Universidad Andres Bello, Chile</i> |     |

|  |     |
|--|-----|
| <b>Chapter 17</b>  |     |
| A Look into Students' Interpretation of Electric Field Lines .....                           | 342 |
| <i>Esmeralda Campos, Tecnológico de Monterrey, Mexico</i>                                    |     |
| <i>Genaro Zavala, Tecnológico de Monterrey, Mexico &amp; Universidad Andres Bello, Chile</i> |     |

|   |     |
|---|-----|
| <b>Chapter 18</b>   |     |
| Research-Based Strategies in an Electric Circuits Lab: Tutorials and RealTime Physics Approaches..... | 365 |
| <i>Monica Quezada-Espinoza, Tecnológico de Monterrey, Mexico</i>                                      |     |
| <i>Genaro Zavala, Tecnológico de Monterrey, Mexico &amp; Universidad Andres Bello, Chile</i>          |     |

**Section 4**  
**Research With Technology and Statistics Support**

|  |     |
|--|-----|
| <b>Chapter 19</b>  |     |
| Integration of Digital Technologies: Collaborative Practices in Teaching Mathematics ..... | 395 |
| <i>Andrés Vázquez Faustino, Universidad Pedagógica Nacional, Mexico</i>                    |     |

|   |     |
|---|-----|
| <b>Chapter 20</b>   |     |
| The Effectiveness of Computer-Aided Assessment for the Purposes of a Mathematical Sciences Lecturer ..... | 415 |
| <i>Stephen James Broughton, Oxford Brookes University, UK</i>   |     |
| <i>Paul Hernandez-Martinez, Loughborough University, UK</i>   |     |
| <i>Carol L. Robinson, Loughborough University, UK</i>   |     |

|  |     |
|--|-----|
| <b>Chapter 21</b>  |     |
| Construction of the Definite Integral Concept Using Open Source Software ..... | 432 |
| <i>Lizzeth Aurora Navarro-Ibarra, Instituto Tecnológico de Sonora, Mexico</i>  |     |
| <i>Omar Cuevas-Salazar, Instituto Tecnológico de Sonora, Mexico</i>            |     |
| <i>Alan Daniel Robles-Aguilar, Instituto Tecnológico de Sonora, Mexico</i>     |     |

|  |     |
|--|-----|
| <b>Chapter 22</b>  |     |
| Context as Action in the Teaching of Statistical Concepts: An Activity Theory Perspective .....                      | 451 |
| <i>Helen Harth, Loughborough University, UK</i>  |     |
| <b>Chapter 23</b>  |     |
| Statistics in Journalism Practice and Higher Education .....   | 471 |
| <i>Jairo A. Lugo-Ocando, University of Leeds, UK</i>   |     |
| <b>Chapter 24</b>  |     |
| Understanding Quality of Statistics in News Stories: A Theoretical Approach from the Audience's<br>Perspective ..... | 485 |
| <i>Alessandro Martinisi, University of Leeds, UK</i>   |     |
| <b>Chapter 25</b>  |     |
| The Uses of Science Statistics in the News Media and on Daily Life .....   | 506 |
| <i>Renata Faria Brandao, University of Sheffield, UK</i>   |     |
| <b>Compilation of References</b> .....   | 524 |
| <b>About the Contributors</b> .....  | 576 |
| <b>Index</b> .....   | 586 |

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# Chapter 1

## Training Educational Researchers in Science and Mathematics: A Case Study Through a Binational Workshop Mexico–UK

**María-Soledad Ramírez-Montoya**  
*Tecnologico de Monterrey, Mexico*

### **ABSTRACT**

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

### **INTRODUCTION**

Capability building in the areas of Science, Technology, Engineering and Mathematics (STEM) is a concern shared by international organizations. In this context, 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, issued a call to apply for projects through the Researcher Link Program. This program’s aim was to link academic communities in Mexico and the United Kingdom (UK) to develop proposals aimed at developing skills for STEM.

In this environment, the project “Training directed to Researchers with Interest in Science and Mathematics Education” (No. 8 / II-E / 2014) was presented and approved. The project aimed to develop research abilities for mathematics and science education through the exchange of research among participants

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from Mexico and the United Kingdom, in order to promote skills in researchers with critical analytical skills and a proactive and international vision, as well as to support networks for research and innovation, to work on intellectual growth as a whole and to seek opportunities for research and publication.

The topic for the project was strategically selected by Mexican and British researchers as an opportunity to contribute to the human resources that work directly with learning environments in science and mathematics, in various educational sectors. Statistics about education in Mexico in these knowledge areas indicate very low levels of performance, hence the relevance of the training of doctoral students to investigate new possibilities.

The project was offered to science and mathematics doctoral students. A call for this training workshop was launched both in Mexico and the UK. The applications were evaluated by 11 research professors from both countries and finally 22 doctoral students were accepted to participate in the workshop.

The aim of this chapter is to frame this experience theoretically, contextually and empirically, in order to open the presentation of this book. The chapter considers the case of the knowledge construction project of the Mexico-UK bilateral workshop aimed at writing research documents, which are presented in this book.

## **LITERATURE REVIEW**

The evolution of a society is achieved through the transformation of education. Carrying it out requires educational research with the purpose of improving teaching practices (Oliva, 2011). It is through the study of teaching practices, the creation of new knowledge and the development and communication of innovations, that these changes occur (Lopez, Sañudo & Maggi, 2013). The acquisition of research competencies that allow to contextualize and analyze a problem to propose innovative solutions is necessary (Fernández and Cardenas, 2014; Saldarriaga, 2016). Hence the importance of the training of researchers.

Training educational researchers involves scientific and technological processes to develop individuals with knowledge, methodologies and an attitude of social commitment to provide options for improvement. The Research Competencies Scale (RCS), developed by Swank and Lambie (2016) to evaluate the mastery of skills to identify gaps in the literature review, use of methodology, research ethics, and dissemination of results, is a tool that, although it is in the stage of validation, is useful for self-assessment on the level of research skills. The construction of knowledge through networks with intersection nodes to build collaboratively is highly valued to broaden the vision and impact of researchers (Ramirez-Montoya, 2012) and of technological knowledge management systems that will enable the nodes' connection and the visibility of the scientific and academic production of doctoral programs (García-Holgado, García-Peñalvo & Rodríguez-Conde, 2015). In short, the challenges and possibilities in training doctoral students create endless possibilities for generating epistemological, scientific and technological knowledge.

A doctoral student has the ultimate challenge of presenting results of an investigation based on the discipline in which he or she specializes. Humphrey, Marshall and Leonardo (2012) found that an effective instruction in research increases the probability of presenting a thesis in the first four years from 15% to 70%. For Okech, Atramovich, Johnson, Hoskins and Rubel (2006), the fact that a student shows interest, commitment and quality in their work is closely related to the research training. Hence the importance of addressing research as a key element of the curriculum.

## **RESULTS**

### **Case Context**

The case of the project “Training directed to researchers with interest in Science and Mathematics Education” is responsibility of Tecnológico de Monterrey, supported 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 through its Researcher Link Programme.

Participants in the project were 33 people: 11 research professors from Tecnológico de Monterrey and various UK universities: University of Edinburgh, Loughborough University, University of Nottingham, University of Glasgow, University of Leeds and the University of Stirling, as well as 22 doctoral students in science and mathematics education from Tecnológico de Monterrey, National Pedagogical University, Polytechnic University of Chiapas, National Polytechnic Institute, Autonomous University of Aguascalientes, Sonora Institute of Technology, Autonomous University of Chihuahua, Loughborough University, King’s College London, University of Nottingham, University of Sheffield and University of Leeds.

The aim of the project was to contribute to the training of doctoral students and to organize and conduct a workshop to support the doctoral students’ competencies development. The workshop “Training directed to researchers with interest in Science and Mathematics Education” had the following purposes:

- Contributing to the discussion of future researchers about the teaching and learning of science and mathematics.
- Establishing networks to promote academic research and joint collaboration between Mexico and the United Kingdom.
- Refining the content of the project’s book chapters on the basis of the ideas presented at the workshop.

### **Workshop’s Contributions for Students**

The development of this workshop provided insights into student training and the building of knowledge through experiencing educational research in various contexts. It also expanded the vision from local towards international environments, sharing with academics and students. Similarly, the workshop was relevant to participants because of the work with conceptual ideas and practices to improve the students’ processes as researchers. These meanings emanated from the words of participating doctoral students:

*The feedback was very useful, as well as the ‘peer review’. It was also good to look at other students’ chapters and to offer a constructive criticism and become familiar with others’ work.*

*It was extremely useful to get feedback both from one professor and from other participants. I believe that the end result improved a lot.*

*First of all, the previous feedback given to me by the teachers was of much use because it guided me to a much more specific and deep investigation, outpointing what the important details that I needed to remark were. Then, by being at the lectures, I got some ideas, especially for the solutions and recommendations section, since the lecturers shared their experiences, and gave us some advice I had not even considered*

## CONCLUSION

Training of doctoral students in science education and mathematics is significant, since through it a consolidation of valuable human resources for the scientific growth of countries is achieved. This project had the participation of eleven research professors from Mexico and the United Kingdom who, through the workshop, contributed to the training of students in the theoretical/methodological aspects that will help them improve their dissertation research; it also had the support of an expert in scientific writing that helped to consolidate the writings, mediated by peer review.

The importance of the development of this binational workshop is of significance in expanding the vision on student training and in building knowledge through experiencing educational research in various contexts. It also expanded the vision from local towards international environments, sharing with academics and students. Similarly, the workshop was important to participants, because of the work with conceptual ideas and practices that improve students' processes as researchers.

Qualitative indicators enunciate an impact on the development of research capabilities in doctoral students from Mexico and the United Kingdom, regarding the competencies that students developed for information retrieval, scientific writing, and critical thinking for the analysis of data in science and mathematics research. Evidence of this ability development is demonstrated in the progress of their research work through writing and the explicit recognition of students and teachers in the data provided in the questionnaires.

The explicit linkage of national and international groups occurred throughout the project process, from organization to implementation, evaluation and dissemination of results. Similarly, post-project, researcher professors are planning to expand linking through agreements between institutions and are proposing new projects to seek funding together to enable them to continue to build together. Similarly, doctoral students make explicit their intention to continue to participate through the network created with this project.

*Figure 7. Participants of the project “Training directed to researchers with interest in Science and Mathematics Education” (number 8/II-E/2014). Cancun, Quintana Roo, México, November 2015.*



## **Training Educational Researchers in Science and Mathematics**

This book is an invitation to continue building knowledge and collaborative networks and research for training doctoral students that contribute to the growth of science and technology. Students and research professors in the project (Figure 7) acknowledge the support granted 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, which made possible, through the Researcher Link Programme, to realize this project for a binational workshop, expected to be the beginning of many future collaborations.

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## KEY TERMS AND DEFINITIONS

**Academic Networks:** Linkage of people from education related communities collaborating with a common objective.

**Binational Workshop:** Training experience shared by communities from two countries.

**Integral Knowledge:** Positive integration of attitude, abilities and knowledge.

***Training Educational Researchers in Science and Mathematics***

**“Research” Competency:** Control and use of disciplinary, methodologic, circumstantial knowledge applied on solving social and educational problems that have as a necessary condition the production of knowledge.

**Scientific-Intellectual Research Competencies:** Knowledge and use of concepts and content to apply in situations for inquiry.

**Technical Instrumental Research Competencies:** Knowledge and use of tools and procedures in situations for inquiry.

**Training of Researchers:** Process by which to form subjects with knowledge, methodology and social commitment attitudes to contribute bettering options.