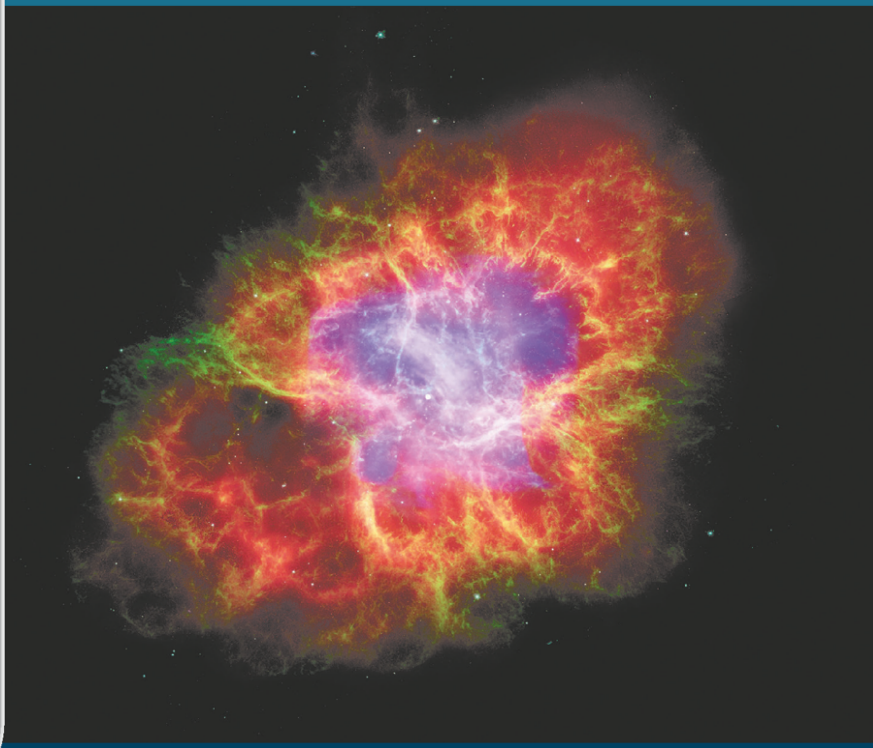
Secondary Education in a Changing World

Secondary STEM Educational Reform



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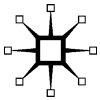

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I would like to dedicate this book to three dear mentors who have impacted my life and my career significantly. First, to Dr. Piyush Swami from the University of Cincinnati who served as my dissertation chair and treasured colleague. I hope you enjoy new adventures in your retirement. Second, to Dr. Jane Butler Kahle, from Miami University, one of the pioneers of science education who agreed to mentor me during my doctoral program and has continued to be a cherished colleague. Last, but not least, to Dr. Charlene M. Czerniak, my colleague who brought me in to the University of Toledo and taught me many of the keys to being a successful and productive faculty member. I am proud to call all three of these great science educators dear friends, and I hope to build upon the important contributions they have made to our field.

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Series Editors' Foreword

Among the educational issues affecting policy makers, public officials, and citizens in modern, democratic, and industrial societies, none has been more contentious than the role of secondary schooling. In establishing the Secondary Education in a Changing Worlds series with Palgrave Macmillan, our intent is to provide a venue for scholars in different national settings to explore critical and controversial issues surrounding secondary education. We envision our series as a place for the airing and resolution of these controversial issues.

More than a century has elapsed since Emile Durkheim argued the importance of studying secondary education as a unity, rather than in relation to the wide range of subjects and the division of pedagogical labor of which it was composed. Only thus, he insisted, would it be possible to have the ends and aims of secondary education constantly in view. The failure to do so accounted for a great deal of difficulty with which secondary education was faced. First, it meant that secondary education was "intellectually disorientated," between "a past which is dying and a future which is still undecided," and as a result "lacks the vigor and vitality which it once possessed" (Durkheim, 1938/1977, p. 8). Second, the institutions of secondary education were not understood adequately in relations to their past, which was "the soil which nourished them and gave them their present meaning, and apart from which they cannot be examined without a great deal of impoverishment and distortion" (10). And third, it was difficult for secondary school teachers, who were responsible for putting policy reforms into practice, to understand the nature of the problems and issues that prompted them.

In the early years of the twenty-first century, Durkheim's strictures still have resonance. The intellectual disorientation of secondary education is more evident than ever as it is caught up in successive waves of policy changes. The connections between the present and the past have become increasingly hard to trace and untangle. Moreover, the distance between policy makers on the one hand and the practitioners on the other has rarely seemed as immense as it is today. The key mission of the current series of

book is, in the spirit of Durkheim, to address these underlying dilemmas of secondary education and to play a part in resolving them.

In *Secondary STEM Educational Reform,* Carla C. Johnson has brought together a collection of essays authored by a diverse group of science educators who have been involved in implementing programs at various sites throughout the United States in STEM (Science, Technology, Engineering, and Mathematics) education. At the heart of the book and central to the argument of its seven chapters is the concept of *turbulence* or the interaction between STEM reform policies and the stakeholders who develop them.

The book's contents consider two broad categories of turbulence, those found at the micro level of the school and the school district and those found at the macro level of the state and the nation. The essays explore a number of different forms of turbulence at these levels. At the micro level, they consist of such factors as the personnel policies that govern teachers and staff, salaries, scheduling, and student support policies. At the macro level, the impetus for turbulence is to be found in policies related to accountability and funding with the most important being those involved in the implementation of the No Child Left Behind legislation. The book's chapters provide an overview of how instances of turbulence manifest themselves in STEM reform projects, the success of programs that operate in the midst of different forms of turbulence, and the challenges that such projects face.

The volume includes chapters that address a number of key issues involved in STEM reform and how an understanding of the dilemmas posed by the presence of turbulence affect those initiatives. Included in the volume are essays exploring an array of STEM initiatives including programs for minority students, efforts within economically distressed communities, rural reform programs, the interplay between literacy and programs in mathematics and science, the governance of preservice science and mathematics teacher preparation programs, and the interplay between STEM programs and regional improvements in economic development and quality of life.

In the way of conclusion, Johnson offers a postscript in which she returns to the preceding chapters and suggests how each of them offers solutions to problems of turbulence. The remedies are wide ranging and include among others efforts to enhance professional development programs, to establish community-business partnerships, to offer teachers increased time for planning, and to introduce and support programs for individualized instruction.

Secondary STEM Educational Reform is the latest book in the series that focuses its attention on pedagogical and curricular issues involving

secondary education reform. We believe that that there is a critical connection among issues of curriculum, pedagogy, and educational policy. *Secondary STEM Educational Reform* is a good example of a study that explores that linkage. We believe that the academic disciplines are playing a critical role in the globalized trajectory that contemporary secondary educational reform is taking. Taking our cues from the work of Durkheim, it is our intention to continue to publish books, particularly comparative studies, which connect secondary school reform with disciplinary knowledge in its broadest, most integrated forms.

Barry M. Franklin
Gary McCulloch
Series Coeditors

Preface: Defining Turbulence in STEM Educational Reform

Carla C. Johnson
University of Cincinnati

The Secondary STEM Educational Reform book is a collection of chapters from authors who have been engaged in implementation of programs designed to transform STEM education K-12, as well as provide suggestions on navigating inevitable *turbulence* associated with reform. Turbulence is the term we have used to describe the interplay of external variables that directly influence school reform (Johnson and Marx, 2009; Johnson, 2010; Johnson and Fargo, 2010). Specifically, turbulence is the interaction between policy (formal and/or informal) and stakeholders engaged in reform. Most policy decisions are based upon either budgetary or accountability rationales and is out of the control of teachers, as well as directors of reform programs who are often not employed by the participating school district. Turbulence has both micro (school and district) and macro levels (state and national) and the interplay of components within and across levels can facilitate or impede educational change.

Micro-level policies that may create turbulence are primarily focused in areas relating to personnel, scheduling, student support, learning environment, accountability, and community engagement. Personnel-level policies that are attributed to turbulence include teacher workload, salary, job assignment, and opportunities for professional growth. As funding for education continues to dwindle, districts and schools seek ways to better structure their funding for staff positions. Unfortunately, this results in many secondary teachers who teach multiple various courses—often outside their area of expertise—requiring more preparation to teach effectively concurrently when teacher planning time within the school day is also being cut to further maximize instructional time. Teacher salaries remain low, forcing many to secure second jobs at the end of the school day and during summer breaks to make ends meet, reducing the time for

teachers to plan, collaborate, or engage in professional growth. District development funding has in many cases been redirected to support operational budgets, thus district and school sponsored workshops for teachers are declining.

Scheduling policy includes the format of the school day including opportunities for extended class time and equitable allocation of instructional time for all subjects, as well as use of staff meeting time within the contracted school day and teacher planning and collaboration time. In lower-performing schools, more time is being devoted to reading and mathematics due to national accountability policy—reducing the time for science, social studies, physical education, and the arts (Ruby, 2006; Johnson, 2007). Staff meeting time is often utilized ineffectively as an opportunity to deliver information that could have been communicated by email. Time for teachers to meet, collaborate, and plan is often nonexistent both during the school day and within designated staff meeting times.

Student support policies that can create turbulence include class-size limitations and support for enrichment, remediation, and support for English as second language and special education students. Demands to cover curriculum and teach to the test have rendered teachers virtually unable to harness the "teachable moment" in classrooms. Opportunities for enrichment and remediation are infrequent. Pull-out programs for nonnative English-speaking students are declining, as some districts have gone to an all ESL-endorsed teacher policy—meaning that all teachers must secure ESL endorsement and make accommodations within their classes for students.

Resources for learning and facilities are the key components of learning environment policy. Districts often inequitably disperse funding for curriculum, materials, technology, and other resources across their schools—further widening the accessibility to high-quality instruction for many students. Facilities vary within and across districts depending upon property tax revenue as well.

Though most accountability policies are handed down from a macro level (state or national), there are a growing number of districts who have enacted their own accountability policy including district-developed unit assessments and pacing guides. In fact, some districts have testing for each unit of each subject in each grade level. Many administrators believe the way to better scores on assessments is to practice across the school year (Anyon, 2001; Kozol, 2005). Valuable instructional time is lost and though the intent of these tests may have been to take a formative look at student learning and remediate, there simply are not enough hours in the day to do this in most schools.