SUCCEEDING WITH INQUIRY IN SCIENCE AND MATH CLASSROOMS

JEFF C. MARSHALL

ASCD®
NSTA press
National Science Teachers Association
Hawker Brownlow EDUCATION

SUCCEEDING WITH INQUIRY IN SCIENCE AND MATH CLASSROOMS

Introduction

While reading a book or listening to a presentation on teaching practices, do you ever catch yourself thinking, "Yeah, I already know that"? Well, this book will help you progress beyond that sort of passive acknowledgment to a deeper exploration of your teaching and, specifically, the beliefs that inform it, the practices that guide it, and the actions that facilitate it. For administrators and instructional coaches, your active involvement is just as critical.

You are likely to take either of two general approaches as you read this book, each with dramatically different outcomes. You can be actively involved by continually asking how an idea or topic relates to your practice, students, department, school, and district. Or you can scan the book, grabbing a few tips to try out in tomorrow's lesson. The first approach seeks to transform your teaching practice by improving its overall quality over time; the second approach, though common, aims for a few modest tweaks, often neglecting any long-term improvements.

TIP

To encourage thought and discussion, I've included notes called Transformations in Practice (TIPs) throughout the book. When you come to each tip, I hope you will pause and explicitly reflect on your practice, instruction, or perceptions related to the immediate topic.

Chapter 1 begins by helping you examine your current values, practices, and actions as teachers. It helps you to understand the unique

perspectives and approaches that you bring to the classroom. In so doing, you can target areas that need improvement as well as those where you excel.

The remaining chapters will address the details needed to make such instruction successful. Chapter 2 makes the case for why inquiry should be a critical component of instruction and learning when the major ideas are tackled in your discipline or at your grade level. If you are an advocate of inquiry-based instruction, then your goal becomes how to improve the quality of the inquiry in your classroom.

Knowing and even valuing the importance of inquiry-based instruction does not mean inquiry automatically plays a leading role in your classroom. Chapter 3 assists with transforming your instruction by providing a framework that unites three major learning constructs that have been shown to improve student achievement: inquiry instruction, formative assessment, and reflective practice.

After years of hearing about the importance of inquiry-based instruction from commission reports, state and national standards, and leaders in education, many educators are at the point of understanding the basics of inquiry. However, most do not know *explicitly* how to plan and implement high-quality inquiry-based instruction. Chapters 4 and 5 discuss what inquiry looks like in science and mathematics classrooms. Chapter 4 discusses short examples for a wide range of core concepts, and Chapter 5 models inquiry-based instruction for a science unit and a mathematics unit.

Success with your lessons is ultimately not based on the curriculum or even the instruction but on the level of success your students experience. While end-of-unit and annual assessments help you understand how meaningful your students' learning was, you can tap some predictors for success well before then. Chapter 6 explores 19 things that teachers can do that are directly correlated with student achievement in science and mathematics. Using these predictive indicators, you can project how students will do on both content knowledge and process skill assessments based on teacher performance.

During nearly two decades of teaching both students and teachers, I have realized that motivation, desire, and knowledge are critical to leading inquiry-based instruction. However, without proper classroom

113008 • 9781760015503 • © 2015 Hawker Brownlow Education

management, lessons can quickly unravel, and you may be tempted to throw up your hands and say, "Inquiry is just not possible with my students." Chapter 7 looks at effectively managing an inquiry-focused classroom. With key findings from brain research and educational psychology, you will learn how to remove or significantly reduce the barriers that may try to block your students from successful inquiry-based learning.

Finally, Chapter 8 summarizes how inquiry-based instruction can become a cornerstone of your teaching. This chapter will help you to develop an individual plan for success and serve as a guide to transform your classroom.

1 Need for INQUIRY in Your Classroom

1

What Are Your Values, Practices, and Actions as a Teacher?

Should you just roll the dice, or is there a better way to determine the instructional strategies and assessments used to guide today's lesson? You are rolling the dice if you choose an instructional strategy based on what is easiest, what you haven't used in a while, or what your default strategy is. This lack of intentionality in your approach assumes that there is not a best—or at least not a better—way to instruct. It is a crapshoot because some days it works, but perhaps not for every student that day or for the whole class when your students are tested on the material.

Just as all our students come with unique experiences and backgrounds, we as teachers all have different experiences and training that prepare us to excel or flounder in the classroom. In this chapter, you will examine the experiences, beliefs, values, and actions that frame your daily teaching practice. An honest self-assessment will provide a starting point from which you can develop clear targeted objectives. Each objective comes with examples of what it looks like and what you need to do to move toward more effective instructional practice.

The difference in student achievement in a classroom led by an exemplary teacher is about 12 months greater than that of the student achievement led by a poorly performing teacher. Specifically, the students in the classroom of exemplary teachers on average progress the equivalent of 18 months in a single academic year versus 6 months of growth for students in the classroom of poorly performing teachers (Rice, 2003). The greatest

academic growth is not dependent upon students' gender, race, or socioeconomic status. Rather, the teacher's effectiveness is the single greatest determinant of student success (Darling-Hammond, 2000).

Our students deserve at least 12 months of growth each year from each teacher, and inquiry-based instruction can help you achieve that feat. Furthermore, research shows that students of teachers who have been part of our professional development and have been encouraged to use more and better inquiry-based instruction tend to outperform a similarly matched control group of students by two to seven months of academic growth (Marshall, 2012).

The common theme of various components of this chapter, whether flying at 30,000 feet or zooming in at ground level, is the importance of being an intentional practitioner. We are all intentional at some level, but how well we target our planning, instruction, interactions, and vision toward truly improving the achievement of all students is the subject of this book. Specifically, we will focus on succeeding with students in inquiry-based learning environments. Figure 1.1 gives an overview of values, practices, and actions that we explore in this chapter.

Figure 1.1
Perspectives That Inform Your Values and Practices

Perspective	Core Values and Practices	Question to Address
30,000´	Teaching philosophy	What do you value?
10,000´	Core ideas	What is truly important for students to know and be able to do?
1,000´	Success	How do you know when students have been successful?
100´	Strategies	How are students engaged in learning?
Ground level	Interactions, relationships, and learning	How can learning be maximized?

113008 • 9781760015503 • © 2015 Hawker Brownlow Education

What Do You Value?

Your teaching philosophy provides the broad 30,000-foot (global) perspective of what you value as a teacher. Let's explore your philosophy.

TIP Your Values

Take a moment to write your teaching philosophy in one to two concise sentences—your elevator presentation of what you value as a teacher. You may need several drafts before you meaningfully capture who you are as a science or math educator. Remember, your philosophy statement is a dynamic statement and should evolve as you grow as an educator over the years.

If you are like most readers, you might now begin to peek ahead to see what the "right" answer is. After all, our educational upbringing has taught us to look for the single right answer instead of seeking thoughtful, unique solutions—a challenge that I address in this book.

It may seem counterproductive at this point to state your teaching philosophy, but I assure you that you will be continually referring to it as you read this book. As you form your philosophy, consider some of the following issues: What is your belief about student success in your class? What fosters student success in your class? What is your role in such success? What do students experience in your classroom that maximizes learning? In our quick-paced, sound-bite, hurry-on-to-the-next-fad world, you may be inclined to skip this exercise, but the explicit reflection on and acknowledgment of your beliefs, values, and actions is critical for moving your practice forward.

What Is Truly Important?

The next level of actions and values to consider, perhaps the 10,000-foot view, describes what core ideas (major concepts) students should know and be able to do when they complete your class. Core ideas are defined in a myriad of ways, but here they refer to the essential ideas or the 8 to 10 things that you want your students to know or be able to do by the end of the year. These core ideas are guided by district, state, or national standards and essentially compose the foundation of your curriculum, instruction, assessment, and classroom discourse, but they can be useful in other ways. You can provide core ideas to parents, students, and

administrators as they seek to better understand the major instructional goals of your class, which when concisely stated in layman's terms allows all stakeholders to better support you and your program.

Interestingly, award-winning teachers view standards differently from most experienced mathematics and science teachers (Hudson, McMahon, & Overstreet, 2002; Marshall, 2008). Specifically, award-winning teachers tend to view national standards (National Council of Teachers of Mathematics [NCTM], 2000; National Research Council, 1996) as a framework to guide their classroom instruction, whereas other math and science teachers with 10 years of experience or more tend to view the standards as an obstacle that needs to be overcome or a collection of items that need to be "covered." With the 2013 Next Generation Science Standards (NGSS) and the 2010 Common Core State Standards in Mathematics (CCSSM), this tendency will continue—exemplary teachers will see standards as a guide for instruction whereas other will see standards as obstacles—unless something changes.

In science, a core idea for a chemistry class might include "Students will understand the trends and interactions found on the Periodic Table of Elements." This core idea requires that students demonstrate understanding of things such as periodic trends, reactivity of elements and relative strengths, and the way chemical formulas are written based on characteristics of various elements. In mathematics, core ideas may include "Algebra I students will develop an understanding of statistical variability for 6th-grade students" and "Students will represent and solve equations and inequalities graphically."

TIP Core Ideas

What are the 8 to 10 core ideas that you want your students to really understand by the end of the school year? Why are these the most critical ideas? What are the least essential topics, ideas, or lessons that you currently teach? How can you trim or minimize the time that these lower-priority items consume in your class, and how will you use this additional time better?

When Have Your Students Been Successful?

For many teachers, teaching is about planning a lesson, implementing that lesson, and then checking to see how well students understand

113008 • 9781760015503 • © 2015 Hawker Brownlow Education