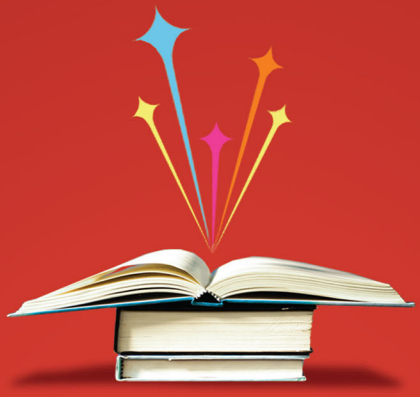
FOREWORD BY TOM SHERRINGTON

POWERFUL CLASSROOMS



EVIDENCE-INFORMED STRATEGIES AND RESOURCES

PATRICE M. BAIN, Ed.S.

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Praise for *Powerful Classrooms*

"Whether you are just starting your evidence-informed journey or already well on the way, *Powerful Classrooms* is filled with strategies and insights that will help you on your path to a truly powerful classroom. Bain's unique perspective is buoyed by a multitude of diverse educators' voices and evidence-informed approaches, making this book an invaluable resource."

—Kent Wetzel, leadership development teacher specialist, Frederick County Public Schools, Maryland

"As an education practitioner determined to improve learner outcomes, you'll definitely sense the golden thread running throughout this book; that every teacher can be successful if they appreciate the impact that comes from teaching students how to learn. Patrice Bain has unselfishly made life so much easier for all of us, by providing further "evidence" for the science of learning, both through her own significant classroom research, and by capturing the voices of other educational influencers who use evidence-based strategies to create intentional classrooms."

—Liz Keable, "Metacognition in Practice" specialist

"This book delivers what teachers really need to transform research into reality – concrete examples from Patrice's own pioneering experience combined with other teachers' insights from their own powerful classrooms."

—Diane Lauer, chief academic officer, St. Vrain Valley Schools, Colorado

"In a perfect world, every teacher would have an evidence-informed expert and friend in the classroom next door to generously share the most powerful teaching strategies! Patrice Bain is that best friend and teaching colleague. In *Powerful Classrooms*, she not only delivers the best, most actionable evidence-informed advice and guidance, but she also introduces the reader to her friends – creating an inspiring community of expertise within a book that will become a trusted companion."

—Margaret (Meg) Lee, educator, connector, and author of Mindsets for Parents

"Patrice Bain is a teacher's teacher. By telling her own journey in cognitive science, her book is a celebration of teachers across the world who have embraced the science of learning in their classrooms. This is a must-read, how-to manual for any educator looking to better inform their practice with what scientists know about how we learn."

—M-J Mercanti-Anthony, Ed.D, principal, Antonia Pantoja Preparatory Academy, NYC Public Schools

"Patrice has done it again! *Powerful Classrooms* is an essential guide that bridges cognitive science and classroom practice, offering educators evidence-based strategies that we can start using straight away. Teachers who caught the bug with the first *Powerful Teaching* book will find this companion filled with tools, tips, and resources, all enriched by Patrice"s deep experience as a master teacher. Where was this book when I was in teacher school?"

—Zach Groshell, PhD, teacher, instructional coach, host of the Progressively Incorrect podcast

"*Powerful Teaching* inspired you to embrace the messiness of learning. *Powerful Classrooms* by Patrice Bain builds on this foundation by equipping you with concrete, innovative strategies that help you navigate this complexity. These strategies not only acknowledge the intricacies of modern education but actively harness them to enhance student engagement and learning outcomes. This book is your essential guide to transforming classroom challenges into opportunities by mastering the beautiful chaos of real learning."

—Shannon Schinkel, high school educator and host,
The Embrace the Messy Podcast with Shannon Schinkel

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To Mark and Roddy
For pursuing the idea of conducting research in classrooms

To Pooja
Who helped turn research into reality

To Amber
And all teachers who embrace and bring the science of learning to their students

To Suzy and Shane
For the spark that inspired me to write this book

To Steven
My forever

Contents

Foreword

In my work I have the privilege of meeting hundreds of teachers in different school contexts. I also have the honor of watching them in action, wrestling with the everyday challenges of running classrooms so that their students are all thriving – socially and emotionally and also in terms of their learning. As I sit at the back of the room, I'm often struck by the thought that teaching is a truly extraordinary process: setting out a set of ideas and activities that allow each and every child across a class to make sense of new concepts and skills and to build confidence using them. It's a universal feature of great teachers that they foster relationships infused with kindness and respect: they seek to inspire and motivate. Teachers are generally wonderful people seeking to do good! But even if it looks artful and effortless on the surface, it's not ever easy. In practice, teaching groups of children successfully all at once is a very significant challenge for everyone.

This isn't so much because each child is so different in the way they learn – as Dan Willingham says, we are more alike than different in this regard. The challenge arises because of the inherent common difficulties all learners experience – that our working memories are limited, we can only handle a small amount of information at a time, and we are prone to forgetting a lot of what we first encounter. Added to this, our students arrive with

such varying levels of prior knowledge and emotional responses to success and failure, and it's logistically complicated to check in on how multiple people are doing, all at one time, finding out how they have made sense of the material we're trying to teach.

Fortunately, help is at hand! Learning processes have been extensively researched and, increasingly, teachers are exploring how to implement ideas from research in their day-to-day practice. Patrice Bain has been at the forefront of this work for many years. I've enjoyed hearing her tell the story of researchers coming to study her classroom a few times and it's never short of totally inspiring! Her book *Powerful Teaching*, written with Pooja Agarwal, represents a perfect example of research and practice developing in tandem, each influencing the other. This is exactly the kind of information and inspiration that teachers need.

As a full-time teacher trainer and author of the series *Teaching WalkThrus*, where my colleague Oliver Caviglioli and I have tried to communicate a wide range of well-known teaching ideas via some five-step visual guides, I know from firsthand experience just how hard it is for teachers to take ideas from a book, written by someone else, and translate them into practice in their own contexts – their classroom, their children, their subject, their school. What people often cry out for are examples. The concepts can be interesting in theory – they are intellectually rewarding to discuss and explore. But the vital question is: What does this look like in practice?

In this epic book, Patrice has pulled so many ideas together with example after example – it's quite remarkable. I'm absolutely certain that teachers of children at every age, in schools all around the world, will find the ideas and suggestions here incredibly valuable. If teachers are anything like me, even a surface browse will be making their brains fizz with ideas. But as they stop to read more slowly, they'll find that Patrice has laid out a clear path for them, linking the fundamental ideas from

research to the nuts and bolts of specific lesson sequences. This means that, when trying to implement the ideas, teachers are always clear on the reasoning behind them. In my work, I find this is vital. It's much more likely that techniques will become embedded as solid, effective routines if teachers are clear about their purpose from the start.

A final point to note about this fabulous book is the rather brilliant and highly original final section about influencers and sources of inspiration. Each contributor has set who influences them in the world of cognitive science, coupled to some references to their own work. Patrice is giving people space to honor the work of others in a manner that is absolutely typical of her generosity of spirit and her determination to spread the love for educational research and evidence-informed teaching.

It's been a significant honor to meet and talk to Patrice about her work and I'm delighted to have been asked to make a contribution to this book; I know for sure it will find a wide audience. This means that a lot of children are going to end up learning more and enjoying school more, finding inspiration in their personal learning journeys – and there's nothing more exciting or important than that!

Tom Sherrington, author and Director of Teaching
WalkThrus International

Introduction

Welcome to *Powerful Classrooms: Evidence-informed Strategies and Resources*.

"I wanted to shout from the mountaintops that the science of learning works." Writing in *Scientific American*, Annie Murphy Paul used these words of mine as one of the big takeaways from our interview. *Powerful Teaching: Unleash the Science of Learning*, by Dr. Pooja Agarwal and me, was released in 2019, and since then I've been on the hike up that mountain, speaking on podcasts and presenting at many conferences and professional development sessions for educators, in person and virtually, across the globe. I have intentionally used social media to spread what

I know and what other teachers using scientifically proven strategies have learned. I hope you will join us on this hike and help get us to a promontory where each teacher can shout this new knowledge down to your chosen valley.

This book is a resource. It is a companion to *Powerful Teaching,* but written in my teaching voice. I wanted to create a place where teachers had access to a multitude of strategies at their fingertips. I describe research and why it works and I discuss it through my own eyes, my words, and what I experienced working alongside cognitive scientists in my classroom. I highlight teachers, leaders, and instructional coaches from around the world who have incorporated evidence-informed teaching into pedagogy. I feature my edu-heroes, my influencers – many of those I have followed for years.

Learning is messy and I invite you to be messy with this book. Like something? Dog-ear the page. Write in the margins. I practice what I preach and hope you will complete the exercises that go along with each chapter. Keep your pencil handy. Adapt the strategies to fit your students. The final chapter is a Do-It-Yourself Retrieval Guide. Feel free, at the end of each chapter, to use the strategy of retrieval to complete a section in this Guide. Or perhaps you might like to try spaced retrieval and, by waiting until you have finished the book, quiz yourself to see how much you are able to retrieve. You may also want to use it in a Book Study. It's your book.

And most of all, thank you for joining me in this grand adventure of learning. I hope you will ponder my ideas and experiences, and accompany me and my like-minded heroes who are changing the way research, learning, and teaching are making their way to the mountaintops.

Chapter 1

How It Started

How often have we had the opportunity to be in the room, at the table, when a revolution begins? And, how often in our naivete do we simply navigate the waters, doing what needs to be done, and not realizing the enormity of what happened in that room until years later? Emerging before our eyes is a learning revolution based on cognitive science and robust research. The research began in my own classroom, and what scientists learned there is making its way around the globe.

HERE'S MY BACK STORY

My teaching career began in a small school district in southern Illinois, USA, in the early 1990s. My subject was World History, appearing in our curriculum for sixth graders for the first time. I had an incredible principal, Dr. Roger Chamberlain,

who believed in encouraging his faculty to soar. I was also very fortunate to have a forward-thinking and fair superintendent, Mr. Jack Turner, and a like-minded school board. Because of their encouragement, I sought opportunities, and was rewarded by being named a Finalist for Illinois Teacher of the Year in 2000, and a European Fulbright Scholar in 2004. However, after having taught for over 12 years, enjoying opportunities stemming from teaching awards, and finishing an advanced educational degree, I was perplexed. The majority of my students received excellent grades, yet some did not. Why?

I didn't know the "how" nor the "where" of learning to answer the "why" for the differences in success between my students. Up until this time, most research on learning in the United States had been conducted at universities, in laboratories, with college students. The scholarly papers were published in academic journals and the findings were locked in ivory towers. And even though, at this time, I also served as adjunct faculty at two local universities teaching pedagogy to instructors pursuing advanced degrees, I wasn't aware this information existed. An epiphany arose: I had been taught how to teach, and I taught others how to teach, but I had no idea how we learn.

I had a serendipitous meeting with Dr. Mark McDaniel, a cognitive scientist at Washington University in St. Louis, Missouri. He was researching memory and, for the first time, I began to see a connection between learning and the science of memory formation. Could this be the link to success for the students who were not doing well? Dr. McDaniel introduced me to Dr. Henry Roediger, another cognitive scientist from Washington University. (McDaniel and Roediger are authors of a wonderful book about learning: *Make It Stick*.) I was not aware of their credentials nor expertise; in fact, even the term "cognitive scientist" was lost on me. To me, they were simply Mark and Roddy. (In hindsight, I shake my head at the audacity!) I remember having them over to my house in the country, enjoying a glass of wine on the porch

amidst the trees, as conversations continued. I told them of my frustrations at the disconnect between teaching and learning. They discussed their research ideas. The lightbulb moment happened: they wanted to study how students learn in an authentic, public-school classroom. Would I consider a research study in my classroom? My immediate thought was that this might not only be the answers to my questions but could also benefit my underperforming students.

Many stakeholders were involved in deciding whether the study would go forward. Satisfying my district's administration, getting the community's support, and funding became steps along the path. Meetings with my school administration ensued. A question from my superintendent became my focus: *Why* do you want this? I answered with conviction, "I want to know how my students learn." Roediger and McDaniel obtained funding through the Institute of Education Sciences and my administration gave its approval. I obtained permission from the parents of my students, and in August 2006, we were ready to begin.

On that August day I met another researcher from Washington University, Pooja Agarwal. As we climbed the staircase to my classroom, we pondered. Where should we begin? We knew the focus of the study would be testing (which we now refer to as retrieval). There were no classroom studies for us to replicate. Many new conditions needed to be taken into account, which were nonexistent in university laboratory settings, such as fire drills, tornado drills, student absences, and the frequent interruptions of the overhead speaker: "Mrs. Bain, will you please send (student's name) to the office; he is leaving for an appointment." And, of course, because we were working with adolescents, we needed to consider how drama, divorcing parents, ill grandparents, etc., had an impact on learning. Designing research for a classroom required looking at a multitude of variables.

Since Pooja and I were in the best position to see the whole picture, we were granted the autonomy to create our ideas and take

them to the Washington University cognitive scientists for their input and approval. For the first semester, 18 weeks, Agarwal was in my class daily, observing my teaching. We had weekly meetings to devise research methods. To me, this process was invaluable. I was not expected to change my teaching to fit the research design; rather, the design was of mutual respect for the research, the teaching, and the students. In January 2007, the research on retrieval (as measured and encouraged by testing) began.

Later that year, I was invited to be the sole US K–12 teacher to work with cognitive scientists, in conjunction with the Institute of Education Sciences in Washington D.C., writing *Organizing Instruction and Study to Improve Student Learning*.[1] Once again, I had the good fortune to have a seat at the table. The recommendations emerging from this guide gave me clues for designing further experimental research with my students. For the next few years, Dr. Agarwal and I studied how spaced practice, interleaving, and feedback-driven metacognition played a role in retrieval and learning. I saw firsthand how my students flourished using the methods we studied. And I saw how they went from a simple recall of facts to deep and critical thinking; this allowed me to devise and develop strategies based upon the research.

About ten years after the research started in my classroom, I had a clear vision of exactly what our research had accomplished. Through robust research we had shown that grades, learning, and knowledge retention showed great gains using our results. I had another epiphany. It wasn't *me*, the teacher, making this difference. It was the research and evidence-informed methods and strategies I was using. I wanted to shout from a mountaintop: *every* teacher, no matter where in the world the classroom might be, could have the same success with students. People began to take notice of the research. Annie Murphy Paul spent a day in my class, observing my teaching and talking with my students for an article in *Scientific American*. A camera crew filmed a day in my class for a PBS (Public Broadcasting

System) NOVA documentary: "The School of the Future." For several years I worked with REL (Regional Educational Lab) Mid-Atlantic giving presentations to teachers in Pennsylvania, Maryland, Delaware, and New Jersey. My co-presenters included Dr. Hal Pashler, Dr. Ken Koedinger, and Dr. Nate Kornell. I was interviewed along with Dr. Henry Roediger and one of my students, Zoe Hejna, for an NPR (National Public Radio) program. And finally, to document our story, and provide a map for others to follow, Dr. Agarwal and I published *Powerful Teaching: Unleash the Science of Learning*.[2] The purpose of my next publication: *A Parent's Guide to Powerful Teaching*[3] was to assist teachers in having a learning dialogue with parents and caregivers, in addition to helping families understand how learning happens and providing strategies for helping with schoolwork at home.

The learning revolution and research continue. What began in my classroom has expanded into many schools. A meta-analysis and research database can be found at Retrieval Practice.[4] My bookshelves are filled with books rooted in cognitive science and the authors feel like kindred spirits. What was once tucked away in journals and ivory towers is now available to all. Each time a teacher reads a research and evidence-based book, attends professional development on the science of learning, listens to a related podcast, and incorporates the findings in the classroom, another seat is added to the table and the number of participants in this revolution increases.

And as we encounter new teaching methodologies, our new standard and duty is to ask, "On what evidence is this based?"

Little did I know that my simple question, "How do we learn?" would be answered by science-based methods that have spread globally, and have become mainstream for many. My curiosity about learning led to answers that enabled me to begin the first day of every school year with: "I'm your teacher and I'm going to teach you how to learn," because I *know* it works. I was in the room where it happened.

NOTES

1. Pashler, Harold, Patrice M. Bain, Brian A. Bottge, Arthur Graesser, Kenneth Koedinger, Mark McDaniel, and Janet Metcalf. *Organizing Instruction and Study to Improve Student Learning*. Washington, D.C.: National Center for Educational Research, Institute of Education Sciences U.S. Department of Education, 2007.

2. Agarwal, Pooja K., and Patrice M. Bain. *Powerful Teaching: Unleash the Science of Learning*. San Francisco: Jossey-Bass, 2019.

3. Bain, Patrice M. *A Parent's Guide to Powerful Teaching*. Woodbridge: John Catt Publishing, 2020.

4. Retrieval Practice. Database of retrieval practice research. Available at: https://www.retrievalpractice.org/strategies/2019/10/28/database-of-retrieval-practice-research [Accessed 10 May 2024].

Chapter 2

The Research

RESEARCH IN MY CLASSROOM

Let me begin with a confession. I don't enjoy reading research papers. As a very busy teacher, I maintained the "one-minute rule": If my interest wasn't piqued in one minute, I moved on. (Which is why I am very grateful to researchers, like Dr. Pooja Agarwal, Dr. Erika Galea, Dr. Nidhi Sachdeva . . . and many more, who sift through studies and give us what's important in bite-sized chunks.)

Yet we all know research is vital to our profession and aids student learning. I saw lightbulbs of learning click on in my students' eyes as I applied the conclusions of scientific studies in my class. Since 2007, many articles and papers (and even a book: *Powerful Teaching*!) discuss the very research that happened in my classroom.[1] What follows, however, are my words, describing the research in layperson's terms, discussing the research from a

teacher's point of view. You may wish to replicate the study in your own classroom, or simply apply the methods and watch the results.

Here is a glimpse into my classroom. My school was located in a small district in southern Illinois. At the middle-school level where I taught, students had different teachers for different subjects, each one specializing in math, science, language arts, social studies, art, music, or physical education. I taught social studies to 6th graders (~11-year-olds), with the focus on World History. In my school district's curriculum, this was the students' introduction to the subject; the majority of my students did not possess background knowledge. Students used textbooks that consisted of overall units (e.g. ancient river civilizations), broken down into chapters (e.g. Nile, Tigris/Euphrates, Indus, and Huang). The chapters were broken down into lessons (e.g. geography, history, ways of life, etc.). My methods of teaching included reading, lecture, presentations, storytelling, and projects. I had six classes each day with an average of about 22 students per class.

At the start of the research, we (researcher Pooja Agarwal and I) spent a semester looking at retrieval, or the bringing forth of information students had previously learned. Our hypothesis was that retrieval was effective; but how could we design a study around it? A clear choice could have been exposing some of the students to retrieval and others not. Yet, if the hypothesis was that retrieval enhances learning, that option did not feel ethical. Why would we offer benefits to some students while denying those benefits to others? This called for a change in action; rather than *who* was a control group, our answer became *what* was the control group.

The control group became the questions on my chapter tests for which students had not practiced retrieval. The experimental group became the questions on the test on which retrieval was to be used.

Here is how we introduced the strategy of retrieving material into the class. Prior to beginning a unit, I gave a copy of the

chapter exams to Ms. Agarwal (who later became Dr. Agarwal). She divided the exam questions into two sets:

1. Control group (no retrieval).
2. Experimental group (those items which would be retrieved, via quizzes, prior to the exam).

The method for quizzing was the use of multiple-choice questions via clickers. Each of my six daily classes received a different set of retrieval questions on these quizzes. There were two to three clicker quizzes given throughout the course of the chapter being studied, thus also incorporating spacing. (More information on retrieval and spacing is found in Chapter 4.) To ensure I could not influence the outcome, I was never privy to which exam questions would be retrieved in the quizzes and which questions would not be retrieved. Moreover, I was never in the classroom when the retrieval quizzes were given; Ms. Agarwal handled the quizzes and data.

I taught all of my classes and gave the chapter tests, as usual. After I had graded the tests and gone over them with the students, Ms. Agarwal took the students' papers and compiled the data.

Here are some of the results:

Experiment 1

% of Correct Answers on Retrieved vs. Nonretrieved Exam Questions

Chapter	Retrieved Questions (%)	Nonretrieved Questions (%)
4	93.0	83.0
5	93.0	79.0
6	91.0	81.0
7	84.0	82.0
Mean of 4, 5, 6, 7	**90.25**	**81.25**

(*continued*)

(*continued*)

According to the experiment design for chapters 4–7, questions for the multiple-choice chapter exams were divided into two groups: retrieved questions (experimental group 1) and nonretrieved questions (control group). A total of **492 chapter exams** were used for the data for this portion of Experiment 1.

As we pondered the research, a thought occurred. Are the students scoring higher simply because they had seen the material of the tested questions an additional time? This led to another experiment – Experiment 2. Our hypothesis was: If "seeing" the information was as effective as retrieval, scores should be the same. During these clicker quizzes, some of the questions required retrieval, but others simply presented material again, without retrieval being required. Students saw a correct fact on the board; however, there were no multiple-choice items for them to choose. For example, see a screenshot of what a "read-only" statement looked like.