This book is about how the visual representation of ideas helps us think critically. The central idea behind the book is simple: Here are cases of how visual representation (mapping) was used to facilitate critical thinking and how it worked out. If you are new to mapping, this book will give you a very good idea of what mapping is and why visual representation is effective. You will see this “simple” mapping strategy and tool in action and how it worked out for practitioners. If you have used mapping, then you do not need us to persuade you to read on. You will be surprised to see the range of uses, the theoretical underpinning, and the effectiveness of the tool across ages and uses. It may help to hear about what motivates a teacher to give mapping a serious close look.

Some years ago, some of the faculty on our campus gathered to show one another how they were using technology in their teaching. At that gathering, Professor Jeffrey Beaudry talked about mapping and a course designer, Barbara Stebbins, at our university’s Center for Technology Enhanced Learning who I had worked with closely, strongly encouraged me to get to know Jeff and to learn more about mapping. I didn’t take mapping too seriously. I had looked at a brief display of mapping some years earlier and it seemed too simple, and I thought it was not likely to add much to my teaching.

A few more years went by. I continued to develop my interest in discussion, both in classroom discussion and online discussion. That interest led to a 2010 IGI Global book, *Cases on Online Discussion and Interaction: Experiences and Outcomes*, in which teachers talked about how they facilitated discussion in their classes. It became clear that a major problem in discussion was finding ways to bring about critical thinking. The more we explored critical thinking, the more it became clear that it is a real puzzle to understand what it is, how it works, and what we can do to facilitate it. Most scholarly attempts to increase critical thinking were bumping into a dead end. Researchers found that many students were only minimally improving their skills in critical thinking in college.
What this book demonstrates is that teachers using mapping techniques of various kinds, at various grade levels, with various assignments and levels of difficulty, find that mapping aids thought and writing. It facilitates critical thinking.

What began as a focus on discussion and critical thinking turned into questions about writing essays and critical thinking. A review of the scholarly literature did not offer much encouragement. However, work by a philosopher in Australia suggested that we could aid students to improve their critical thinking. Tim van Gelder had written a number of papers on his attempts to increase critical thinking in his students. He even gathered empirical evidence and showed in several papers that mapping had a real effect on critical thinking. Tim van Gelder’s work strongly suggested that mapping could help. He wrote:

For the suitably skilled person, mapping a complex argument promotes clarity and insight, more rigorous and complete articulation, and more judicious evaluation. Teachers use argument mapping to help students acquire basic concepts, better understand how arguments are constructed, and enhance their reasoning skills. Argument mapping can be an effective way to improve general critical thinking skills. In the workplace, argument mapping can promote rational resolution in complex, fractious debates; improved communication of important arguments; and better decision-making. (van Gelder, 2013)

Finally, I talked to Professor Jeff Beaudry about mapping. Happily, Jeff, being a scholar and teacher, mentored me. At that time, I began to design a field study of my students’ essay writing in an introductory communication course. I compared students who mapped to students who did not map on a series of analytical essays they wrote for the course. That work is presented in this book. Mapping worked. And little did I know as I did my research and as I experimented with my students’ use of mapping that scholars all over the globe were using mapping, often in more intricate ways compared to my approach and with more depth of understanding of the cognitive forces operating than I had. I came to know that only after Jeff and I put out a call to teachers to write about how they used visual representation (often in the form of mapping) to facilitate critical thinking. We were thrilled with what teachers submitted for this book. The manuscripts came from many distant places, with a variety of locations on the globe, from a variety of cultures and languages, with a range of ages of participants, doing a great variety of tasks with visual representation, but the work converged on a demonstration that mapping and visual representation more generally do aid in a number of cognitive outcomes including critical thinking. A theme that weaves through all of the chapters is meaningful learning. Meaningful learning has been the passion of our teaching careers and
is based in the research literature on cognition as well as personal experience as learners and teachers. Meaningful learning is echoed throughout the book, from the foreword by Joseph Novak to the very last chapter. Meaningful learning is all the more important as a central concept in this book, since we did not plan for this theme to emerge. As you read these chapters, our hope is that you will deepen your understanding of the use of mapping and visual representation, and the huge potential to improve critical thinking.

CHAPTERS

In this, I present a brief summary of each chapter. Overall, 13 out of 19 chapters focus on teachers and classrooms, and the remaining chapters treat the topics more generally or talk about critical thinking and visual representation in terms of collaboration and new social identities. What follows are executive summaries of each chapter, ranging from third grade to higher education, undergraduate and postgraduate education, from classrooms in 8 countries. Visual representations like concept maps, mind maps, and argument maps are used as displays of understanding and, most importantly, as a medium for productive collaboration.

Introduction: Thinking Critically about Visual Representations: A Visual Journey to Understand Critical Thinking (Beaudry)

Teachers are searching for ways to solve the perennial problem of how they can improve their craft and improve the quality of the learning and achievement of their students. This chapter reviews past research and discusses themes that represent all 19 case studies in this book and does this by exploring the connections of visual representations to improve critical thinking.

Chapter 1: The Nature of Third Grade Student Experiences with Concept Maps to Support Learning of Science Concepts (Merrill)

The chapter by Merrill provides an in-depth view of teaching and learning in a third grade science classroom with concept maps. Concept mapping was introduced as a strategy to increase students’ understanding of watersheds, and students were asked to use the iPad app, InspireMaps, to do their mapping. Merrill used a modified version of the Hay and Kinchin assessment tool to score the concept maps, and conducted interviews with a sample of students throughout the unit.
Chapter 2: Critical Thinking and Writing Informational Texts in a Grade Three Classroom (Bright and Smith)

The authors examine grade three students’ work with informational texts over a month-long unit to analyze students’ thinking skills about text structures and features. Students were introduced to informational mentor texts to discover insight into expository text structures and create their own “All About…” using a variety of visual representation formats such as lists, checklists, and diagrams. In addition, students were taught to use common expository text structures such as description, sequence, and comparison. These structures were visual scaffolding for students to organize their writing and use the skills of conceptualizing, applying, synthesizing, and evaluating their knowledge.

Chapter 3: Examples of Concept Mapping in a School Setting: A Look at Practical Uses (Goldberg)

The chapter presents a variety of strategies for the use of mind mapping and concept mapping. It is one of the few chapter in which the mind maps are done entirely by hand. Goldberg offers a series of applications for mapping, which include reading comprehension, brainstorming, pre-writing for essays and research papers, “big picture” thinking, and others that go into the everyone’s “toolbox” for learning, and performance success is not common knowledge. This chapter presents relevant information about where, when, and how to use concept mapping as well as critical “how-to” tips for implementation by interested parties.

Chapter 4: Can Mapping Improve the Quality of Critical Thinking in Essay Writing in an Introductory Level, Core Curriculum Class? (Shedletsky)

This chapter began with the question: Can mapping improve the quality of critical thinking in essay writing in an introductory level, core curriculum class? Two sections of the course, Introduction to Communication, were compared, without mapping and with mapping. Dependent measures were: (1) the word count for summarizing the critical incident to be analyzed, (2) the number of concepts/theories employed to analyze the critical incident, (3) the number of times a connection was made between the analytical concepts/theories and the critical incident, (4) the number of words used in summarizing the essay as a whole, and (5) the total number of words in the essay. In addition, the data were analyzed for practice since there were three attempts at essay writing.
Chapter 5: A Case on Teaching Critical Thinking and Argument Mapping in a Teacher Education Context (Oral)

This chapter is based on the classroom work of a course on critical thinking designed as part of a pre-service teacher education program in English language teaching at a large-size Turkish state university. With its dual focus on both modernist and postmodern approaches to critical thinking, the course offers scope for class work that concentrates on the skills to identify the parts and structure of arguments. To this end, argument mapping has been utilized to enhance understanding of the components of arguments and to facilitate the analysis of arguments.

Chapter 6: Confronting Critical Thinking Challenges “in” the College Classroom (Utah and Waters)

The chapter brings together the two key concepts of the book, critical thinking and concept mapping. The goal of this pilot study was to develop a learner-centered teaching tool that would promote meaningful learning and enable higher education instructors to model critical thinking through concept mapping. Concept mapping allows university instructors to demonstrate basic critical thinking processes and provides students with the opportunity to practice the critical thinking that is essential to their success as self-regulated learners. It can also facilitate meaningful learning by encouraging students to integrate new knowledge into prior knowledge structures.

Chapter 7: Making Sense of Intercultural Interaction (Dunsmore)

The chapter by Dunsmore on inter-cultural interaction builds on the assumption that critical thinking goes well beyond memorization, and that learners should be able to self-assess as well as assess and incorporate multiple cultural perspectives. Critical thinking means that we make judgments based on criteria, communicate the meaning of the judgment, the process, and the evidence for making it. The use of concept mapping and visualization is as important as text-based learning, lectures, and studying because it supports deep learning by incorporating prior knowledge. Visual representation of new knowledge supports the active role of the learner in the construction and co-construction of knowledge.
Chapter 8: Self-Inquiry and Group Dynamics: A Multidisciplinary Framework for Critical Thinking (Gonzalez, Frumkin, and Montgomery)

This chapter focuses on critical thinking and combines several models for visuals, concept mapping, consideration of multiple perspectives in van Gelder’s visual deliberation, and illustrates how they can be used primarily for formative assessment of speaking and writing. These strategies were used to enhance shared critical reflection between faculty and students in a graduate-level capstone course. In this culminating educational experience, teachers created a supportive learning environment for students to develop the highest possible levels of critical thinking by embedding mapping in self-inquiry and collaborative group work.

Chapter 9: Teaching Critical Thinking to First-Year Medical Students through Concept Mapping (Sadik)

Sadik examined the use of concept mapping to improve knowledge of medical biochemistry and support a shift in curriculum from traditional lectures to clinical case-based problem solving. Clinical cases required clear objectives and outcomes, guiding questions for the case. In this approach, students used critical thinking for the construction of concept maps, and over a semester, students and faculty co-constructed nine concept maps in a series of small group discussions. The primary purpose for concept maps was formative assessment, although a rubric was used for scoring concept maps.

Chapter 10: Concept Maps as Replacements of Written Essays in Efficient Assessment of Complex Medical Knowledge (Gomez, Griffiths, and Navathe)

In the chapter by Gomez, Griffiths, and Navathe, concept mapping is examined as a key strategy for more efficient assessment of medical knowledge in a distance aviation medicine course. This case study examines the teacher-student interactions around concept maps in an online course setting. The authors conclude that concept maps could be suitable replacements of written essays in the assessment of complex medical conceptual knowledge; because of the efficiency and timesaving of concept maps, they are faster to read and grade, and can quickly reveal student understanding.
Chapter 11: Talmud Diagrams (Ury)

The Talmud Diagrams are unique additions to these papers about critical thinking and visual representations. The diagrams have formal rules for construction, analogous to cartographic maps that “guide students through the complex terrain of logic that characterizes passages in the Talmud.” The use of diagrams reduced the cognitive load of students; since they did not need to figure out the structure of the discussion or argument, they were allowed to focus on learning the principles of the legal discussion. According to Ury, diagrams and forms of arguments are easier to remember than the specific words and text of an argument.

Chapter 12: Conceptual Mapping Facilitates Coherence and Critical Thinking in the Science Education System (Gorman and Heinze-Fry)

In this case, the authors propose a pathway of visual mapping through which the science education system from professional educators who produce representations of national and state standards to curriculum coordinators at the school district level to individual teachers and students in the classroom could be aligned in order to promote meaningful learning of a connected set of concepts. Conceptual mapping is demonstrated to be a tool that promotes critical thinking, cohesion, and meaningful learning in opposition to the learning of arbitrary facts and rote memorization. The authors offer many examples of conceptual maps that have been produced to externalize thinking at each level, and a “synthesis case” to show how students demonstrate critical thinking to create conceptual maps.

Chapter 13: Critical Thinking, Critical Looking: Key Characteristics of an Educated Person (Emanuel and Challons-Upton)

Critical thinking involves the comprehension and expression of the meaning or significance of a wide variety of experiences, situations, data, events, judgments, conventions, beliefs, rules, procedures, and criteria. One important aspect of critical thinking is the analysis, interpretation, and understanding of images. This is generally known as visual literacy. Visual literacy may be initially demonstrated at the basic levels of recognition and understanding – recognizing an image, telling what a symbol means, indicating the name of a painting and/or its artist. As one becomes more skilled at analyzing and interpreting the meaning of visuals, they are maturing toward visual fluency. In this chapter, two works of art—the “Coffee Cup” print and “The Death of Marat” painting—are provided along with example analysis.
Chapter 14: Mind Mapping for Critical Thinking (O’Connell)

Mind mapping is a visual technique that exploits the way we actually think—through synaptic connections and non-linear associations. Because mind mapping gives practitioners, be they professional or student, access to subconscious observations and connections, it is a powerful thinking tool, useful in a variety of situations in business and in education. This chapter focuses on how mind mapping fosters the kind of flexible and organic thinking vital to critical thinking and the creative problem-solving process. A step-by-step outline of how to mind map in both individual and group settings is followed by examples of mind maps from both business and education.

Chapter 15: Concept Maps, VoiceThread, and Visual Images: Helping Teachers Spawn Divergent Thinking and Dialogic Learning (Snyder)

The context of this chapter has its roots in an educational movement that recognizes the importance of preparing youth for living and working in a global community. Central to this is a belief in 1) engaging students in collaborative learning, 2) developing cultural sensitivity, 3) using digital media for communication and creativity, and 4) transforming pedagogical practice to foster reflection, divergent thinking, and creativity. The question addressed in this chapter is how teachers can use digital media and visual images to spawn divergent thinking and dialogue in a global learning context. This chapter presents a case analysis to examine evidence of inquiry-based collaborative learning and three-dimensional thinking among students when using digital images and collaborative software in a global partnership project.

Chapter 16: Learning Argumentation Practices in School with a Graphical Synchronous Discussion Tool (Glassner and Schwarz)

Several computerized representation tools have been developed to enhance collective argumentation in schools. The authors describe Digalo, a graphical synchronous e-discussion tool. They focus on how Digalo was used in a program dedicated to foster dialogic and dialectic thinking among students in lessons centered on scientific and social issues. The studies undertaken on the use of Digalo suggest important lessons that moderators of e-discussions should keep in mind while designing, moderating, and evaluating small-group e-discussions.
Chapter 17: Mapping the Doctorate: A Longitudinal Study of PhD Students and their Supervisors (Howson and Kinchin)

This chapter reports on the results of a four-year longitudinal study of PhD students and their supervisors, from which the evidence gained suggests that the students tend to focus on the PhD in terms of a product to be completed (in terms of writing a thesis and peer-reviewed journals), whilst the supervisors tend to concentrate more on the process of learning and scientific development, placing the student’s contribution into the wider disciplinary discourse. The structural observations from the concept maps generated within this research are that the students perceive the PhD as a linear structure, whereas the supervisors are more likely to generate a cyclic structure to illustrate the dynamic, iterative processes of research more generally.

Chapter 18: Evolution of the Concept-Linked Integrated Media Builder (CLIMB) for Centers for Ocean Sciences Education Excellence (COSEE) Network (deCharon)

Funded by the Centers for Ocean Sciences Education Excellence (COSEE) program of the National Science Foundation (NSF), COSEE-Ocean Systems (OS) has employed concept mapping to facilitate collaboration and communication between ocean scientists and educators. This chapter focuses on three key areas in which COSEE-OS has supported critical thinking: (1) the collaborative process of making meaningful learning by creating, analyzing, and improving concept maps with others; (2) facilitating subject-matter experts in the formulation of concept map-based presentations, which audiences can use to evaluate the validity of their connections and conclusions; and (3) the training of scientists to use concept mapping as a technique to more clearly delineate and explain how their research is tied to societally relevant issues. Three case descriptions on how COSEE-OS concept mapping facilitation and infrastructure have been applied to ocean sciences education efforts—both within the COSEE Network and beyond to the National Aeronautics and Space Administration (NASA)—are also presented.

Chapter 19: Concept Maps and the Systematization of Knowledge (Torres, Kucharski, and Marriott)

The act of doing research, reviewing recent literature, checking data, articulating results and meanings are important but not enough when working with scientific publications in graduate schools. A vital part of the work is authoring an informative text that can be clear enough as to communicate findings of the study and, at
the same time, reinforce chosen arguments. This chapter focuses on an experiment at a renowned Brazilian graduate school of Education that uses Concept Mapping and collective assessment of such maps as fundamental pre-writing stages to guide the authorship of well-thought, well-knit scientific/argumentative texts. Results indicate that the experiment was successful in making students negotiate meanings, clarify ideas and purposes, and write in an academically acceptable style. All this was conducted from a methodological standpoint that makes meaningful knowledge, collective construction, and the reflective, critical work of the author from the first draft to the final collectively written version the foundation to perform a better job at communicating the processes and results of the investigative thought, well-knit scientific/argumentative texts.

OUR INVITATION FOR YOU TO READ ON

As we have collaborated over the past three years, we have maintained a level of interest and engagement about this project that goes beyond the academic; we are teachers continuing the search for a better classroom. We have come to a firm agreement, validated by these fellow teacher-practitioners, that visual representations and mapping and critical thinking are linked together and will be valuable tools to assist us in the pursuit of excellence in teaching, learning, and assessment. The case studies we have gathered in this book will provide us with resources for future collaborative, critical thinking, and visual representations. We hope they inspire teachers at all levels.

Leonard J. Shedletsky
University of Southern Maine, USA

Jeffrey S. Beaudry
University of Southern Maine, USA