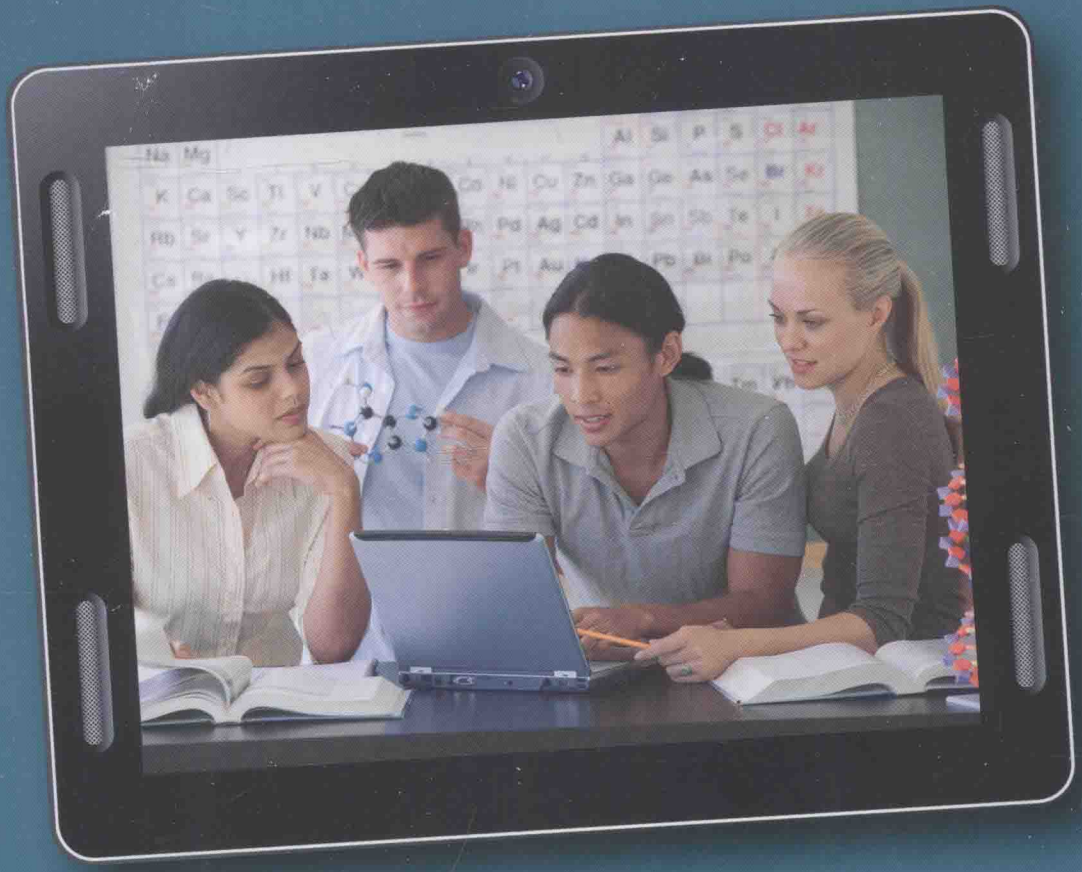
FOURTH EDITION

MEANINGFUL LEARNING WITH TECHNOLOGY



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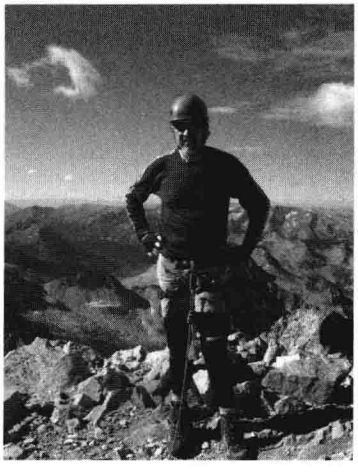

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Preface

Implications of Learning with Technology

Welcome to the fourth edition of this book. Each edition, including this one, is based on the assumption that meaningful learning requires active engagement in authentic learning tasks, articulation, and reflection on personally and socially constructed meaning, collaboration in those tasks whenever possible and, most important, an intention to learn. This assumption is grounded in a constructivist epistemology. Constructivism is a philosophy for describing processes of meaning making. Although it is a philosophy that is relatively new to educational practice, it has always existed. Since the beginning, humans have interacted with the world and struggled to make sense out of what they have experienced. This is as natural to humans as breathing and explains why we have a relatively large cerebral cortex. People naturally construct their own meaning for experiences. Unfortunately, that is where the rub occurs with our industrial model of education, where learners are evaluated by high-stakes tests for reproducing what "experts" deem important. Regardless of what we teach students or the experiences they have, they will naturally construct their own interpretations of those experiences. They may learn what we teach them, but what they will remember and use in the future are their own personal and socially relevant interpretations.

Like the previous three editions, the purpose of this edition is to demonstrate ways that technology can be used to engage and support meaningful learning. As in the third edition, the structure and treatment of learning in this edition is organized around learning processes, such as inquiring, experimenting, writing, modeling, community building, communicating, designing, visualizing, and assessing. That is, in each chapter, we describe how different technologies can be used to engage and support the learning processes stated above. The chapters describe the learning-with-technology processes conceptually. In most examples, we discuss specific software applications, many of which are web-based or available to download from the Internet. We focus on how to use technologies to engage meaningful learning, not on cookbook lessons that you can apply tomorrow morning. If we took that approach (providing specific lesson plans), they probably would not work the way that we intended in your classrooms, because students naturally construct their own meaning from experiences. So, our purpose is not to demonstrate how to use these technologies, but rather to demonstrate how *learners* can use these technologies. The process may be more difficult, but the meaning that you and your students derive from it will be deeper. We believe this approach is worth the effort.

What's New in This Edition

The Fourth Edition of *Meaningful Learning with Technology* includes the following significant revisions and additions:

- Review/discussion of ISTE NETS, 21st Century Skills, and Technological Pedagogical Content Knowledge (TPACK)
- NET Standards for Students and 21st Century Skills that may be met through the learning activities described
- Chapter Objectives at the beginning of each chapter
- Addition of *Rubrics for Assessing Characteristics of Meaningful Learning* in the Appendix
- Focus on social educational networking and Web 2.0 tools for learning and collaboration
- Expanded section on information literacy skills (e.g., evaluating Web resources, online privacy, and safety issues)
- Updated and expanded use of examples to support the described learning technologies with additional examples of primary grade elementary students
- Emphasis on practical application with technologies that many teachers currently use (e.g., interactive whiteboards, PowerPoint)

Evolution of Technology's Potential

As stated in Chapter 1, we believe that although technologies can be used to provide additional testing practice, when they are used to engage students in active, constructive, intentional, authentic, and cooperative learning, then students will derive more meaning. Throughout this book, we contend that learning takes place in environments where students truly understand and engage in the nature of the tasks they are undertaking. Only then, when individuals understand and freely invest the effort needed to complete a task or activity, does meaningful, authentic learning occur. When learning tasks are relevant and embedded in a meaningful context, students see them as more than simply busywork.

Using technologies to engage meaningful learning assumes that our conceptions of education will change, that schools or classrooms (at least those that use technologies in the ways that we describe) will rethink the educational process. Although few people would ever publicly state that schools should not emphasize meaningful learning, meaningful learning is not engaged or assessed using standardized tests. Meaningful learning presupposes that parents, students, and teachers will realize the implications and demand change, so that meaningful learning is valued more than memorization and simple recall of information. Technologies may not be the cause of the social change that is required for a renaissance in learning, but they can catalyze that change and support it if it comes.

Implications for Teachers

In order for students to learn *with* technology, teachers must accept and learn a new model of learning. Traditionally, teachers' primary responsibility and activity have been directly instructing students, where teachers were the purveyors of knowledge and students the recipients. That is, the teacher told the students what they knew and how they interpreted the world according to the curriculum, textbooks, and other resources they have studied. Teachers are hired and rewarded for their content expertise. This assumes that the ways that teachers know the world are correct and should be emulated by the students. Students take notes on what teachers tell them and try to comprehend the world as their teachers do. Successful students develop concepts similar to those of their teachers. In this kind of learning context, students will not be able to learn *with* technology because they will not be able to construct their own meaning and manage their own learning if the teacher does it for them.

So, first and foremost, teachers must relinquish at least some of their authority, especially intellectual. If teachers determine what is important for students to know, how they should know it, and how they should learn it, then students cannot become intentional, constructive learners. They aren't allowed. In those classroom contexts, there is no reason for students to make sense of the world–only to comprehend the teacher's understanding of it. We believe that the students' task should not be to understand the world as the teacher does. Rather, students should construct their own meaning for the world. If they do, then the teachers' roles shift from dispensing knowledge to helping learners construct more viable conceptions of the world. We said earlier that we believe that not all meaning is created equally. So the teacher needs to help students to discover what the larger community of scholars regards as meaningful concepts and to evaluate their own beliefs and understandings in terms of those standards. Science teachers should help students comprehend the beliefs of the scientific community. Social studies teachers should examine with their students the values and beliefs that societies have constructed. In this role, the teacher is not the arbiter of knowledge but rather is a coach who helps students to engage in a larger community of scholars.

Teachers must also relinquish some of their authority in their management of learning. They cannot control all of the learning activities in the classroom. If teachers determine not only what is important for students to know, but how they should learn it, then students cannot be self-regulated learners. They aren't allowed.

Finally, teachers must gain some familiarity with the technology. They must gain skills and fluency with the technology. However, they will be unsuccessful in helping students to learn *with* technology if they learn about the technologies in order to function as the expert. Rather, they should learn to coach the learning of technology skills. In many instances, teachers will be learning with the students. This may be a bit uncomfortable for some teachers, but we posit that it may be necessary! We have worked in many school situations where the students were constantly pushing our understanding of the technology. Often, we were barely keeping ahead of the students. They can and will learn *with* technologies, with or without the help of the teacher. That does not mean that as a teacher, you can abdicate any responsibility for learning the technologies. Rather, teachers should recognize that it isn't necessary for them to be the expert all of the time.

These implications can be problematic for teachers. They require that teachers assume new roles, sometimes with different beliefs than they have traditionally pursued. Although these implications may be challenging, we believe that the results will justify the efforts. And just as teachers must assume new roles, learning *with* technology requires that students also assume new roles.

Implications for Students

If teachers relinquish authority, learners must assume it. Learners must develop skills in articulating, reflecting on, and evaluating what they know; setting goals for themselves (determining what is important to know) and regulating their activities and effort in order to achieve those goals; and collaborating and conversing with others so that the understanding of all students is enriched. Many students are not ready to assume that much responsibility. They do not want the power to determine their own destiny. It is much easier to allow others to regulate their lives for them. How skilled are students at setting their own agendas and pursuing them? Many students believe in their roles as passive students; they are used to that role! However, our experience and the experiences of virtually every researcher and educator involved with every technology project described in this book show that most students readily accept responsibilities for learning when those learning opportunities are meaningful. When given the opportunity, students of all ages readily experiment with technologies, articulate their own beliefs, and construct, co-construct, and criticize each others' ideas. When learners are allowed to assume ownership of the product, they are diligent and persevering builders of knowledge.

Constructivist approaches to learning, with or without technology, are fraught with risks for students, parents, teachers, and administrators. Change always assumes risks. Many of the activities described in this book entail risks. We encourage you to take those risks. The excitement and enthusiasm generated by students while they construct their own understanding using technology-based tools is more than sufficient reward for taking those risks.

Standards and Frameworks for Learning

Teachers are challenged to ensure that students meet a myriad of required national, state, and local standards. It was impossible to tie each of our recommended activities to these myriad standards so we chose the most relevant national standards, National Educational Technology Standards (NETS), provided by the International Society for Technology in Education (ISTE), as our focus. We also address 21st Century Skills that are embodied in the Framework for 21st Century Learning. NETS and 21st Century Skills are designed to provide educators with frameworks and standards that guide them in creating rich, technology-supported learning environments. Teachers often become overwhelmed by the numerous indicators students are required to demonstrate in meeting state standards, see each of these indicators as discrete, and subsequently design disconnected instruction that isolates individual objectives. Instead, teachers should think broadly, recognizing that rich project-based learning that incorporates problem-solving and authentic tasks can meet many standards simultaneously. Rather than structure this book around specific grade level

lesson plans, we focus each chapter on a type of learning (e.g., writing) and offer ways that several types of technologies can be used to enhance that category of learning outcomes.

With thoughtful planning, it is also just as feasible to simultaneously meet a number of content standards. This results in efficient use of students' time, but most important, it helps pull teachers away from an isolated standards model of teaching, where instruction is more likely to be prescriptive and disconnected from authentic learning activities. With a deeper focus, not only will teachers be helping students meet a multitude of standards, they will also be offering rich, interesting learning opportunities that engage students and compel them to think beyond the superficial. Challenging students' cognitive skills by providing motivating instruction that fulfills multiple standards is a worthy accomplishment–one that all teachers should strive for.

We encourage you to consider the complex learning outcomes described in this book as you design instruction for your students. Although authentic, complex, technology-supported activities may seem to be the antithesis of what is needed to prepare students for high achievement on tests, they are not. On the contrary, the meaningful learning that results from this work can not only encompass the knowledge needed for successful test taking, but will also develop individuals who are capable of real thinking—the kind of thinking that is perhaps even more essential than ever for success in the 21st century.

New! CourseSmart eTextbook Available

CourseSmart is an exciting new choice for students looking to save money. As an alternative to purchasing the printed textbook, students can purchase an electronic version of the same content. With a CourseSmart eTextbook, students can search the text, make notes online, print out reading assignments that incorporate lecture notes, and bookmark important passages for later review. For more information, or to purchase access to the CourseSmart eTextbook, visit www.coursesmart.com.

Supplements

An **Instructor's Resource Manual and Test Bank**, downloadable from our password-protected Instructor Resource Center, is available to adopters of this text. If you are already registered, log in at www.pearsonhighered.com/irc or visit this URL to request access, which will be granted after Pearson verifies instructor status.

The manual contains chapter overviews and outlines, additional class activities, discussion questions, and resources for each chapter, as well as a test bank of multiple choice, true/false, short answer, and constructed response questions.

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Brief Contents

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Goal of Technology Integrations: Meaningful Learning

CHAPTER 1

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Chapter Objectives

1. Identify the characteristics of meaningful learning
2. Contrast learning from technology and learning with technology
3. Compare National Educational Technology Standards (NETS) for students with teacher activities that foster them
4. Describe how technology can foster 21st Century Skills
5. Describe the components of technological pedagogical content knowledge

This edition of *Meaningful Learning with Technology* is one of many books describing how technologies can and should be used in schools. What distinguishes this book from the others is our focus on learning, especially meaningful learning. Most of the other books are organized by technology. They provide advice on how to use technologies, but often the purpose for using those technologies is not explicated.

Meaningful Learning with Technology, on the other hand, is organized by kinds of learning. What drives learning, more than anything else, is understanding and persisting on some task or activity. The nature of the tasks best determines the nature of the students' learning. Unfortunately, the nature of the tasks that so many students most commonly experience in schools is completing standardized tests or memorizing information for teacher-constructed tests. Schools in the United States have become testing factories. Federal legislation (No Child Left Behind) has mandated continuous testing of K–12 students in order to make schools and students more accountable for their learning. In order to avoid censure and loss of funding, many K–12 schools have adopted test preparation as their primary curriculum. Perhaps the most unfortunate phenomenon of this process is the current generation of students who will complete their K–12 education knowing only how to take tests. Because the purpose of those tests is administrative, students are seldom fully invested in the process so they make little attempt to understand the knowledge being tested. The students do not ask to take the tests. The tests assess skills and knowledge that are detached from their everyday experience, so they have little meaning. The testing process is individual, so students are prevented from cooperating with others. The tests represent only a single form of knowledge representation, so students are not able to develop conceptual understanding, which requires representing what you know in multiple ways. Simply stated, learning to take tests does not result in meaningful learning.

In order for students to learn meaningfully, they must be willfully engaged in a meaningful task. In order for meaningful learning to occur, the task that students pursue should engage active, constructive, intentional, authentic, and cooperative activities. Rather than testing inert knowledge, schools should help students to learn how to recognize and solve problems, comprehend new phenomena, construct mental models of those phenomena, and, given a new situation, set goals and regulate their own learning (learn how to learn). In order to help students accomplish those goals, we have organized the book around meaningful learning activities, not technologies.

- Inquiring with Technologies—Information gathering and literacy
- Experimenting with Technologies—Predicting outcomes
- Designing with Technologies—Creative knowledge construction
- Communicating with Technologies—Meaningful discourse
- Community Building and Collaborating with Technologies—Social interactions and identity building
- Writing with Technologies—Constructing meaningful prose
- Modeling with Technologies—Building models for conceptual change
- Visualizing with Technologies—Constructing visual representations

- Assessing Meaningful Learning and Teaching with Technologies—Resources for assessment, for both teachers and students

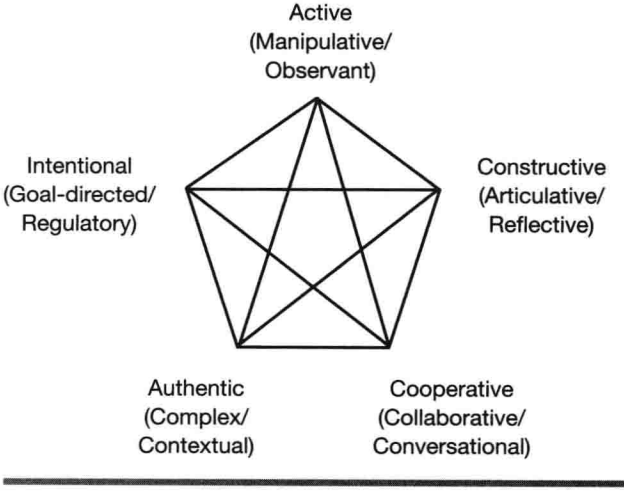
Those tasks are meaningful when they require intentional, active, constructive, cooperative, and authentic learning (see Figure 1.1). These attributes of meaningful learning are emphasized throughout the book as the goals for using technologies as well as the criteria for evaluating the uses of technology. Let's examine these attributes a little more closely.

- **Active (Manipulative/Observant)** Learning is a natural, adaptive human process. Humans have survived and therefore evolved because they were able to learn about and adapt to their environment. Humans of all ages, without the intervention of formal instruction, have developed sophisticated skills and advanced knowledge about the world around them when they need to or want to. When learning about things in natural contexts, humans interact with their environment and manipulate the objects in that environment, observing the effects of their interventions and constructing their own interpretations of the phenomena and the results of their manipulations. For instance, before playing sandlot baseball, do kids subject themselves to lectures and multiple-choice examinations about the theory of games, the aerodynamics of orbs, and vector forces applied to them? No! They start swinging the bat and chasing fly balls, and they negotiate the rules as they play the game. Through formal and informal apprenticeships in communities of play and work, learners develop skills and knowledge that they then share with other members of those communities with whom they learned and practiced those skills. In all of these situations, learners are actively manipulating the objects and tools of the trade and observing the effects of what they have done. The batter who consistently hits foul balls will adjust his or her stance and grip on the bat in order to manipulate the ball's path of flight and observe the effects of each manipulation. Meaningful learning requires learners who are active—actively engaged by a meaningful task in which they manipulate objects and parameters of the environment they are working in and observing the results of their manipulations.

- **Constructive (Articulative/ Reflective)** Activity is necessary but not sufficient for meaningful learning. It is essential that learners articulate what they have accomplished and reflect on their activity and observations—to learn the lessons that their activity has to teach. New experiences often provide a discrepancy between what learners observe

Figure 1.1

Characteristics of Meaningful Learning



and what they understand. That is when meaningful learning begins. They are curious about or puzzled by what they see. That puzzlement is the catalyst for meaning making. By reflecting on the puzzling experience, learners integrate their new experiences with their prior knowledge about the world, or they establish goals for what they need to learn in order to make sense out of what they observe. Learners begin constructing their own simple mental models that explain what they observe, and with experience, support, and more reflection, their mental models become increasingly complex. Ever more complex models require that learners mentally represent their understanding in different ways using different thought processes. The active and constructive parts of the meaning-making process are symbiotic.

- **Intentional (Goal-Directed/Regulatory)** All human behavior is goal directed (Schank, 1994). That is, everything that we do is to fulfill some goal. That goal may be simple, like satiating hunger or getting more comfortable, or it may be more complex, like developing new career skills or studying for a master's degree. When learners are actively and willfully trying to achieve a cognitive goal (Scardamalia & Bereiter, 1993/1994), they think and learn more because they are fulfilling an intention. Technologies have traditionally been used to support teachers' goals, but not those of learners. Technologies need to engage learners in articulating and representing their understanding, not the teachers'. When learners use technologies to represent their actions and construction, they understand more and are better able to use the knowledge that they have constructed in new situations. When learners use computers to do skillful planning for doing everyday tasks or constructing and executing a way to research a problem they want to solve, they are intentional and are learning meaningfully.

- **Authentic (Complex/Contextual)** Most lessons taught in schools focus on general principles or theories that may be used to explain phenomena that we experience. However, teachers and professors remove those ideas from their natural contexts in order to be able to cover the curriculum more efficiently. When they do, they strip those principles of the contextual cues that make them meaningful. Physics courses are a prime example. Teachers read a simplified problem and immediately represent the problem in a formula. Students may learn to get the correct answer, but what are they learning? The students learned to understand the ideas only as algorithmic procedures outside of any context, so they have no idea how to apply the ideas to real-world contexts. Everything physical that occurs in the world involves physics. Why not learn physics through baseball, driving, walking, or virtually any other physical process on earth?

  Most contemporary research on learning has shown that learning tasks that are situated in some meaningful real-world task or simulated in some case-based or problem-based learning environment are not only better understood and remembered, but also are more consistently transferred to new situations. Rather than abstracting ideas in rules that are memorized and then applied to other canned problems, learning should be embedded in real life, useful contexts for learners to practice using those ideas.

- **Cooperative (Collaborative/Conversational)** Humans naturally work together in learning and knowledge-building communities, exploiting each others' skills and appropriating each others' knowledge in order to solve problems and perform tasks. So,