You have probably heard countless times that teachers must be technologically savvy in order to meet the needs of today’s generation of students. Like most prospective and practicing teachers, you are no doubt willing to expend the effort to attain this distinction, but you may not quite know what is expected of you or how to go about acquiring the necessary skills and competencies. That is the purpose of this chapter: to inform you of expectations and provide a roadmap for preparation.

**LEARNER OUTCOMES**

The reading presented should help you:

- Describe the International Society for Technology in Education (ISTE) and the ISTE National Educational Technology Standards (NETS) projects
- Recognize how the NETS•T were developed and how they are used in teaching
- Identify the relationship between the NETS•T and the accreditation process
- Recognize the performance profiles for teacher preparation
- Describe how a teacher candidate can prepare to meet the NETS•T
- Identify ways to use this book most effectively

**Understanding ISTE and the NETS**

When exploring a new area of interest, it is helpful to consult professional and amateur organizations associated with the area. These organizations, frequently called societies or associations, are often nonprofit entities comprised of individuals interested in research and dissemination of new knowledge in their fields. Although there are a number of organizations concerned with technology in education, ISTE is recognized as a leading professional society whose mission is to help prepare students, teachers, and administrators to use technology effectively. The work of ISTE has influenced teachers, students, and administrators worldwide. The mission of ISTE and the NETS projects is examined in preparation for the forthcoming chapters.
Examining the Mission of ISTE

The mission of a professional society is basically its purpose for existence. It is typically a brief, carefully framed statement, crafted by a group of its members to show what the society believes, what goals it hopes to accomplish, and how it hopes to accomplish those goals. A mission—or mission statement, as it is often called—helps a professional society remain focused on its purpose so that it does not stray from its intent with changes in leadership or other factors. It also provides those outside the society with a snapshot of the society and serves as a recruitment tool for those considering membership. It is worth noting that, from time to time, missions are revisited and modified to change with the times or reflect the changing nature of the profession itself. ISTE’s mission is available to all prospective and current members and to all those interested in its purpose:

ISTE is a nonprofit professional organization with a worldwide membership of leaders and potential leaders in educational technology. We are dedicated to providing leadership and service to improve teaching and learning by advancing the effective use of technology in PK–12 education and teacher education. We provide our members with information, networking opportunities, and guidance as they face the challenge of incorporating computers, the Internet, and other new technologies into their schools.

As part of ISTE’s mission, sets of standards have been developed for PK–12 students (NETS•S), teachers (NETS•T), administrators (NETS•A), coaches (NETS•C), and computer science educators (NETS•CSE). Together, these standards are known as the National Educational Technology Standards, or NETS. The first four of these standards are located in the appendix.

Exploring the Early NETS•T Project

All professions have standards that professionals in the field are expected to meet or exceed. Standards help build integrity within and outside a profession by explicitly stating expected levels of competencies and skills. The original NETS•T (reproduced on page 3) were published in 2000 and consisted of the following six standards:

I. Technology Operations and Concepts: Teachers demonstrate a sound understanding of technology operations and concepts.

II. Planning and Designing Learning Environments and Experiences: Teachers plan and design effective learning environments and experiences supported by technology.

III. Teaching, Learning, and the Curriculum: Teachers implement curriculum plans that include methods and strategies for applying technology to maximize student learning.

IV. Assessment and Evaluation: Teachers apply technology to facilitate a variety of effective assessment and evaluation strategies.

V. Productivity and Professional Practice: Teachers use technology to enhance their productivity and professional practice.

VI. Social, Ethical, Legal, and Human Issues: Teachers understand the social, ethical, legal, and human issues surrounding the use of technology in PK–12 schools and apply those principles in practice.
A Constructivist Approach to the National Educational Technology Standards for Teachers

All classroom teachers should be prepared to meet the following standards and performance indicators.

I. TECHNOLOGY OPERATIONS AND CONCEPTS
Teachers demonstrate a sound understanding of technology operations and concepts. Teachers:
A. demonstrate introductory knowledge, skills, and understanding of concepts related to technology (as described in the ISTE National Educational Technology Standards for Students).
B. demonstrate continual growth in technology knowledge and skills to stay abreast of current and emerging technologies.

II. PLANNING AND DESIGNING LEARNING ENVIRONMENTS AND EXPERIENCES
Teachers plan and design effective learning environments and experiences supported by technology. Teachers:
A. design developmentally appropriate learning opportunities that apply technology-enhanced instructional strategies to support the diverse needs of learners.
B. apply current research on teaching and learning with technology when planning learning environments and experiences.
C. identify and locate technology resources and evaluate them for accuracy and suitability.
D. plan for the management of technology resources within the context of learning activities.
E. plan strategies to manage student learning in a technology-enhanced environment.

III. TEACHING, LEARNING, AND THE CURRICULUM
Teachers implement curriculum plans that include methods and strategies for applying technology to maximize student learning. Teachers:
A. facilitate technology-enhanced experiences that address content standards and student technology standards.
B. use technology to support learner-centered strategies that address the diverse needs of students.
C. apply technology to develop students’ higher order skills and creativity.
D. manage student learning activities in a technology-enhanced environment.

IV. ASSESSMENT AND EVALUATION
Teachers apply technology to facilitate a variety of effective assessment and evaluation strategies. Teachers:
A. apply technology in assessing student learning of subject matter using a variety of assessment techniques.
B. use technology resources to collect and analyze data, interpret results, and communicate findings to improve instructional practice and maximize student learning.
C. apply multiple methods of evaluation to determine students’ appropriate use of technology resources for learning, communication, and productivity.

V. PRODUCTIVITY AND PROFESSIONAL PRACTICE
Teachers use technology to enhance their productivity and professional practice. Teachers:
A. use technology resources to engage in ongoing professional development and lifelong learning.
B. continually evaluate and reflect on professional practice to make informed decisions regarding the use of technology in support of student learning.
C. apply technology to increase productivity.
D. use technology to communicate and collaborate with peers, parents, and the larger community in order to nurture student learning.

VI. SOCIAL, ETHICAL, LEGAL, AND HUMAN ISSUES
Teachers understand the social, ethical, legal, and human issues surrounding the use of technology in PK–12 schools and apply that understanding in practice. Teachers:
A. model and teach legal and ethical practice related to technology use.
B. apply technology resources to enable and empower learners with diverse backgrounds, characteristics, and abilities.
C. identify and use technology resources that affirm diversity.
D. promote safe and healthy use of technology resources.
E. facilitate equitable access to technology resources for all students.

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Each standard was followed by performance indicators—specific measurable outcomes that assessed what teachers should have been able to do to show that they had achieved competency in the standard. For example, the first standard is numbered with the Roman numeral “I.” The title, Technology Operations and Concepts, is followed by the description, “Teachers demonstrate a sound understanding of technology operations and concepts.” The two performance indicators for Standard I (A and B) indicate what the teacher will be able to do to demonstrate competency.

I. TECHNOLOGY OPERATIONS AND CONCEPTS

Teachers demonstrate a sound understanding of technology operations and concepts. Teachers:

A. demonstrate introductory knowledge, skills, and understanding of concepts related to technology (as described in the ISTE National Educational Technology Standards for Students).

B. demonstrate continual growth in technology knowledge and skills to stay abreast of current and emerging technologies.

Although the 2000 standards were appropriate at the time they were published and for many years after, a need for updated standards arose to better reflect changes in technology, research, and the global community. As a result, the 2008 refreshed NETS•T were published. Like the 2000 version of the NETS•T, the newer version underwent scrutiny and revision from a wide array of educators and stakeholders. The current NETS•T (ISTE, 2008b) and their performance indicators appear below as well as in the appendix.

The Refreshed ISTE NETS and Performance Indicators for Teachers (NETS•T)

Effective teachers model and apply the National Educational Technology Standards for Students (NETS•S) as they design, implement, and assess learning experiences to engage students and improve learning; enrich professional practice; and provide positive models for students, colleagues, and the community. All teachers should meet the following standards and performance indicators. Teachers:

1. Facilitate and Inspire Student Learning and Creativity

Teachers use their knowledge of subject matter, teaching and learning, and technology to facilitate experiences that advance student learning, creativity, and innovation in both face-to-face and virtual environments. Teachers:

a. promote, support, and model creative and innovative thinking and inventiveness

b. engage students in exploring real-world issues and solving authentic problems using digital tools and resources

c. promote student reflection using collaborative tools to reveal and clarify students’ conceptual understanding and thinking, planning, and creative processes

d. model collaborative knowledge construction by engaging in learning with students, colleagues, and others in face-to-face and virtual environments
2. **Design and Develop Digital-Age Learning Experiences and Assessments**

Teachers design, develop, and evaluate authentic learning experiences and assessments incorporating contemporary tools and resources to maximize content learning in context and to develop the knowledge, skills, and attitudes identified in the NETS•S. Teachers:

   a. design or adapt relevant learning experiences that incorporate digital tools and resources to promote student learning and creativity
   
   b. develop technology-enriched learning environments that enable all students to pursue their individual curiosities and become active participants in setting their own educational goals, managing their own learning, and assessing their own progress
   
   c. customize and personalize learning activities to address students’ diverse learning styles, working strategies, and abilities using digital tools and resources
   
   d. provide students with multiple and varied formative and summative assessments aligned with content and technology standards and use resulting data to inform learning and teaching

3. **Model Digital-Age Work and Learning**

Teachers exhibit knowledge, skills, and work processes representative of an innovative professional in a global and digital society. Teachers:

   a. demonstrate fluency in technology systems and the transfer of current knowledge to new technologies and situations
   
   b. collaborate with students, peers, parents, and community members using digital tools and resources to support student success and innovation
   
   c. communicate relevant information and ideas effectively to students, parents, and peers using a variety of digital-age media and formats
   
   d. model and facilitate effective use of current and emerging digital tools to locate, analyze, evaluate, and use information resources to support research and learning

4. **Promote and Model Digital Citizenship and Responsibility**

Teachers understand local and global societal issues and responsibilities in an evolving digital culture and exhibit legal and ethical behavior in their professional practices. Teachers:

   a. advocate, model, and teach safe, legal, and ethical use of digital information and technology, including respect for copyright, intellectual property, and the appropriate documentation of sources
   
   b. address the diverse needs of all learners by using learner-centered strategies and providing equitable access to appropriate digital tools and resources
   
   c. promote and model digital etiquette and responsible social interactions related to the use of technology and information
   
   d. develop and model cultural understanding and global awareness by engaging with colleagues and students of other cultures using digital-age communication and collaboration tools
5. Engage in Professional Growth and Leadership

Teachers continuously improve their professional practice, model lifelong learning, and exhibit leadership in their school and professional community by promoting and demonstrating the effective use of digital tools and resources. Teachers:

a. participate in local and global learning communities to explore creative applications of technology to improve student learning

b. exhibit leadership by demonstrating a vision of technology infusion, participating in shared decision making and community building, and developing the leadership and technology skills of others

c. evaluate and reflect on current research and professional practice on a regular basis to make effective use of existing and emerging digital tools and resources in support of student learning

d. contribute to the effectiveness, vitality, and self-renewal of the teaching profession and of their school and community

The ISTE NETS performance indicators allow outcomes to be measured. Notice, for example, that in Standard 2, performance indicator a, the word “design” is used rather than “know” or “understand how to.” To design is to do something, and that something can be observed. On the other hand, how can someone really be sure if someone else “knows” something? How many times, for example, have students nodded, looked interested, or uttered the proverbial “hmmm” when, in reality, they had no idea what you meant? Statements such as performance indicators that are written in a way that allows the outcome to be measured are known as observable or measurable performance statements. Someone can observe the behavior of another and measure to what extent the outcome was performed.

It is worth noting that the NETS for Students (NETS-S), originally published in 1998, were refreshed in 2007, and the NETS for Administrators (NETS-A), originally published in 2002, were refreshed in 2009. The NETS Refresh Project testifies to ISTE’s commitment to staying relevant and up to date.

Global Reach of the NETS

“ISTE relied on the wisdom of educators to help us update the NETS during the three-year NETS Refresh effort. Educators from nearly 40 countries provided feedback to ISTE as the NETS were being refreshed, helping to strengthen them and to make them relevant to educators around the world. ICT skills are embedded in the NETS at all levels. … Schools in Norway, Costa Rica, Malaysia, Japan, Australia, Philippines, Micronesia, Korea, Turkey, are among many working to adapt the NETS as their information and communication technologies (ICT) framework.”

(www.iste.org/standards/global-reach.aspx)
Examining the NETS-T in the Accreditation Process

ISTE’s Accreditation and Professional Standards Committee is credited with developing the NETS Projects for students, teachers, and administrators. More than a decade of contributions by the committee has resulted in numerous standards, guidelines, and publications. The ISTE NETS-T Project has yielded the following with regard to teacher education:

- standards for accreditation of teacher preparation programs for specialization in educational computing and technology
- unit guidelines describing essential conditions needed to support technology use in teacher preparation programs
- general standards for providing a foundation in technology for all teachers

These standards and standard-related documents provide teacher educators with the wherewithal to prepare teachers to effectively use technology in education. Around the world the NETS are widely adopted, adapted, aligned, or referenced.

The National Council for Accreditation of Teacher Education (NCATE, www.ncate.org) is a coalition of 33 specialty professional associations (including ISTE) of teachers, teacher educators, content specialists, and local and state policy makers. NCATE uses a performance-based system in its accreditation process of schools, colleges, and departments of education.

NCATE is interested in teacher preparation as it relates to the knowledge, skills, and dispositions of teacher candidates. Being an NCATE-accredited school, college, or department of education testifies to the quality of teacher preparation the institution delivers. Of the 33 specialty professional associations involved with NCATE, some have submitted program standards that have been approved for use in teacher-education program review (NCATE, 2006). ISTE is one of these associations. It is worth noting that NCATE and the Teacher Education Accreditation Council (TEAC) are joining to form the Council for the Accreditation of Educator Preparation (CAEP). CAEP, which is scheduled “to become operational in 2013, will accredit over 900 teacher education institutions across the nation, producing approximately 175,000 graduates annually” (www.teac.org/category/caep).

ISTE’s Essential Conditions

In order for students to be able to perform the competencies described in the NETS-S, ISTE asserts that certain essential conditions have to be in place from various stakeholders—such as university leaders, faculty, and school personnel—whose collective aim is to educate teacher candidates and beginning teachers at the various levels. These conditions underscore the importance of collaboration among university and school personnel and the larger educational community to help ensure the success of teachers and teacher candidates.
Introduction

Essential Conditions

Necessary conditions to effectively leverage technology for learning

Shared Vision
Proactive leadership in developing a shared vision for educational technology among all education stakeholders including teachers and support staff, school and district administrators, teacher educators, students, parents, and the community

Empowered Leaders
Stakeholders at every level empowered to be leaders in effecting change

Implementation Planning
A systemic plan aligned with a shared vision for school effectiveness and student learning through the infusion of information and communication technologies (ICT) and digital learning resources

Consistent and Adequate Funding
Ongoing funding to support technology infrastructure, personnel, digital resources, and staff development

Equitable Access
Robust and reliable access to current and emerging technologies and digital resources, with connectivity for all students, teachers, staff, and school leaders

Skilled Personnel
Educators, support staff, and other leaders skilled in the selection and effective use of appropriate ICT resources

Ongoing Professional Learning
Technology-related professional learning plans and opportunities with dedicated time to practice and share ideas

Technical Support
Consistent and reliable assistance for maintaining, renewing, and using ICT and digital learning resources

Curriculum Framework
Content standards and related digital curriculum resources that are aligned with and support digital-age learning and work

Student-Centered Learning
Planning, teaching, and assessment center around the needs and abilities of students

Assessment and Evaluation
Continuous assessment, both of learning and for learning, and evaluation of the use of ICT and digital resources

Engaged Communities
Partnerships and collaboration within communities to support and fund the use of ICT and digital learning resources

Support Policies
Policies, financial plans, accountability measures, and incentive structures to support the use of ICT and other digital resources for learning and in district school operations

Supportive External Context
Policies and initiatives at the national, regional, and local levels to support schools and teacher preparation programs in the effective implementation of technology for achieving curriculum and learning technology (ICT) standards

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Preparing Teacher Candidates to Meet the NETS-T

The ISTE standards and performance indicators provide a roadmap for attaining the competencies and skills needed to effectively use technology in education, as each student and indicator lends a piece to help teachers on their way.

NETS-T provide direction. The standard titles and descriptions provide a sense of direction. They show teachers where they are going and serve as the compass that sets them on the right path.

NETS-T show a destination. The performance indicators show teachers what they should be able to do once they have completed their journey of learning. These outcomes will be the destination.

Using This Book for Professional Preparation

Full comprehension of this book’s contents relies on the relationship of the whole book to its parts. For example, teachers should understand the human issues and ethics related to technology use—primarily addressed in Chapter 4—before they integrate the technology addressed in other chapters. Taken as a whole, the book should help prospective and practicing teachers better understand expectations associated with NETS•T and how they can apply the NETS•T to their teaching practices.

Chapter Outline

This text was written so that prospective and practicing teachers can easily locate and comprehend the NETS•T and their respective performance indicators. The NETS•T are presented in sequential order, and each standard is assigned a chapter of its own. The structure of a typical chapter (in this case, Chapter 1) is outlined in the At-a-Glance Chapter Outline (next page). Chapters 1–5 follow this outline.

In Your Experience and Section Explorations

Each chapter’s In Your Experience and Section Explorations are designed to help you develop reflective and effective practices in your teaching.

In Your Experience

How would you describe your current study skills? Do you typically progress through a text using some type of strategy, or do you skip straight to assignments? How can you improve your study skills?

Introduction Summary

In this Introduction you became familiar with the NETS•T, how the standards were developed, and their relationship to accreditation. You also learned about the performance profiles for teacher preparation and how a teacher candidate can prepare to meet the ISTE NETS for Teachers. Finally, you learned how to make best use of this book.
The remainder of this book is devoted to equipping you for your personal journey of learning. Each NETS•T standard and performance indicator will be addressed, and you will be given opportunities to practice new skills and competencies.

At-a-Glance Chapter Outline

Outline of Chapter 1 (as an example)

NETS•T1: Facilitate and Inspire Student Learning and Creativity

Standard in Brief
Indicators
Learner Outcomes

NETS•T1a: Promote, Support, and Model Creative and Innovative Thinking and Inventiveness
- [Content for performance indicator T1a]
  - In Your Experience
  - Section T1a Explorations
  - Section T1a Review

NETS•T1b: Engage Students in Exploring Real-World Issues and Solving Authentic Problems Using Digital Tools and Resources
- [Content for performance indicator T1b]
  - In Your Experience
  - Section T1b Explorations
  - Section T1b Review

NETS•T1c: Promote Student Reflection Using Collaborative Tools to Reveal and Clarify Students’ Conceptual Understanding and Thinking, Planning, and Creative Processes
- [Content for performance indicator T1c]
  - In Your Experience
  - Section T1c Explorations
  - Section T1c Review

NETS•T1d: Model Collaborative Knowledge Construction by Engaging in Learning with Students, Colleagues, and Others in Face-to-Face and Virtual Environments
- [Content for performance indicator T1d]
  - In Your Experience
  - Section T1d Explorations
  - Section T1d Review

Chapter 1 Summary
References


Facilitate and Inspire Student Learning and Creativity

STANDARD IN BRIEF

Teachers use their knowledge of subject matter, teaching and learning, and technology to facilitate experiences that advance student learning, creativity, and innovation in both face-to-face and virtual environments.

PERFORMANCE INDICATORS

Teachers:

a. promote, support, and model creative and innovative thinking and inventiveness

b. engage students in exploring real-world issues and solving authentic problems using digital tools and resources

c. promote student reflection using collaborative tools to reveal and clarify students’ conceptual understanding and thinking, planning, and creative processes

d. model collaborative knowledge construction by engaging in learning with students, colleagues, and others in face-to-face and virtual environments
FOSTERING INGENUITY

Endless possibilities for creativity, productivity, and ingenuity dwell within each and every student. Teachers can either invite students to explore their full potential, or they can stifle student exploration by withholding opportunities and support. In this chapter you will learn ways to advance the creative process, inspire ingenuity, and support knowledge construction through the use of technology.

LEARNER OUTCOMES

The reading and assignments presented in Chapter 1 should help you:

- Use technology to advance human creativity in the classroom
- Prepare and inspire students to use technology in problem solving
- Introduce students to collaborative tools that can promote critical and creative thinking
- Engage in the construction of knowledge in various learning environments
NETS•T1a
Promote, Support, and Model Creative and Innovative Thinking and Inventiveness

Creativity comes in many forms. It is evident in the performing and visual arts, in the innovation of inventions, and in the realm of deep and profound thinking. Who has not marveled at one time or another at the outcome of human creativity? Magnificent buildings, great literary works, beautiful melodies, and many other forms of creative expression have helped elevate the mundane to the magnificent, the ordinary to the remarkable, and the forgotten to the memorable. As the kernel of creativity takes seed in every student at every age, teachers must do all they can to foster its growth and support. Exploring creativity and the creative process is the focus of this section.

The concept of creativity has been explored and debated by scholars for centuries (Hausman, Jarvie, & Rothenberg, 2009), yet consensus on its meaning has yet to be reached. The creative process has been described by philosophers such as Aristotle and Plato (Hausman, et al., 2009); psychologists (Gardner, 1985, 1989, 1997); artists (Lehrer, 2009); scientists (Gross & Do, 2009); doctors (Heilman, 2005); educators (Hansen, 2005), and others who have used both quantitative and qualitative terms to describe this phenomenon. Regardless of the meaning attributed, creativity is consistently given high honor among all disciplines.

In education, “Create” is thought to be the most complex cognitive process for a learner, based on the revised work of Bloom’s original taxonomy of educational objectives (Anderson & Krathwohl, 2001). The ability to create generally relies on a learner’s ability to remember, understand, apply, analyze, and evaluate. Figure 1.1 shows the hierarchical relationship of the revised structure.

![Figure 1.1](image-url)

FIGURE 1.1 The cognitive process dimensions (based on A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom’s Taxonomy of Educational Objectives, Anderson & Krathwohl, 2001, p. 28).
The phenomenon of creativity can be thought of as involving both process and product. Anderson and Krathwohl describe creating as “putting elements together to form a novel, coherent whole or make an original product” (in Krathwohl, 2002, p. 215). The “putting together” implies process, and “to form or make” implies movement toward the creation of the resulting product.

According to Howard Gardner (1997) intellectual power plays a role in creativity, but it does not serve an exclusive role. Gardner believes, rather, that four dimensions are involved in the phenomenon of creativity: (1) intellectual power, (2) personality structures, (3) specific domains or disciplines, and (4) field. Figure 1.2 briefly illustrates each dimension as it relates to creativity.

Gardner’s theory of multiple intelligences (MI) has been widely embraced by educators as a way of understanding students’ diverse talents and abilities. According to Gardner (1999), multiple intelligences exist, including the verbal/linguistic, logical/mathematical, visual/spatial, bodily/kinesthetic, musical/rhythmic, interpersonal, intrapersonal, and possibly naturalist, spiritual, and existential (see Figure 1.3). These intelligences exist in all of us to varying degrees. Although an individual may excel in two or three intelligences and have, therefore, great intellectual power in these areas, he or she is thought to have some degree of intelligence in the other areas. Teachers may have a limited role in personality structure or in specific domains, disciplines, and fields, but they have great potential to promote intellectual power by providing rich and varied experiences, opportunities, and interactions to help students exercise their intellectual power.
Multiple Intelligences and Their Strengths

Bodily/Kinesthetic
  Fine and gross motor skills

Existential
  Aesthetics, philosophy, and religion and how these play into the big picture of life

Interpersonal
  Social learning and connections

Intrapersonal
  Understanding oneself

Logical/Mathematical
  Mathematics, logic, reason, and problem-solving

Musical/Rhythmical
  Perception of patterns (e.g., songs, poetry)

Naturalist
  Categories and hierarchies

Verbal/Linguistic
  Oral and written expression and mastery of foreign language

Visual/Spatial
  Visualize ideas and solutions before expressing them orally, in writing, or through other means

Teacher as Facilitator of Creativity

Although it is still not clear precisely how nature and nurture impact learning and creativity, research suggests that both biological and environmental influences likely play a role in the outcome. Leaders in the field of brain research and creativity believe that creativity can be encouraged.

Can creativity in individuals be encouraged regardless of the makeup of their brain, or are we limited by such factors as the number of glial cells and amount of white matter? “I believe creativity can be ‘encouraged,’” Dr. Heilman responded. “We have known for decades that when young rodents are put in a stimulating environment, they have a much richer neural network than their sibs who were not raised in this environment. Thus, bringing up children in an enriched environment and making certain that they receive a good education is critical for their brain development.

“The frontal lobes appear to be the part of the cortex that is most important for creativity, in that they are critical for divergent thinking and might modulate the coactivation of diverse cognitive networks so important in innovation. The means by which family and friends might be able to encourage the development of the frontal lobes is to encourage independent and divergent thinking.” (Balzac, 2006, para. 17–18)
Fortunately, teachers have the opportunity to encourage all types of thinking—including independent and divergent—by providing a rich, stimulating classroom environment.\(^5\)

The very act of teaching assumes that learners are teachable and that intelligence(s) can be developed. Constructivist teaching and learning acknowledge that both the teacher and the students are important and contributing members in a teaching-learning relationship, and that both bring prior knowledge and experiences with them into the learning environment. For this reason, constructivist teaching practices capitalize on concepts and experiences familiar to students so that students are able to connect new knowledge with prior knowledge and construct new meaning (Morphew, 2009).

Three key elements that contribute to a constructivist learning environment are (1) meaningful experiences, (2) interactions, and (3) prior knowledge (Morphew, 2002). Teachers can provide these elements in a variety of ways, such as through classroom experiences, interactions among peers, and collaborative and cooperative experiences.

As a constant interaction among various biological and environmental factors, intelligences are educable; they change and grow. According to MI theory, the more time an individual spends using a particular intelligence and the better the instruction and resources, the smarter the individual becomes in that area. Translated into practice, this key feature reads: “All children can learn.” It also works against pigeonholing or excluding individuals according to certain intelligences. (Baum, Viens, & Slatin, 2005, p. 22)

The experiences teachers introduce to students should be carefully planned, executed, and assessed for effectiveness. Walters and Gardner (1986) define “crystallizing experiences” as turning points in the development of a person’s talents and abilities. These experiences often happen in childhood but can happen anytime in a person’s life (Armstrong, 2009). Intelligences can be activated through crystallizing experiences, such as field trips, guest speakers, and hands-on open exploration that promote intellectual power and boost creativity.

In contrast, deactivators—described by Armstrong as paralyzing experiences—can squelch intelligences. Harsh criticism of a student’s drawing, intentional withholding of resources, and anger and humiliation aimed at any educational attempt can thwart growth and development.

Armstrong (2009) identifies five environmental influences that can either promote or stunt intellectual growth:

1. Access to resources or mentors
2. Historical-cultural factors
3. Geographic factors
4. Familial factors
5. Situational factors

Access to resources or mentors includes both individuals and material items. Historical-cultural factors involve external factors related to the context of society and culture that may influence funding or promotion of creativity. Geographic factors entail the location and setting where a person is raised or lives, and familial factors include family associations that influence decisions and opportunities. Finally, situational factors involve the situation of one’s life that influence development, such as socioeconomic
status, responsibilities, and so forth. Figure 1.4 illustrates how each of these environmental influences impacts intellectual growth.

Teachers can be especially instrumental with regard to Armstrong’s first environmental influence because they serve as mentors and selectors/providers of resources. Even though teachers may have limited influence on the last four factors, they should be mindful of these influences as they pertain to their students’ lives and histories in order to provide students with the most appropriate experiences. This requires higher-order thinking, creativity, and informed professional judgment on the part of teachers; they must understand the multiple factors that influence student development, be able to analyze and evaluate plans to meet students’ needs, and engage in creativity to inspire student ingenuity.

Gardner acknowledges the important role teachers play in making education decisions when he speaks of their actions with regard to MI theory:

> There is no one right way or education approach to implement MI theory. The MI theory is not an educational prescription; [it is] best left up to educators to determine uses to which MI theory can and should be put to use. (Gardner, 1995, p. 206)

Although Gardner denies a one-size-fits-all approach to activating multiple intelligences, he does offer a preferable or optimum sequence to promote creativity and growth:

> I find it preferable to devote the early years of life—roughly speaking, up to the age of seven—to a relatively unstructured or “creative orientation” where students have ample opportunity to proceed as they wish and to explore media on their own. … Thereafter, given the child’s increasing inclination toward the learning of rules, it is both appropriate and advisable to inculcate basic skills. This is a time when children readily acquire skills and have some appreciation of the reasons for doing so.

> Even though the focus should ideally shift from creativity to basic skills and then back again, it is crucial that the other alternative be kept in mind during each developmental phase. The early years of life ought to feature at least some areas of skill acquisition, some development of useful working habits. By the same token, the years of middle childhood should incorporate some open-ended exercises, some free productions, as well as constant reminders that there is never a single best way to do something. So long as these alternative options—the accent on skills and the flair for creativity—are kept in mind at all times, the growing child is likely to be able to capture the best of both orientations. (Gardner, 1989/2006, p. 128)
Figure 1.5 illustrates the preferable sequence to promote creativity and growth according to Gardner.

![Figure 1.5 Preferable sequence to promote creativity and growth (based on the work of Gardner, 1989).]

As noted earlier, teachers can provide a variety of crystallizing experiences, but they can also model creativity and innovation. Hansen (2005) argues that the creative teacher is the responsive teacher. He writes:

Rather than issuing solely from what the teacher brings to the educational setting—consider again terms such as expertise and knowledge—creativity can point to what the teacher is capable of deriving or drawing from it. Creativity as responsiveness denotes a form of openness to the setting, which may or may not complement or fit harmoniously with what is preset, prefigured, or anticipated. Experienced teachers would be the first to say that there are times when it becomes educationally vital to shelve a preset plan. There are times when one form of creativity in teaching, embodied in a well-wrought lesson plan, must give way to another form, embodied in what I am calling responsiveness. The art of teaching consists, in part, of balancing these expressions of pedagogical creativity. (p. 58)

So what, then, can teachers do to promote both the process and product of creativity? In light of the section discussion, a few general suggestions are offered:

- Become familiar with students’ multiple intelligences and aim to boost their intellectual power
- Provide meaningful experiences that help students develop abilities at various levels, moving toward the highest level—create—and ones that promote independent and divergent thinking
- Provide experiences that promote independent and divergent thinking
- Foster creativity by addressing both process and product
- Provide crystallizing experiences and avoid paralyzing experiences
- Consider experiences that represent Gardner’s optimum or preferable sequence for promoting creativity
- Be a creative, responsive teacher who is open to multiple ways of inspiring creativity (see Figure 1.6)
Technology as a Creativity-Promoting Medium

Although some argue that computers can get in the way of design (Lawson, 2002), many (Armstrong, 2009; McKenzie, 2005; Moursund, 2003) view computers and technology as an adjunct to promoting creativity and intelligences. Multiple ways exist for technology to be used as a creativity-promoting medium. These ideas are not meant to be prescriptive but rather should serve as stimuli for teacher thought and creativity.

Identifying and Promoting Students’ Multiple Intelligences

Everyone has all the intelligences. An intelligence can be strengthened. A number of inventories exist that can help teachers assess their students’ multiple intelligences. Early on in the school year it might be worthwhile to administer an inventory and repeat the inventory at different times to determine growth and progress. Teachers may wish to use a spreadsheet or database (see Chapter 3) to help make sense of the collective and individual intelligences represented by their students. Keep in mind that these data should be used to help students and not to hinder their growth. This inventory is meant as a snapshot in time—it can change. MI is meant to empower people, not label them (McKenzie, 2005).6

In addition to multiple intelligences, students possess different ways of and preferences for learning. Some students learn best by seeing and hearing, and others by engaging in hands-on exploration. Furthermore, some students prefer quiet study, while others enjoy social learning. A number of print and online resources exist to help teachers identify learning preferences. Teachers may wish to explore learning preferences as a way to better serve students and promote intellectual power. Combining students’ learning-preference data with their multiple-intelligence data should give teachers strong evidence for how they can plan effective, intellectual-power-boosting lessons.
Another way to help promote creativity and growth is to revisit and consider the different environmental influences affecting students mentioned earlier in this chapter. Being aware of these influences should help teachers make appropriate and informed education decisions and plans. Said succinctly, teachers should aim to know their students and plan to meet their needs.

In terms of resources, consider the many digital and nondigital technologies that are available to help address multiple intelligences (see Table 1.1).

**TABLE 1.1  Digital and nondigital technologies that address multiple intelligences**

<table>
<thead>
<tr>
<th>Multiple Intelligences and Strengths</th>
<th>Digital and Nondigital Technologies</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bodily/Kinesthetic</strong></td>
<td>Construction tools, kitchen utensils, screws, levers, wheels and axles, inclined planes, pulleys, wedges, physical education equipment, manipulative materials, mice, joysticks, simulations that require eye-hand coordination, assistive technologies, digital probes</td>
</tr>
<tr>
<td>Fine and gross motor skills</td>
<td></td>
</tr>
<tr>
<td><strong>Existential</strong></td>
<td>Art replicas, planetariums, stage dramas, classic literature, classic philosophy, symbols of world religions, virtual communities, virtual art exhibits, virtual field trips, social media sites, blogs, wikis, virtual reality, simulations</td>
</tr>
<tr>
<td>Aesthetics, philosophy, and religion and how these play into the big picture of life</td>
<td></td>
</tr>
<tr>
<td><strong>Interpersonal</strong></td>
<td>Class discussion, sticky notes, greeting cards, laboratories, telephones, walkie-talkies, intercoms, board games, costumes, collaborative projects, social media sites, message boards, instant messengers, video chat (Skype)</td>
</tr>
<tr>
<td>Social learning and connections</td>
<td></td>
</tr>
<tr>
<td><strong>Intrapersonal</strong></td>
<td>Journals, diaries, surveys, voting machines, learning centers, children’s literature, class debates/discussions, real-time projects, online surveys, online forms, digital portfolios with self-assessments</td>
</tr>
<tr>
<td>Understanding oneself</td>
<td></td>
</tr>
<tr>
<td><strong>Logical/Mathematical</strong></td>
<td>Cuisenaire rods, unifix cubes, tangrams, measuring cups, measuring scales, slide rules, graphing calculators, spreadsheets, search engines, directories, file transfer protocol (FTP) clients, gophers, WebQuests, problem-solving tasks, programming languages</td>
</tr>
<tr>
<td>Mathematics, logic, reason, and problem-solving</td>
<td></td>
</tr>
<tr>
<td><strong>Musical/Rhythmical</strong></td>
<td>Pattern blocks, puzzles, musical instruments, phonographs, head-phones/ear buds, tape players/recorders, digital sounds, online pattern games, multimedia presentations, online video sites (such as YouTube), speakers, CD/DVD discs and players, podcasting</td>
</tr>
<tr>
<td>Perception of patterns (e.g., songs, poetry)</td>
<td></td>
</tr>
<tr>
<td><strong>Naturalist</strong></td>
<td>Magnifying glasses, microscopes, telescopes, bug boxes, scrapbooks, sandwich bags, plastic containers, databases, DVDs, USB portable storage devices, file managers, semantic mapping tools</td>
</tr>
<tr>
<td>Categories and hierarchies</td>
<td></td>
</tr>
<tr>
<td><strong>Verbal/Linguistic</strong></td>
<td>Textbooks, pencils, worksheets, newspapers, magazines, word processors, electronic mail, desktop publishing, web-based publishing tools, keyboard, speech recognition devices, text bridges</td>
</tr>
<tr>
<td>Oral and written expression and mastery of foreign language</td>
<td></td>
</tr>
</tbody>
</table>
Facilitate and Inspire Student Learning and Creativity  ■  Chapter 1

<table>
<thead>
<tr>
<th>Multiple Intelligences and Strengths</th>
<th>Digital and Nondigital Technologies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual/Spatial</td>
<td>Projectors, televisions, videos, picture books, art supplies, chalkboards, dry erase boards, slide shows, charting and graphing tools, monitors, digital cameras/camcorders, scanners, graphics editors, HTML editors, digital animation, digital movies</td>
</tr>
<tr>
<td>Visualize ideas and solutions before expressing them orally, in writing, or through other means</td>
<td></td>
</tr>
</tbody>
</table>

Sources: Adapted from McKenzie, 2005, p. 53; also based on Gardner, 1999.

If graphic organizers (such as concept maps or timelines) are developmentally and age-appropriate, consider using online tools or software applications to create visual representations of their multiple intelligences. Graphics may help students better grasp their strengths and the areas that need strengthening. Some of the available software applications and online tools to generate these kinds of graphic organizers are included in Resource List 1.1. TeAch-nology, for example, provides tools that generate graphic organizers for both registered and unregistered users.

**RESOURCE LIST 1.1  ■  Tools and Software to Create Visual Representations of Multiple Intelligences**

- **Inspiration**: www.inspiration.com/kidspiration
- **Microsoft Visio**: http://office.microsoft.com/visio
- **Scribus**: www.scribus.net
- **TeAch-nology**: www.teach-nology.com

If teachers decide to assign this activity, they should remember to promote it as a crystallizing experience. Promoting competition with regard to intelligences will likely be paralyzing for many students. Instead, teachers should aim to encourage and highlight intelligences at which students excel. In some cases, students who are not “high achievers” according to intelligences traditionally rewarded in schools (e.g., logical/mathematical), may find that they excel in several areas they were not even aware of.

**Boosting Intellectual Power**

Once familiar with students’ multiple intelligences, teachers can consider opportunities—both experiences and resources—that can help boost students’ intellectual power. The list should contain meaningful experiences that help students develop abilities at various levels, moving toward the highest level, create. Expect the list to change from year-to-year with each new group of students, and remember that expecting students to move straight from understand/remember to create is simply too great a conceptual leap for them to make without adequate preparation.

Teachers may want to revisit Table 1.1 to examine resources that address multiple intelligences and consider which level(s) of the revised Bloom’s taxonomy they would best serve. For example, to promote remembering of business terminology, drill-and-practice software may be used. Simulation software, on the other hand, may best be used to help students create simulated businesses in the virtual world.
Encouraging Independent and Divergent Thinking

Helping students “think outside the box” requires practice and acceptance. If students provide creative answers that do not fit neatly with a teacher’s preconceived expectation and are met with disapproval or disparagement, they may react by abandoning creative interpretation because it is simply easier to go with the flow and status quo. Conversely, providing open-ended experiences that allow for numerous “right” answers promotes creative thinking. One way to provide meaningful open-ended experiences is through project-based learning (PBL).

PBL allows students to work through a problem, either individually or in a cooperative group, to solve it. In PBL, technology-based tools can be used effectively to help solve problems. Moursund (2003) identifies three categories for uses of computer tools in education:

1. **Generic tools.** Software programs such as word processors, spreadsheets, database managers, graphics packages, email, and web browsers cut across many disciplines. A student who learns to use these tools can apply them in almost every area of intellectual work.

2. **Subject-specific tools.** There are tools designed for a particular academic discipline; for example, hardware and software that aid in musical composition and performance. Software for doing mechanical drawing (computer-assisted design) is another widely used subject-specific tool. Many different disciplines have developed hardware and software specifically to meet the needs of professionals within those disciplines.

3. **Learner-centered tools.** There are tools that require some programming skills but that also focus on learning to learn and on learning subjects besides programming. Most hypermedia and web-authoring systems serve as examples. Many of the generic tools include a built-in “macro” feature that adds learner-centered options. Both database managers and spreadsheets usually have such capabilities. (p. 90)

Moursund (2003) explains that by using computer-assisted learning, computer-assisted research, and distance learning students will experience first- or second-order effects, which will lead to creativity:

- “Computer-assisted learning (CAL) is the interaction between a student and a computer system designed to help the student learn. Computer-assisted research is the use of IT as an aid to doing library and empirical research. Distance learning is the use of telecommunications designed to facilitate student learning” (p. 91).

- Using these tools in one of these three ways can lead either to what Moursund describes as first- or second-order effects: A first-order effect essentially amplifies a task, and a second-order effect requires students to use higher-level thinking. Moursund writes, “The use of a computer to directly gather data from a scientific experiment is a first-order effect. Use of a computer to control the experiment is a second-order effect” (p. 96).

- Helping students to use both first- and second-order effects will help them move through the levels of learning needed to approach the creative process. Here again, teachers must use their own creativity to deliberately develop plans that provide first and second-order effects. “A major goal in PBL is to move students into routine use of the second-order levels of IT” (p. 96).
Promoting Independent and Divergent Thinking

Independent thinking does not preclude cooperative learning. Independent thinking, in the sense it is used here, implies thinking for oneself based on the meaning derived from an experience. Cooperative learning (which will be discussed in greater depth in Chapter 2) allows learning to happen in a social setting where the exchange of ideas stimulates growth of students independently and collectively. Students may share experiences and prior knowledge and engage in the construction of knowledge.

Addressing Both Process and Product

When planning experiences, teachers need to allow the opportunities and provide the resources needed to explore and produce an outcome. One way for teachers to help remind students and themselves that they value and expect both process and product is to include credit for both on rubrics and other assessment tools. (Chapter 2 deals with assessment in detail.)

Teachers can make technology work for themselves and their students by providing crystallizing experiences. Technology-related experiences should be positive ones. Providing a safe, comfortable computer environment with ample lighting and appropriate ergonomics is one way to provide a positive technology experience. (Chapter 4 covers how to set up an ergonomic and safe computer station.) Providing enough time to use technology is another way that can leave students feeling positive rather than frustrated when time is cut too short to complete learning that has begun. Virtual field trips, online chats with experts, and hands-on experiences used in conjunction with first-order and second-order experiences are examples of crystallizing experiences, as are user-friendly software applications that help students process ideas and produce creative outcomes.

Creating an Optimum Sequence to Promote Creativity

Teachers may do well to consider experiences that represent Gardner’s (1989/2006, p. 128) optimum or preferable sequence for promoting creativity when planning learning experiences for their students. They should consider students’ ages and developmental levels as they prepare opportunities for creative expression. In other words, creative explorations should be tailored to students and their characteristics, including age and developmental levels.

More specifically, Gardner’s optimum sequence first involves exploration, then basic skills, and then exploration—again, to stimulate creativity. Keeping this sequence in mind may help teachers better tailor student opportunities for creativity based on age and developmental level.

Gardner notes that some level of basic skills instruction is advisable in the early years. Capitalizing on a young child’s natural curiosity can actually help motivate students to learn the basic skills needed to explore further. For example, exclusive use of drill-and-practice software may be ill-advised for young students, but when it is used along with graphic-design software to create digital stories, the combination may inspire creativity and help students learn basic skills.
Being a Creative, Responsive Teacher

Creative teachers, as Armstrong noted, are flexible and willing to alter plans when the situation calls for it. They routinely hone their own skills, learn new ideas and concepts at various levels of learning, engage their multiple intelligences, seek out crystallizing experiences, collaborate with colleagues and students, engage in ongoing professional development (see Chapter 5), and inspire creativity through modeling. In other words, teachers, too, are students of creativity and can grow and develop as individuals and professionals by following many of the same strategies suggested in this section for student learners.

Inviting Multiple Ways of Inspiring Creativity

Once again, keep in mind that there is no one way to approach promoting creativity. Following a prescription would go against the very sentiment espoused here for approaching teaching and learning in novel ways. However, by being ready and open to new ways of practicing their profession, teachers can help their students blossom into the creative people they are capable of becoming. Approaching each teaching day with the expectation that something great can happen—that in class, at any given time, one or more students will make that one essential connection—may allow students to process ideas or produce something truly creative.

In Your Experience

Identify one crystallizing experience in your life.

- Did this experience impact your personal or private life?
- How so?

Section T1a Explorations

1. Create a graphic organizer that represents your understanding of creativity and the creative process. You may wish to use one of the graphic-organizer generators available online (e.g., www.teach-nology.com) or a software tool such as Microsoft Publisher, Open Office, or Inspiration.

2. List crystallizing experiences that you believe would help increase your creative potential at this point in your life. Explain how the items listed may achieve this. Create a table that depicts first-order and second-order effects you have experienced within the past 12 months. Analyze your table and explain how you may increase your second-order effects in the next 12 months.

3. Describe how your educational experience was either consistent or inconsistent with Gardner's optimum or preferable sequence for promoting creativity. How might your own experience impact your teaching? Create a timeline that shows your experiences of using instructional
technology, and extend it for the next 10 years. How do you project your use of technology in the next 10 years? You may wish to use timeline software (such as the free timeline at www.simile-widgets.org) to create your timeline.

4. Interview a person whom you consider to be creative. Is the content of this section consistent with the experiences of your interviewee? (For example, did the interviewee experience crystalizing experiences?)

5. Use your knowledge and experiences in your field to create a product that represents your understanding of this section. For example, if your field is music, write a song that summarizes the content of this section. If you are in the sciences, write an experiment that can test a hypothesis with regard to inspiring creativity. If your field is elementary education, create a bulletin board or a game for students that captures the creative process.

Section T1a Review

Creativity and the creative process can be fostered in your students and in yourself, but it will take a deliberate effort for this to happen. Expect to exert extra effort. Assessing students’ multiple intelligences and meeting their needs and interests takes a great deal of thought and planning. Likewise, staying abreast of new technologies through collaboration and professional development takes energy and effort. Still, as a professional educator, your willingness to go the extra mile for your students can achieve much toward the greater good. Your classroom is full of potential Einsteins, Pasteurs, Mozarts, and Picassos. Think what the world would be like without human creativity. Now think of how much improved the world can be because you are willing to help your students become agents of creativity.
Chapter 1   ■   NETS•T Performance Indicator 1

NETS•T1b
Engage Students in Exploring Real-World Issues and Solving Authentic Problems Using Digital Tools and Resources

A cursory review of world history reveals a wide variety of problems and issues that have challenged humans to take action for survival and prosperity. One does not have to look far or long to recognize that technology has played a role in many of these problem-solving efforts. Technology as it relates to agriculture and food production is one example. The field of medicine is another because of the ways technology has advanced the diagnoses and treatments of serious health issues and threats. Communication is yet another salient example, as telecommunications and other technologies have connected people worldwide. Education, too, has used technology to solve problems through distance education, instructional technology, and assistive technologies. This section explores how problems have been identified and solved through technology.

Technology’s Role in Historical and Contemporary Issues

On a daily basis, the news media broadcasts endless catastrophes. Long ago, it took days, weeks, or even months to learn of a world calamity; now it takes minutes. Rather than wait for chariots to bring news of an impending war or distant disaster, one only needs to turn on a 24/7 television news program, connect to an online newspaper, or use some other technology to witness a visual and audio play-by-play report of late-breaking news across the globe.

Closer to home, the news is broadcast frequently enough to give the uninitiated a sense that their corner of the world is ridden with a steady stream of problems. Many television news stations have augmented their morning and evening broadcasts with online versions that provide frequent and sometimes immediate updates of newsworthy community problems such as crime, accidents, and natural disasters.

The immediacy of this reporting can be nearly overwhelming for adults who, through life experience, have learned to cope with a constant barrage of disturbing news. For the young, however, it can be even more unsettling. It is not difficult to see how advances in real-time communication and reporting can lead some to see the world’s problems—both global and local—as too big and too plentiful for any human effort to solve effectively.

Although the constant supply of world problems and issues can weigh heavily on its citizens, it can also be viewed in a more positive light. Quickly knowing that a region of the world has experienced a disaster can give the worldwide community an opportunity to respond with offers of assistance. The devastating 2010 earthquake in Haiti is a recent example of a problem that triggered global efforts to help those affected. The response to the 2011 Japanese earthquake and tsunami disaster is another example of how human efforts came together to help a community in need.
The many human efforts that worked collectively to help those impacted by these two disasters no doubt involved a great deal of technology. The scientific community used advanced technology to determine the probability of further seismic danger. The medical community used life-saving equipment. The search-and-rescue teams used technology to help locate and assist victims, and other humanitarian efforts involved various forms of technology to provide food, clothing, and shelter.

Although some real-world problems are sudden, such as these two natural disasters, others are ongoing. Hunger, poverty, disease, deforestation, illiteracy, mental illness, economic declines, pollution, and crime are examples. Technology has a history of helping to solve problems by making the problems known and aiding solutions. Medical technology has helped practitioners better understand brain function and treat related illnesses, scientific instruments have helped scientists track existing environmental dangers and prevent others from occurring, and computer modeling has helped economists make informed economic decisions. to name a few. Whether the real-world issues are unexpected or ongoing in nature, technology clearly plays an important role in identifying and solving them.

ICT-Assisted PBL

An effective method that can be used in the classroom to explore and help solve problems of a sudden and ongoing nature is information (and communication) technology-assisted project-based learning. Project-based learning (PBL) was introduced in the previous section as an effective method for investigating topics. ICT-assisted PBL (which I sometimes refer to as PBL-IT and is also known as IT-assisted PBL) is a methodology that uses principles of PBL and information technology together to explore issues. According to Moursund (2003), the educational goals of an ICT-assisted PBL lesson plan are “authentic” and “closely aligned with what it takes to solve real-world problems and perform well on the job” (p. 58).

Moursund (2003) believes four goals should be a part of any ICT-assisted PBL lesson plan:

1. Students should get better at solving problems and carrying out complex tasks. … They should get better at working in a P/T Team [problem or task team] environment.
2. Students should improve their higher order and critical thinking skills and make use of their lower-order knowledge and skills.
3. Students should increase their knowledge and skill in undertaking a project and in using IT in a project environment.
4. Students should take increased responsibility for their own learning and work. They should make progress toward becoming independent, self-sufficient, lifelong learners and responsible workers. (p. 58)

Teachers can help students identify global and local problems and engage in Moursund’s four components by following the steps shown in Figure 1.7. These planning steps may be used to help identify a contemporary world issue that needs to be addressed and solved and engage students in the creative exploration of solutions.
According to Moursund, this seven-step process can be used to plan an ICT-assisted PBL lesson. In brief, to begin, the project content must be decided, including a working title, mission statement, and brief summary of content area. Next, general and specific project goals are established. After defining goals, planners consider the prerequisite knowledge and skills students should have to successfully work through the project and any modifications they will need to foster student success. Teachers then need to decide whether individuals or teams will approach the project, the roles students will play, and the extent to which teams will be permitted to define their projects. A timeline for completion is established, including project completion and checkpoints along the way. Resources need to be selected based on availability and relevance, and finally, methods of assessment are chosen to determine the extent to which students meet or exceed expectations.

Boss and Krauss (2007) support a reinvented PBL that uses digital tools and resources as a boost to what we already know and use in the traditional classroom rather than a replacement:

Reinventing the project approach doesn’t mean discarding this venerable model. Rather, we advocate building on what we already know is good about project-based learning. By maximizing the use of digital tools to reach essential learning goals, teachers can overcome the boundaries and limitations of the traditional classroom. Some tools open new windows onto student thinking, setting the stage for more productive classroom conversations. Others facilitate the process of drafting and refining, removing obstacles to improvement. Still others allow for instant global connections, redefining the meaning of a learning community. When teachers thoughtfully integrate these tools, the result is like a “turbo boost” that can take project-based learning into a new orbit. (p. 12)
Boss and Krauss believe the hallmarks of a reinvigorated approach to projects include these characteristics:

- Projects form the centerpiece of the curriculum—they are not an add-on or extra at the end of a “real” unit.
- Students engage in real-world activities and practice the strategies of authentic disciplines.
- Students work collaboratively to solve problems that matter to them.
- Technology is integrated as a tool for discovery, collaboration, and communication, taking learners places they couldn’t otherwise go and helping teachers achieve essential learning goals in new ways.
- Increasingly, teachers collaborate to design and implement projects that cross geographic boundaries or even jump time zones. (2007, p. 12)

Identifying Contemporary World Issues

The ICT-assisted PBL lesson plan, as described above, calls for identification of a problem. As demonstrated earlier in this section, technology plays an important role in awareness. Technology that makes online news programs possible is an obvious example of a means through which sudden and long-term real-world issues can be made known, but other less obvious communication tools exist, including email, blogs, social-networking sites, RSS feeds, news filters, and texting. In fact, any technology that connects two or more people can serve as an awareness-facilitating medium.

Many people are aware of how effective emailing can be for keeping up with news from friends and family, but they may not be as aware of how email can be used as a tool for identifying contemporary issues. Email users may sign up for any number of email alerts and updates offered by organizations associated with a cause. The alerts may contain information on current research efforts, ways to help with efforts, and emerging trends. Receiving these alerts is a time-saving way to stay abreast of self-selected contemporary issues in a timely fashion.

Email users can also sign up for email lists and email groups associated with a particular issue. Email users not only receive relevant and updated information, but they may also contribute to the conversation by posting information to the listserv or group.

Text message alerts are an extension of email and work in much the same way. Subscribers can receive text messages of an urgent or nonurgent nature based on their request. Text messages are especially helpful when an issue of immediate concern, such as a potentially volatile or dangerous situation, is at hand and readers are made aware of actions that need to be taken to avoid danger and remain safe. Another extension to email communication is the use of digital phone messages that play messages on phone speakers to alert listeners to important alerts.

Rather than using email, text, or phone alerts, some Internet users receive updates on important topics by using an RSS (Really Simple Syndication or Rich Site Summary) service that allows news on selected topics to be channeled to one website. This service is helpful for those who prefer to focus their Internet-viewing time on a few selected topics rather than on a broad range of issues.
Blogging and microblogging sites can also play a role in making individuals aware of potential, current, and emerging issues and can help focus readers on issues related to special interests. Blogs and microblogs are frequently topic specific. Some are strictly related to entertainment, others to politics, and others to education. Within these broad topics, some blogs and microblogs are narrower in focus. By regularly reading these blogs and microblogs, readers are able to pick up on contemporary issues that might not make it to larger news outlets. Readers can often post responses and comments related to blog and microblog content, making an exchange of ideas possible.

Social networking is a sometimes unrecognized source of news and information. Professional social-networking sites, for example, may serve as places to become aware of emerging issues in a field. A group of teachers communicating through a professional social-networking site may identify a deleterious effect on the outcome of education following a change in education policy, thereby allowing them to work toward a course of action to help resolve the issue. (See Chapter 4 for an in-depth discussion of the ethical and confidential use of social networking with regard to teachers.)

As noted earlier, online news services are widely available to alert viewers and readers to global, local, ongoing, and unexpected issues through text, video, and podcasts. Some online news services allow viewers to filter what appears on their news page. If viewers prefer to read about health and politics but not about other available issues, they can opt out of the other issues and see only news on their selections.

As noted, any communication medium that allows two or more people to communicate can serve to bring issues to the forefront. Table 1.2 includes some of the many technologies that can help teachers and students identify contemporary world issues and define a project and project goals.

**TABLE 1.2 Technologies that can help identify contemporary world issues that may be used in ICT-assisted PBL**

<table>
<thead>
<tr>
<th>Technology</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Telephone</td>
<td>Land lines, mobile phones (including smart phones)</td>
</tr>
<tr>
<td>Internet</td>
<td>Online news, email, Really Simple Syndications (RSS feeds), blogs, microblogging, social-networking sites, email user groups, email lists, websites, podcasts, archived resources (e.g., news articles, primary documents)</td>
</tr>
<tr>
<td>Radio</td>
<td>News program broadcasts, two-way radio, Citizens' Band radio (CB radio), talk shows</td>
</tr>
<tr>
<td>Learning Management Systems</td>
<td>Blackboard, Moodle</td>
</tr>
<tr>
<td>Video</td>
<td>Documentaries</td>
</tr>
<tr>
<td>E-literature</td>
<td>E-books, e-journals, online databases</td>
</tr>
<tr>
<td>Television</td>
<td>News, talk shows, documentaries</td>
</tr>
</tbody>
</table>
Exploring World Issues

In ICT-assisted PBL, students explore an issue through research and examination. Technology plays an important role in the exploration of a topic, much like it does in the identification role. A number of software applications are available that can help students hone skills and acquire knowledge essential for exploring a topic.

Computer-based tutorials are interactive programs that allow users to gain mastery of a concept or skill. They exist for virtually every discipline and level. If students are exploring an environmental issue such as recycling, they may complete a tutorial that provides a thorough background on the recycling process and checks comprehension of content as they progress through the tutorial.

Teachers can use tutorials to spark student interest, refine skills, provide reteaching, or provide enrichment. Many free web-based tutorials are offered, and a multitude of commercially available tutorials are available at reasonable cost. Freeware and shareware tutorials are also relatively abundant.

Having easy and cost-effective access to quality tutorials allows students to learn about topics not included in their curriculum. “Taking the Mystery Out of Copyright,” available through the Library of Congress website (www.loc.gov/teachers/copyrightmystery), is one example of a freely available tutorial that students and teachers can use to learn more about copyright and related issues.

The Multimedia Educational Resource for Learning and Online Teaching (MERLOT) website (www.merlot.org) provides a searchable collection of peer-reviewed and selected online learning materials including tutorials, simulations, case studies, and other learning objects. Although MERLOT is primarily a service to higher-education faculty, staff, and students, it is a gateway to a rich variety of online materials that may be appropriate for some elementary and secondary students.

Another tool that can help students acquire prerequisite skills or knowledge to explore a topic is an integrated learning system (ILS). An ILS typically utilizes networked hardware and subject-specific software, such as reading or math, that delivers programmed instruction to students and moves them through levels of mastery. Integrated learning systems may encompass the equivalent of several courses of a subject. Students progress at their own rates and appropriate levels. Practice is provided based on mastery, as is evaluation.

Many ILSs provide teachers with student data that help them use the ILS as a complement to traditional instruction. ILSs normally provide management tools to help oversee learning experiences. Compass Learning (www.compasslearning.com); Plato Learning (www.plato.com); and Pearson Education (www.pearson.com) are a few integrated learning systems available to the educational market.

In addition to tutorials and ILSs, informational websites can be used to make researching and exploring world issues easier. Reputable, quality websites, such as those included in Resource List 1.2, may provide a variety of resources, such as videos, podcasts, text, discussion forums, interactive maps, webcams, and other tools, to help students delve into topics in greater depth.
RESOURCE LIST 1.2  Information sites for students to explore world issues

Government-sponsored sites

These sites provide a variety of resources, such as videos, podcasts, text, discussion forums, interactive maps, webcams, and other tools, to help students delve into a topic in greater depth.

NASA Kids’ Club: www.nasa.gov/audienceforkids/kidsclub/flash

Kids.gov: www.kids.gov

Types of e-literature where students can locate information

- Amazing Kids!: www.amazing-kids.org
- Kid Outdoors: www.kidcrosswords.com/kidoutdoors
- Scholastic News: www2.scholastic.com

E-zines that are adjuncts to printed material

- Weekly Reader: www.weeklyreader.com
- Highlights: www.highlights.com

Digital references

This links to many e-publications such as e-encyclopedias and e-books.


Sources of free text- and audio e-books

Thousands of free e-books and audio books can be accessed through these sites.

- Project Gutenburg: www.gutenberg.us
- Free Books: www.free-books.org

In addition to the sites in Resource List 1.2, other sources of e-publications, such as scholarly e-journals, may be available through school and community media and library services that often have paid subscriptions to these digital resources.

Online databases, such as those in Resource List 1.3, can be used by students to help locate research reported in journals and books. Field-specific databases are sometimes available through school and community library and media services.

RESOURCE LIST 1.3  Online databases for students and teachers

Subscription-based searchable databases

- EBSCOhost: www.ebscohost.com
- LexisNexis: www.lexisnexis.com
Before allowing students to explore topics through the aforementioned means, teachers should provide students with instruction (such as that described in Chapter 4) on how to distinguish between reputable and disreputable sites so that they can obtain reliable and updated information.

**Solving World Issues**

Identifying and exploring global and local issues are critical in ICT-assisted PBL, but alone they are not enough. In order to solve problems, action must be taken. Making informed decisions about possible courses of action comes about from considering all the factors involved and discovered in the exploration phase and deciding which action may have the most favorable outcome. A number of computer applications can help students in this phase.

One of the resources that may be helpful in the ICT-assisted PBL process is problem-solving courseware. Problem-solving software comes in a variety of forms, such as computer games and simulations that engage higher-level thinking. This type of courseware can help move students through the hierarchies described by Anderson and Krathwohl (2001), culminating in the use of higher-order thinking and creativity.

Problem-solving courseware may be web based, or it may be a stand-alone software product. Some problem-solving software provides informational feedback to help users master certain skills and grasp greater depth of understanding. Other products provide more specific feedback to users and are capable of adapting or changing the difficulty of content presentation and problem-solving exercises, based on the user’s performance.

As students move through problem-solving courseware, they are required to make informed decisions based on their understanding of the problem. The outcomes—solutions—depend on student decisions and can, therefore, be very different for students or groups using the software. Engaging students in authentic problem solving that helps them experience both favorable and unfavorable outcomes based on their decisions makes this type of software especially useful in ICT-assisted PBL. Furthermore, because problem-solving courseware serves to move students through increasingly complex knowledge, it serves as an excellent means for fostering higher-order skills and creativity. Used in conjunction with traditional instruction, it has tremendous potential to maximize learning in the classroom. Problem-based courseware titles are available from such vendors as Plato.com.

Computer gaming is another type of computer application that allows students to influence outcomes based on their decisions. Computer games are an invention of relative recent history and serve to entertain and educate. Just about every traditional hands-on game now has a computer game counterpart. A matching card game traditionally played with physical, hand-held cards can be played on a computer. Similarly, a game of baseball can be played on a computer using Nintendo’s Wii (www.nintendo.com/wii) game system. The natural allure of computer games has caught the attention of many manufacturers hoping to tap into the education market.
Computer games are interactive and typically use one or more types of graphics (such as text and video) and often sound (audio). Some games require players to input simple data, such as answers to questions, and provide feedback to players. More complex computer games, such as simulated real-world experiences, engage players in role playing, decision making, and action taking. Simulated games often require higher-order thinking skills and creativity to solve problems. Web-based brain games, such as those available at Luminosity (www.lumosity.com), are thought to help improve memory and attention.

Once selected, some games can be used as a whole class activity or multiplayer activity. Other games may be used by individual students for enrichment or as part of the regular curriculum. The nature of computer games naturally promotes higher-order thinking and creativity.

Moursund (2006b) supports the use of games in education:

Games provide an excellent environment to explore ideas of computational thinking. The fact that many games are available both in a noncomputerized form and in a computerized form helps to create this excellent learning environment. A modern education prepares students to be productive and responsible adult citizens in a world in which mind/brain and computer working together is a common approach to solving problems and accomplishing tasks. (p. 8)

Moursund believes that games can be an effective educational tool because they are able to immerse the player in the environment (situation) of the game: “The attention grabbing and attention holding characteristics tend to shut out distractions” (2006b, p. 35).

One of the most recent developments in computer video gaming is massively multiplayer online games (MMO). These allow multiple users to play simultaneously across the Internet. For example, NASA has developed an MMO educational game (http://ipp.gsfc.nasa.gov/mmo).

Computer simulations are yet another type of interactive application that allows users to engage in authentic problem-solving activities. Many simulations create virtual worlds that mimic the real world but lack certain features that are not easily or reasonably available or accessible. For example, experiencing an ancient civilization is not normally feasible. Most students do not have the luxury of traveling long distances or even visiting relevant museums, and, of course, they are unable to travel back through time. However, a well-developed simulated game can make an ancient culture seem realistic and exciting to students in the classroom.

Discover Babylon (http://fas.org/babylon) is one such game that allows users to visit ancient Mesopotamia. It was developed jointly by the University of California at Los Angeles’ Cuneiform Digital Library Initiative, the Federation of American Scientists, Escape Hatch Entertainment, and the Walters Art Museum.

The Education Arcade (TEA, http://educationarcade.org), a Massachusetts Institute of Technology and University of Wisconsin-Madison partnership, is working toward making the use of video games an integral, important, and effective part of education. Their mission reflects their focus:

Our mission is to demonstrate the social, cultural, and educational potentials of video games by initiating new game development projects, coordinating interdisciplinary research efforts, and informing public conversations about the broader and sometimes unexpected uses of this emerging art form in education.
Revolution is TEA’s role-playing game based in colonial Williamsburg during the American Revolution. It promotes problem solving and creative thinking by introducing students to ordinary experiences in history and setting high expectations for involvement and critical thinking. As it says on the site (www.educationarcade.org/node/357):

> Developed as a multiplayer 3-D game, *Revolution* is designed to be played in a 45-minute classroom session in a networked environment. Each participant navigates the space of the town, interacts with other players and townspeople, and is given the opportunity to act in and react to various events that in one way or another represent the coming of the war. *Revolution* includes a strong narrative component, an important aspect to drawing the player into a world of actual historical events. But players also improvise their own stories, based on the resources available to them as well as the choices they make in real-time as the game unfolds. Because the game is networked, players collaborate, debate, and compete, all within a simulation that maintains historical suspension of disbelief with graphical and behavioral accuracy. *Revolution* combines the best elements of live classroom role-playing exercises and period drama films to provide a new kind of teaching resource for understanding American history.

Note the higher-order expectations for student participants to improvise, make choices, collaborate, debate, and compete.

Another brainchild of TEA, developed in conjunction with the MIT Teacher Education Program, is the development of “augmented reality” games that use real-life experiences together with simulated computer experiences. Its first augmented reality game, Environmental Detectives (www.educationarcade.org/node/356), uses global positioning system (GPS) technology in an outdoor environment to discover the origin of toxic spills. Virtual characters are interviewed, and large-scale simulated environmental measurements and data analyses are conducted in the quest to unveil sources. Here again, note the expectations for players to discover, analyze, and problem solve.

Another simulation, RockSim—Model Rocket Design and Simulation Software (www.apogeerockets.com/Rocksim/Rocksim_information), allows users to create rocket designs and play with design parameters to alter rocket performance. The commercially available game by Viva Media, Crazy Machines: The Wacky Contraptions Game, allows students to build virtual machines according to objectives. All of these examples demonstrate how software can be used for creative expression and working out solutions to objectives or problems.

To locate quality programs that promote higher-order thinking and creativity, teachers may wish to consider the following suggestions: look to professional society recommendations and/or do a general search for games related to the content or topic to be taught. Read the literature written to promote the games and note student expectations for higher-order thinking skills and creativity. Search for reputable, reliable reviews of the game. If available, test drive game demos yourself. If you approve but still think further testing is in order, considering soliciting peer and/or student input. If demos are not available but you feel the game is worth a try, you may wish to order the game. Check for return policies in case the game doesn’t suit your students’ needs.
Presenting Solutions to World Issues

Once actions have been decided, it is important to provide students with the time and resources to present their findings and solutions to at least their peers, if not their community. Authoring software allows users to create interactive products for presentations, tutorials, movies, demonstrations, and more. Authoring software is used extensively in business and industry to promote products and services, for training, and for web-page development. Education uses authoring tools on many levels and for a variety of purposes, as well.

At the course level, authoring software allows users to create entire course systems for student use. Most course systems have various components, including content modules, assignment drop-boxes for student uploading of assignments, chat tools, and bulletin boards. Normally, teachers are not directly involved with the creation of courseware, although sometimes they serve as consultants to writers for courseware designers.

At the classroom level, teachers use authoring software to create multimedia presentations, tutorials, movies, and demonstrations. Some authoring tools that teachers and students may wish to use are listed in Resource List 1.4.

**RESOURCE LIST 1.4  » Authoring tools**

**To create presentations**
- HyperStudio: www.mackiev.com/hyperstudio
- Microsoft PowerPoint: http://office.microsoft.com/PowerPoint

**For web-page designs**
- KompoZer: http://kompozer.net
- Adobe DreamWeaver: www.adobe.com/products/dreamweaver

**For animation and videos**
- Adobe Flash: www.adobe.com/products/flash

**For graphic-organizer designs**
- Inspiration: http://store.inspiration.com
- CMap Tools: http://cmap.ihmc.us
- Kid Pix: www.mackiev.com/kid_piz.html

**For computer-aided designs**
- Google SketchUp: http://sketchup.google.com

Students can use various authoring software to exercise higher-order thinking, such as producing and composing, writing, imagining, and inventing. Students can use PowerPoint, for example, to create a presentation with text, audio, and video that summarizes the identification, exploration, and solving of
a problem. They can use SketchUp to design a 3-D model of a solution, Inspiration to show relationships among contributing factors of a problem they explored, or Flash to animate a problem or solution.

Online collaboration tools make it relatively easy to create and share ICT-assisted PBL findings with others. Wiki tools and mind-mapping tools, such as MindMeister (www.mindmeister.com), Google Docs (http://docs.google.com), and SlideShare (www.slideshare.net), are but a few such collaborative tools.

Using digital tools as aids to learning has powerful implications, for as students leave the classroom and move on to the real world, they will already have experience in solving real problems that can impact their lives and the lives of others.

<table>
<thead>
<tr>
<th>In Your Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identify one digital resource you have used in the past for helping to solve a real-world issue. Explain how you used the resource.</td>
</tr>
<tr>
<td>If you are unable to identify one digital resource, explain how you used one nondigital resource to help solve a real-world issue. Consider how using a digital resource would have improved your exploration or problem solving.</td>
</tr>
</tbody>
</table>

Section T1b Explorations

1. Watch a 30-minute television news program and record the contemporary world issues identified. Note any contemporary issues that may be appropriate for student exploration and solving.

2. Connect to an online local news source and record the contemporary world issues presented. Note any local issues that may be appropriate for student exploration and solving.

3. Locate 10 blogs, websites, or other resources that you can use to receive regular updates on a topic of interest to you. Describe how you might use these resources in your teaching practice.

4. Create an ICT-assisted PBL lesson plan using a local, real-world problem as the topic. Explore the topic as if you were the student and offer possible solutions based on your research and use of resources.

5. Based on the contemporary issues you identified, identify resources appropriate for student exploration. For example, if a dip in the local economy was identified, locate computer simulations that might help students better understand how the economy works before trying to solve the real-world economic crisis.
6. Locate at least two online reviews that describe the effectiveness of the resources. Identify the source of the reviews (e.g., blogger review, competitor review) and how the source of the review may impact the review summary. Identify the first-order and second-order effects students might experience when using the resources. Identify which levels of the revised Bloom’s Taxonomy might be engaged by students using the resources. (See Figure 1.1.)

Section T1b Review

Contemporary world issues dominate news programs both day and night and present many challenges for the world’s citizens. With these issues, though, come an abundance of opportunities and resources for students to explore and help solve real-world issues. ICT-assisted PBL is an appropriate method for exploring these problems. Numerous digital tools are available to provide students with opportunities to engage in various levels of learning. Technology can be especially helpful in identifying issues, exploring issues, solving issues, and presenting solutions. Providing students with the tools and time to explore and help solve contemporary world issues will better prepare them as global citizens.
NETS•T1c

Promote Student Reflection Using Collaborative Tools to Reveal and Clarify Students’ Conceptual Understanding and Thinking, Planning, and Creative Processes

Deliberate reflection can be a powerful tool to help students become aware of their own thinking, learning, and growth. Reflection can also be used as a springboard for deeper reflection, as new knowledge is learned and connected to prior knowledge. The reflective process involves students taking time to look back on an experience; identifying where they started, traveled, and ended up; and deciding where they want to go from there. Examining the learning journey using collaborative tools can enhance the reflective process. In this section you will learn how to promote student reflection using these tools.

Creating a Reflective Classroom Environment

As noted in the previous section, our world is full of problem-solving opportunities with options to consider and actions to be taken. Helping students become self-aware, thinking, and caring individuals who are capable of taking informed action is perhaps one of the most rewarding outcomes a teacher can promote, yet preparing reflective students to tackle these problems today and in preparation for tomorrow requires careful planning and effort. Not only must teachers create a classroom environment conducive to reflection, but they must also structure the curriculum so that reflection is possible, welcome, and fostered.

Forethought and planning can help establish a reflective classroom environment, one that allows deliberate thought, time, growth, and informed action. In her work with service-learning, Wade (1997) outlined 10 factors (see Figure 1.8) that should be present for an effective classroom environment that promotes reflection and can be regarded as a framework for other forms of learning.

Respect for students’ ideas acknowledges that students bring experiences and knowledge to the learning experience; they are not simply empty slates, but rather important and vital members of the learning community (Morphew, 1994). Creating a classroom environment where students are expected and encouraged to be active participants rather than passive learners is consistent with constructivist learning and requires that students feel safe in offering ideas and suggestions about their own takes on a problem or project.

Student-to-student talk is an extension of this respect for student ideas. Teachers are viewed as facilitators and not as the proverbial sages on the stage. Within a brick-and-mortar classroom, the physical environment needs to be conducive for student-to-student collaboration. In the broader community of students, the virtual world should also be one that allows easy, safe, and reliable collaboration.
Mutual respect among all in the learning community begins with teachers who model and foster respect. Planned, unexpected, ongoing, challenging, and enjoyable reflection opportunities require time and a facilitator capable of carrying out effective reflection. While it may seem time prohibitive to factor in time for reflection, it is essential if students are going to practice skills that can last a lifetime. In a complex world, it is imperative that citizens of all ages be able to work through options and consider benefits and consequences of their actions.

Wade (1997) describes core components of reflective thinking that lead to informed action:

First, reflection is a deliberate thinking process that is applied to an experience, idea, or issue. Second, reflection takes time and the more time we can devote to reflecting on an experience, the greater potential for learning and insight. Third, reflection can lead to cognitive growth. Reflection should result in new understandings and appreciations. Finally, we reflect to inform our future actions. (p. 95)

Reflection itself can be thought of as a set of attitudes. Rodgers (2002a) distilled four criteria that characterize the concept of reflection and the purposes it serves:

1. Skilled leader
2. Gentle respect among all in the learning community
3. Planned, unexpected, ongoing, challenging, and enjoyable reflection opportunities
4. Adequate time for reflection
5. Reflection sessions
6. Respect for students’ ideas
7. Challenging, fun, and relevant reflection activities
8. Balance of different reflection methods
9. Appropriate room arrangements
10. Reflection activities and openness to unexpected opportunities

These components, when combined, create an effective classroom environment that promotes reflection.
1. Reflection is a meaning-making process that moves a learner from one experience into the next with deeper understanding of its relationships with and connections to other experiences and ideas. It is the thread that makes continuity of learning possible, and ensures the progress of the individual and, ultimately, society. It is a means to essentially moral ends.

2. Reflection is a systematic, rigorous, disciplined way of thinking, with its roots in scientific inquiry.

3. Reflection needs to happen in community, in interaction with others.

4. Reflection requires attitudes that value the personal and intellectual growth of oneself and of others. (p. 845)

Rodgers (2002b) also identified four phases in the process of reflection:

1. Presence in experience: Learning to see
2. Description: Learning to describe and differentiate
3. Analysis of experience: Learning to think critically and create theory
4. Experimentation: Learning to take intelligent action (pp. 234–249)

According to Rodgers, “one may move forward and backward through the process, especially between description and analysis” (p. 234).

Both Wade (1997) and Rodgers (2002b) acknowledge the role of community in the reflective experience, yet without a teacher’s intervention, reflection may not happen at all. Hmelo-Silver (2004) writes, “… reflection rarely happens in groups without a facilitator and so alternative mechanisms, such as structured journals, are needed to ensure reflection” (p. 246). Hence, fostering collaboration in reflection plays a critical role in whether reflection takes place at all.

A number of digital tools are available to help teachers foster reflection in a collaborative environment. Keep in mind that this discussion is in no way exhaustive but may serve as a springboard for novel uses of existing and emerging technology.

**Hard-bound journals.** The traditional hard-bound journal served for years as a tool for reflection in English and other classes, when students were asked to think about where they have been, what they have done, where they wanted to go, or other such questions that triggered reflective thinking. This type of journal was read by a select number of recipients, such as teachers who assigned journal writing or close friends who were permitted to read the printed word. The nature of these journals limited the likelihood of reaching a wide audience and hence the active collaboration between the writer and a community of readers. Today, however, many technology tools exist that enhance journal writing further by promoting student-to-student interaction and collaboration. Some of these tools include blogs, microblogs, discussion boards, social-networking sites, wikis, digital stories, podcasting, videorecording, videoconferencing, and text-messaging systems, to name a few.

**Blogging software** has become simplified to the point that nearly anyone with basic computing skills can set up a blog in a matter of minutes, for free or at minimal cost. Students across the country are using a variety of different websites and software to blog, such as those in Resource List 1.5.
RESOURCE LIST 1.5  ■ Blogging software

Multiuser edublogging platforms

- 21Classes: www.21classes.com
- ClassBlogmeister: www.classblogmeister.com
- Gaggle.net: www.gaggle.net
- Edublogs: http://edublogs.org
- ePals: www.epals.com

Course management systems that allow students to blog within the systems

- Blackboard: www.blackboard.com
- Moodle: http://moodle.org

Most blogging software and sites allow users to post writings and allow readers to respond. Different levels of security and safety settings exist for control by administrators (e.g., teachers, technology coordinators), and teachers need to comply with district and school policies. In most cases, teachers should consider limiting access to blogs until students have learned safety guidelines and what is acceptable and appropriate material to post and respond to. For example, teachers want to protect students from “trolls” and “imposters” who post and pose as interested collaborators.

In some cases students may be permitted to blog freely on a project or problem, but it is advisable to provide structure for blogs so that they do not wander off on a tangent. While some degree of unexpected reflection is desirable and may lead to unexpected learning opportunities, students need enough structure to use their time to meet project goals.

Microblogs. When more frequent but shorter reflections are desired, microblogs (e.g., Edmodo) provide a good option. Microblogs are blogs that permit a limited amount of text to be posted at one time. Regular blogging software and sites may be used as a microblog if text limits are regulated and enforced. Microblogging allows users to learn to write succinctly and with more frequency than with regular blogs, which are typically posted only every few days.

Whether students use blogs or microblogs, they should be taught safety rules and policies (e.g., using screen names, not divulging personal information, using standard written English, and following guidelines for commenting on other students’ blogs).

Teachers should provide rubrics or other assessment tools to students prior to student blogging so that students are aware of expectations. It might be worthwhile to allow students to have a trial run of blogging that will not count toward their class grade as a practice exercise.

To make blogs or microblogs more than reporting of events, students should be led to reflect critically on projects, problems, or class assignments. Guiding questions, for example, can be provided to students to focus their blog content. Another strategy can be for students to use a “KWL” blogging method: K represents what students know, W represents what students want to know or wonder, and L represents what students have learned.10
Wikis. As an adjunct or alternative to blogging software and sites, students can use wikis to record much of the same material. Wikis allow multiple users to edit content, thereby providing access and opportunities for collaboration. Wiki sites can be controlled for limited access.

Discussion boards can be used similarly and are often available within course management systems and through professional organizations and interest groups. In some cases, users must be registered members; in other cases, usage is open to anyone. At the time of this writing, most discussion boards used the written word, but some systems allow the use of recorded voice posts to create threaded discussions. It is critical that teachers are aware of district and school policies with regard to what discussion boards may be used by students for safety and security. The same types of precautions must be applied for students using discussion boards as for using blogs/microblogs, wikis, and other communication and collaboration tools.

Social-networking sites allow users to post pictures, content, videos, and other digital artifacts for limited or wide access, but security and settings vary from site to site and must be used with caution if students are permitted to use them. Much controversy surrounds the use of social networking in instruction, with some schools strictly forbidding its use, while others argue that its benefits outweigh the risks.

Digital storytelling is a way for students to think critically about themselves, their experiences, their classwork, and their projects by using multimedia tools to convey their reflections. VoiceThread (http://voicethread.com) and DigitalStoryteller (www.digitalstoryteller.org) are being used by educators to help their students think critically about themselves and others. Individuals or groups of students can collaborate on digital storytelling projects and grow individually and as communities of learners.

Podcasts. Podcasting can be used as a tool for reflection, as students reflect through recorded audio. Much like digital storytelling, students can record reflections of their journeys as they move through a PBL lesson, for example, or as they explore internship experiences. Vincent (2009) suggests using podcasts for weekly news broadcasts, documenting field trips, recording classroom discussions, and other such exercises that will naturally require student reflection to create and produce.

Podcasts can be sent to recipients through RSS feeds, listened to on mobile technologies such as iPods or Palms, or downloaded and reviewed on the computer. Students can create podcasts individually or in groups and may wish to create dialogue podcasts, in which students listen to other students’ podcasts and create podcasts in response. This back-and-forth dialogue can show reflections over time and document student growth and learning.

Slidecasting, which use slides and podcasting together, is an additional tool that can be used to create and share reflections and invite collaboration and dialogue. SlideShare (www.slideshare.net) is being used by some educators to promote reflection in a collaborative environment. Webcasts, Internet radio shows, videoconferencing, webinars, and videocasts are additional tools.

Graphic organizing tools. Students may find graphic organizing tools helpful to visually lay out their reflections and collaborate on ideas and solutions. Collaborative digital tools, such MindMeister (www.mindmeister.com) and Mindomo (www.mindomo.com), are used by some educators to foster reflection in a collaborative environment. Brainstorming, expected and unexpected reflection, and connections with others are some of the possible outcomes of using such tools in this manner.
While the resources and possibilities are plentiful, some teachers may feel nearly paralyzed by the vast number of tools and applications available. Like anything else, if teachers have never used any or many of these tools, perhaps it is wise for them to take small steps and begin with only one or two tools or applications, rather than try to implement multiple resources and get discouraged by the inevitable setbacks.

Consider what makes sense for current students and what resources are available. Teachers should always investigate online privacy policies and terms of use for all online resources they may consider using to determine age restrictions, how personal information will be used, and other safety and security issues. Teachers can enlist the help of district and school technology coordinators who can help them implement ideas with safety and security in mind.

For instance, if teachers wish to encourage their students to reflect on their own experiences as they would have related to students in the 19th or 20th century, perhaps they can consider using digital storytelling in groups of two or three students. Podcasts, blogs, slidecasts, wikis, and other resources can also be used, but if digital storytelling will accomplish the lesson goals for reflection and collaboration, why not keep it simple? As teachers achieve success and see growth and development and as a collaborative environment develops, they can add additional tools and applications.

Teachers should remember to enlist the help of the district or site technology coordinator to help them set up the necessary software or locate appropriate safe and secure sites. As 21st-century educators, teachers should invite collaboration from their colleagues and from the community when appropriate. Teachers do not need to pursue these student-collaborative ventures alone; in fact, it would be counterproductive to do so. As teachers, we can learn so much from each other and community members and save hours of time by collaborating.

**In Your Experience**

Identify one collaborative tool you have used.
- Was it used for an educational purpose?
- Could it have been used for an educational purpose?

If you have never used a collaborative tool, what one tool would you like to investigate further for educational purposes (e.g., digital storytelling)?
Section T1c Explorations

1. Create a blog using one of the resources described in this section. Make a list of ways you can use blogging in your teaching practice. As you created your blog, what frustrations, if any, did you experience that might impact your students who use blogging software? What are some security precautions you must observe?

2. Create a podcast that reflects on your understanding of the section content. Exchange your podcast with a peer and comment on his or her podcast. Ask your peer partner to do the same.

3. Search the Internet and create a resource list for slidecasts, podcasts, or other collaborative tools your students may use. Exchange your list with peers and create a blog or other web-based resource that includes a compilation of lists.

4. In collaboration with one or more peers, create a digital story that records reflections on a concept or project.

5. With one or more peers, create a wiki that summarizes the concepts in this chapter.

6. Use collaborative graphic-organizer software to create a visual demonstration of your understanding of this chapter. Collaborate with one or more of your peers.

7. Visit one or more of the websites presented in this section. Bookmark any that you may want to use for future reference.

Section T1c Review

Many digital tools and technology resources can be used to help students reflect on experiences, learning, and growth. By providing a classroom environment conducive to exchanges of ideas as well as student-to-student and student-to-teacher interactions, you can help pave the way for enhanced collaborations.
NETS•T1d

Model Collaborative Knowledge Construction by Engaging in Learning with Students, Colleagues, and Others in Face-to-Face and Virtual Environments

Teachers are often referred to as role models. Every school day, they face a captive audience and project their attitudes and behaviors to impressionable students. Students look to teachers to better understand acceptable behaviors, appropriate communication, and a whole host of other actions. The emphasis on social modeling has largely been on behavior. In this section, however, modeling knowledge construction and creative thinking will take center stage.

Exploring Constructivist Learning

This book, as reflected in its title, has a constructivist perspective. Constructivist learning acknowledges that both teacher and students are important and contributing members in a teaching-learning relationship and that both bring prior knowledge and experiences with them into the learning environment. For this reason, the practices of constructivist teaching capitalize on concepts and experiences familiar to students so that they are able to connect new knowledge with prior knowledge and construct new meaning (Morphew, 1994).

Three key elements contribute to a constructivist learning environment:

- meaningful experiences
- prior knowledge
- interactions (Morphew, 2009)

Each of these elements should be present in a learning environment that supports the constructivist perspective.

Meaning here is defined as the co-created sense one makes of phenomena through the interaction of the subject and the subject’s field (Morphew, 1994). Meaningful experiences, therefore, are experiences from which meaning can be derived.

For experiences to be meaningful, they must make sense to the learner. An experience perceived by the student as meaningless, much like the expression “lw;jdlsk,” renders the learning process impotent. Instructing students to wander aimlessly in a meadow without providing any contextual basis approximates the nonsensical expression, “lw;jdlsk.” However, using the experience as a metaphor or analogy taps into students’ prior knowledge, elevating the experience to one of meaning (Morphew, 2009).
Providing relevant curricula to students—curricula that help students connect what they already know to what they are now learning—helps deliver meaningful experiences to students. These are experiences that acknowledge student interests, abilities, and other characteristics and allow students to construct knowledge with others in the learning environment. Using examples that are foreign to students, such as actors and actresses from a bygone era, will not likely have the same appeal and relevance as using those who are easily recognizable. In this same way, presenting advanced concepts to students who have not yet grasped the fundamentals denies them the wherewithal to successfully make the conceptual leap expected.

Providing opportunities for interactions among students and between students and teacher is crucial to forming a constructive classroom environment. Contributions from all participating members of the learning community can trigger growth in all involved. Students with hobbies, interests, or talents help build a rich learning community and can help create greater awareness of connections that might otherwise go unnoticed. A student interested in baseball, for example, may be able to help her peers better understand statistics by presenting her baseball card collection to the class and explaining the content of the cards. A student interested in music may help students make the connection between music and patterns by sharing his sheet music with an explanation of refrains or patterns of notes.

Interacting in a Professional Learning Community

Teachers and students bring knowledge and experiences to the constructivist classroom, but by expanding the community of learners to include experts, community members, parents, and others, student learning can be further enhanced. An inclusive learning community, where stakeholders work together toward a common goal, is sometimes referred to as a professional learning community or PLC. Stoll and Louis (2007) suggest the following definition of PLC:

In sum, the term “professional learning community” suggests that focus is not just on individual teachers’ learning but on (1) professional learning; (2) within the context of a cohesive group; (3) that focuses on collective knowledge, and (4) occurs within an ethic of interpersonal caring that permeates the life of teachers, students and school leaders. (p. 3)

Stoll and Louis take an inclusive approach to PLC, extending membership to such examples as school district staff, higher education institutions, external consultants, and policy makers. They question whether teachers alone can be totally responsible for the success of their students:

Teachers’ knowledge base also traditionally encompasses subject knowledge, pedagogical knowledge, and that relating to child or adolescent development. Is this knowledge base truly broad enough to encompass all of the challenges that face children and young people in a diverse and changing society? There are other relevant and essential knowledge bases … that are likely to be critical in helping improve schools. (p. 4)

Although the question of who makes up the membership of a PLC is important, Stoll and Louis say the purpose of its existence remains unchanged: “to enhance student learning” (p. 5).

A constructivist classroom that is part of a larger PLC should include opportunities for interaction among all stakeholders, both immediate and extended. In terms of logistics, face-to-face interactions are easier within a school between student and teacher. Interactions between those housed within a school...
and those in a district may also find face-to-face interactions to be the first choice. In cases where it is impractical to have frequent face-to-face interactions with stakeholders, virtual interactions can be used to facilitate learning, communication, and collaboration.

Medley (2005), for example, uses computer-mediated discussion with experts to help facilitate student learning.

> Computer-mediated discussions with the experts have challenged and motivated my students. They have learned how to formulate insightful questions. They feel it is a privilege to discuss issues with the author of their textbook or other prominent experts. They not only appreciate new sources of information to which the experts refer them but also realize that they need a broader knowledge base to participate appropriately in a discussion. This realization motivates them to read their textbook or other material more carefully and purposefully. (p. 73)

Whether face-to-face or virtual, ample time and opportunities for interaction among all stakeholders in a professional learning community are well advised.

### Modeling Knowledge Construction and Creativity

Opportunities for a richer and more expanded knowledge base increase when a variety of PLC members are invited to share experiences and prior knowledge within the learning community. When teachers, students, parents, experts, community members, and others contribute to the learning environment, they are helping to construct meaning socially for that community. An effective constructivist environment, where contributions are made and learning is experienced by all, invites active learning rather than passivity and construction of knowledge rather than transmission of it.

Lev Vygotsky, a 20th-century psychologist from the former Soviet Union, is known for his work on sociocultural theory. Sociocultural theory supports the social construction of knowledge in a community of learners. One of the principles associated with sociocultural theory is guided participation, a type of apprenticeship in which tutors work side-by-side with learners, guiding them in the construction of knowledge. Tutors not only guide but participate jointly in the learning activity with the learner (Berger, 2008). In this setting, tutors are both facilitators of learning and learners themselves.

Vygotsky formulated the term “zone of proximal development” or ZPD: “the distance between the actual developmental level as determined between independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers” (1978, p. 86).

A classroom or PLC environment where all are learners and, at least to some degree, all are teachers is one that is ripe for growth and development. This environment allows for the social construction of knowledge and skills and elevates students to more than mere vessels waiting to receive transmitted knowledge.
Face-to-Face Learning

The classroom provides an ideal venue for modeling knowledge construction and creativity as teachers engage in guided participation with their students, colleagues, and others in the professional learning community. This will not likely happen apart from deliberate efforts to make this type of learning a routine event.

To be consistent with an inclusive professional learning community and to maximize learning by students and teacher, both face-to-face and virtual learning should include students, colleagues, and other stakeholders. In such an environment, teachers become students and students become teachers; experts become novices and novices become experts.

Learning with students is something that often occurs naturally as teachers guide their students. Teacher-student dialogue helps students connect concepts as teachers provide meaningful experiences and interactions, while teachers make sense and meaning from student contributions and learn from student experiences. Figure 1.9 demonstrates how, in guided participation, students become teachers and teachers become students.

Technology tools can help facilitate face-to-face learning where teachers can model knowledge construction and creativity through guided participation in a constructivist classroom environment. Although a multitude of practices can be used to help students become teachers and teachers become students, a few examples follow.

ICT-assisted project-based learning lessons can help teachers and students alike explore projects using digital and nondigital tools. Inviting students to explore topics of interest to them—topics that are relevant and meaningful—through ICT-assisted PBL allows teachers to capitalize on students’ prior knowledge and skills. Teachers can participate in various phases of PBL and can demonstrate knowledge construction and creativity as they offer creative solutions and guided participation to students.

Teachers may get to know their students through interest inventories, learning-style inventories, and multiple-intelligence inventories (described previously in the NETS•T1a section). Teachers can help provide meaningful curricula that align with local and national standards based on student characteristics.12

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FIGURE 1.9 Student becomes teacher and teacher becomes student through guided participation.
Figure 1.10 demonstrates how teachers can use a variety of factors to help provide meaningful experiences for students.

Guided participation requires teachers to take an active role in guiding their students by participating in learning while leading students through their zones of proximal development. Teachers, too, have their own zones of proximal development (ZPDs) through which they can move and grow as professionals and individuals.

One way for students to grasp teachers’ ZPDs is to observe teachers’ movement through KWL charts. Teachers can create digital or printed KWL charts that both teacher and students can complete. Although teachers do not know everything, students are not always aware of this phenomenon. Teachers can share their KWL charts to show that, yes, they K (know) quite a bit about the topic at hand, but there is still much to learn. They can also discuss and share the processes that led them from the W (what they wondered about or wanted to learn) to the L (what they learned). This helps students witness the process of knowledge construction in which they, as active participants in the learning community, will likely have participated.

When assigning reflective blog assignments, teachers can create blogs themselves, and use their blogs as examples to students. They can allow and encourage comments from students with regard to teacher blogs. This can serve several purposes: from students’ comments, teachers can assess whether students are grasping the blog content; teachers can learn from student feedback; and they can help students to reflect critically on teacher entries, giving students practice in critical reflection. Face-to-face discussions can follow to augment online dialogue.

Teachers can participate in many of the creative exercises they provide to their students. Simulations in which teachers participate will help students observe growth in their teachers and the process they use to learn and engage in creative solutions. Guided participation will allow teachers to model knowledge construction and creativity to their students.
As teachers plan lessons and select digital and nondigital resources for classroom use, they can share the process for how they selected these resources and why they decided against using other resources. They can demonstrate the selection process as a learning process and a reflective exercise.

Teachers can present some unexpected learning that took place as they conducted research for their lessons. They can demonstrate, for example, that they unexpectedly came upon excellent websites that clarified some misunderstandings they may have had or how they had an “aha” experience. Teachers can also share some newly learned skills that they acquired at a professional conference or workshop with other teachers to show that they are lifelong learners. Moreover, teachers may wish to share some creative works—such as paintings, writing, music—with students and explain the creative process as they know it and use it.

These examples clearly demonstrate that modeling knowledge construction and creativity is possible and can become routine practice in the classroom, allowing teachers opportunities to become students and students to become teachers.

Teachers can also model knowledge construction by fruitful face-to-face learning relationships with colleagues and others. For example, teachers are sometimes formally or informally assigned teacher mentors with whom they can learn through guided participation. Team teaching responsibilities also allow teaching colleagues to work together and learn from one another. In both of these cases, students are likely to see these collegial relationships played out in the classroom, hallways, lunchroom, and other areas of the school building.

Outside the classroom, teachers learn from other professionals through professional development workshops (see Chapter 5), seminars, and professional societies. Here again, teachers can share their own face-to-face learning with students upon their return to the classroom. Furthermore, local school district staff and local subject area experts can be invited to dialogue with students and teachers as they work through content and projects, opening up the knowledge base to teachers and students.

While face-to-face learning and knowledge construction can happen in the classroom, school, or school district with students and others, teacher learning can be expanded to the virtual environment to include those from different geographic regions, cultures, and professions.

**Virtual Learning**

Similar to face-to-face encounters, virtual interactions that lead to learning and growth both individually and collectively are abundant. Computer-mediated communication has the potential to bring together diverse populations that share a common goal and mission, but it is not without its challenges. Based on Trauth and Jessup’s (2000) work, Stoll and Louis (2007) point out:

Sustaining connections and community is made more complex by the explosion of technology, which permits the development of online groups that provide stimulating sources of information and safe, neutral arenas for support, but may also be unstable, more likely to involve imbalanced participation, and less amenable to the sustained, deep, reflective engagement that most of us associate with face-to-face relations that endure over time. (p. 8)
The study of computer-mediated learning communities has been explored with regard to social, political, and cultural factors, and in terms of the measurement of learning processes and interactions (Luppicini, 2002), but much is yet to be learned. Yet, with careful attention to relationships and a focus on the mission of helping students learn, technology can play an important role in bringing together professional-learning-community members where all are capable of learning and growth.

Virtual learning communities (VLCs) or communities that exist in the virtual or blended environment generally use social learning as a means for growth and development. Networked learning involving VLCs emanates from two theoretical bases: (1) learning that involves cooperative or collaborative groups, based on the work of Vygotsky and the construction of knowledge, and (2) learning communities or communities based on sociocultural theory with a focus on the role that membership plays on the growth of an individual as a social being (Allan & Lewis, 2006).

Both orientations have something to offer teachers and, in the end, students. The more teachers learn from colleagues, parents, and others, and the more they share their knowledge with students, the more likely students will be able to witness modeling of knowledge construction and creativity.

Participation in social networks, such as Nings, professional societies, or special interest groups (SIGs), such as ISTE’s mobile learning group, SIGML, or in managed communities of learners (see Allan & Lewis, 2006), allows teachers to learn from other professionals and contribute to the social community. Distance education (e.g., online learning) and e-learning (often associated with training rather than education) provide opportunities for virtual learning through webinars, course management systems, informational podcasts and other tools.

Most social networks allow users to post a blog or microblog. One way that teachers can learn in the virtual environment is to create dialogue-blogging opportunities. With dialogue blogging, teachers post blog entries and allow students from schools or districts different from their own to comment on blog content. In dialogue blogging, teachers learn from students who do not share their geographic boundaries or cultural heritage, and they can share what they have learned with their face-to-face students. In so doing, teachers are modeling their growth, awareness, and learning as citizens of the world.

Teachers can also connect with students in the virtual world by communicating with individual student e-pals. This relationship allows teachers to connect with students from other parts of their state, country, or world. As teachers communicate with these students, their own students will learn to appreciate how the teacher is growing in awareness, empathy, or some other sentiment.

Teachers who participate in virtual worlds, such as Second Life (http://secondlife.com), will likely learn much from other participants (known as “Second Lifers” in Second Life). They can invite their own students to observe their participation as a way of modeling their growth and learning as they socially construct content knowledge collectively with those outside their professional learning communities. In some cases, professional societies create virtual societies in which members can participate and learn. ISTE invites its members, for example, to participate in a virtual world and serve as volunteer docents who welcome new members and orient them to the virtual community.

Professional learning communities, too, might consider creating simulated professional learning communities in a virtual world where participants contribute to the growth and development of the community. In this way, they can see how virtual relationships play out and discover deficits that might
need to be addressed in their real-world professional learning community. In such a virtual community, all members should be encouraged to contribute.

Learning about and contributing to a wiki is another way to show two-way learning. For example, helping to write an online text using wiki tools demonstrates a willingness to teach others in the global environment and to learn from others as they edit teacher entries and make helpful comments. The Wikimedia community Wikibooks (www.wikibooks.org) allows such collaboration. Here again, this process models knowledge construction and creativity to students.

Virtual learning with students, colleagues, and others provides teachers with opportunities for learning that, when freely shared with students, creates a classroom ripe for growth and development.

### In Your Experience

As a student, have you ever engaged in guided participation with a teacher?
- If so, what did you learn, and what did you teach?
- If not, in what circumstances do you believe guided participation would have helped you learn a concept?

### Section T1d Explorations

1. Create a blog using one of the resources described in this section. Request that your teacher and peers comment on your blog entries and, in turn, comment on their blog entries. What kinds of learning took place for you and those reading and commenting on your blog?

2. In narrative form, describe a classroom in which you would like to teach that welcomes exchanges of knowledge and experiences, where students can become teachers and teachers can become students. Create computer graphics to go along with your narrative.

3. Create a slidecast or podcast of the classroom you described in Exploration 2.

4. Suggest a wiki project in which your teacher, peers, and others can participate to share learning and experiences.

5. Make a list of digital and nondigital tools that you can use in your classroom to help facilitate face-to-face and virtual learning for students, teachers, and others in a professional learning community.

6. Explore Second Life to see how professional societies or professional learning communities are using the medium.

7. Make a list of individuals you think should be included in a professional learning community you would like to join. Describe how each might contribute to the community and how each person might learn, grow, and develop as a member.
Section T1d Review

Face-to-face and virtual learning can help teachers grow as individuals and as members of professional learning communities. While challenges exist to using digital tools to enhance learning with students, colleagues, parents, and others, the benefits of growth for teachers should be worth the effort exerted. Most important, when all members of the learning community are learning and teaching, the collective knowledge base grows and has the potential to improve and increase learning for students.

As teachers, when we allow ourselves to be learners alongside our students, we model what it is to be curious and open to learning. While revealing ourselves as fellow learners to students may at first seem a bit daunting, the benefits can be far-reaching and we can demonstrate in concrete ways how rewarding it is to be lifelong learners.
Chapter 1 Summary

In this chapter you became familiar with the processes and products related to creativity, you learned how digital and nondigital resources can be used to advance human creativity in the classroom, and you learned about ICT-assisted PBL as a way to prepare students to solve problems in the real world using collaborative tools. Finally, you learned how to model knowledge construction and creativity through face-to-face and virtual learning. Teachers need to deliberately create opportunities, select resources, and use strategies to promote a constructive classroom environment where these activities are possible. Though they may be daunted at first, teachers need to remember that they are not carrying the weight alone. Through collaboration and cooperation, they can share the responsibilities of educating students with all stakeholders in their professional learning community.

Chapter 1 Notes

1 For another alternative revision to Bloom’s Taxonomy, see The New Taxonomy of Educational Objectives (2nd ed.) by Marzano & Kendall, 2006.

2 Unlike Bloom’s original taxonomy, the hierarchical structure of the revised version contains less rigidity (Krathwohl, 2002).


4 At the time of this writing, Gardner had not included existential or spiritual as intelligences. He has leaned toward including naturalist in the list of original seven intelligences and has considered including existential and spiritual intelligences (e.g., Gardner, 1999, p. 52). In Figure 1.3, the author has included naturalist and existential intelligences but not spiritual intelligence.

5 To learn more about brain research as it relates to learning, see Brown University’s Brain Science website at www.brainscience.brown.edu/research/learning.html

6 To learn more about multiple intelligences and appropriate technologies to use with each, see McKenzie (2005). In this text you will learn to support intelligences through selections of media, software, the Internet, and various digital and nondigital resources.

7 Problem-based learning vs. project-based learning. Problem-based learning, which is also known as PBL, differs from project-based learning. According to Moursund (2007):

   A project in project-based learning need not be rooted in a specific problem that currently interests a lot of people. Thus, a project might be an exploration of food or medicine available to soldiers from the South and the North during the U.S. Civil War. Problem-based learning (also abbreviated as PBL) has students or teams of students working on specific problems. Quite often, the problems are quite specific to the course being taught or the discipline being studied. The goal is to develop a good solution to a specific problem. Problem-based learning has a number of the characteristics of project-based learning, but the goal is to produce a workable solution to a specific problem. (p. 33)
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For more information on problem-based learning, see Moursund, 2007.

**ICT-assisted PBL vs. IT-assisted PBL.** Although *ICT-assisted PBL* and *IT-assisted PBL* (and *PBL-IT*) are similar, they differ in scope. The International ICT Literacy Panel (2002) described the difference and their use of the term *ICT over IT*:

> The panel has used ICT instead of IT (Information Technology). ICT is being used increasingly by global industry, international media, and academics to reflect the convergence between computer and communication technologies. Thus ICT can be viewed as a set of activities and technologies that fall into the union of IT and telecommunications. (p. 2)

8 Rodgers’ (2002a) criteria were based on the work of 20th-century educator John Dewey.

9 Rodgers’ (2002b) phases of reflection grew out of Dewey’s conception of reflection.

10 Donna Ogle is credited with creating a K-W-L strategy sheet. For more information on the original model, see Ogle’s 1986 *Reading Teacher* article, “K-W-L: A Teaching Model That Develops Active Reading of Expository Text.”

11 Tiryakian (1973) writes of meaningful entities: “The subject’s perceptions involve the transaction between the subject and the subject’s field where things outside the subject are transformed into meaningful entities” (p. 195).

> Lowe describes meaning as “the sense given by our consciousness to lived experience” (1973, p. 129). To summarize this succinctly, when a subject experiences phenomena and perceives, meaning is possible. This transaction between the subject and the subject’s field requires activity of the mind and body. In phenomenology, the mind and body are considered inseparable (Becker, 1992). (In Morphew, 1994, p. 9)

12 A word about standards is in order. Standards generally include outcomes or expectations, but they do not normally dictate how to facilitate the learning that will lead to the outcomes. Therefore, teachers generally have some degree of freedom about how they will teach to facilitate student outcomes. This is where teacher creativity—thinking outside the proverbial box—comes in.

13 See Luppicini’s 2006 article for a review of computer-mediated communication research for education (available from www.springerlink.com/content/v023l4727u816016).

### Chapter 1 References


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