

Preface

Introduction

In 1956, a research team of renowned educators would re-define the essence of teaching in the context of three domains. Earlier, educational psychology established itself as a branch of psychology focusing on the development of effective teaching techniques and the assessment of learning outcomes and progress.

How educators perceive their role influences the nature and character of their interaction with technology. In our book, *Professional Portfolios for Teachers: A Guide for Learners, Experts, and Scholars* (Wilcox & Tomei, 1999), we viewed the lifelong career of an educator as divided into roles and responsibilities best depicted as: teacher-as-learner, teacher-as-expert, and teacher-as-scholar. This same classification is helpful to distinguish who should read this book and why.

Target Audience: Who Should Read This Book

Teacher-as-Learner

The relationship between theory and practice in the knowledge base of teaching and in the professional preparation of teachers is a topic of long-standing debate in teacher education. This distinction has never been more controversial

than in the preparation of teachers to use technology in the classroom. Often posed as a dichotomy between technology as a content area and technology as a tool for learning, the best in pre-service teacher preparation programs are obligated to provide both technology knowledge and practice.

At the knowledge level, technology includes an understanding of basic operations and concepts, use of technology to enhance their own productivity and professional preparation, and an understanding of the social, ethical, legal, and human issues surrounding the use of technology in schools.

At the practice level, technology involves designing and developing effective learning environments and experiences supported by technology, implementing a technology-based curriculum to maximize student learning, and evaluating technology resources to facilitate a variety of instructional strategies (ISTE, 2003).

The Taxonomy for the Technology Domain offers the Teacher-as-Learner a host of practical examples of how to incorporate technology literacy, collaboration, and decision-making into future lessons while, at the same time, accumulating the necessary skills and competencies to use technology effectively for their own lifelong learning.

Teacher-as-Expert

The Teacher-as-Expert is the teacher in the classroom. While the typical undergraduate pre-service program lasts four years, this particular phase of an educator's career may last four decades. From the first day at the podium to the final class session, technology promises to be a constant companion in this journey towards professional development and personal growth.

Classrooms are most alive when teachers are learning with their students. Nowhere is that more obvious than with technology. Many teachers rely on their students to provide the technical skills necessary to effectively use technology in the classroom. Professional development is most powerful when teachers form learning communities that support and sustain their collective growth, even if that learning support comes from their own charges (Bizar, 2003).

Teachers who are learning in their own classrooms are very often working at the edge of their comfort zones in areas where they have not gone before. These teachers are modeling for students that learning never ends, that even teachers have room to grow, and that students have knowledge that can be shared and valued.

Classrooms and schools that are most successful use "best practice" strategies for teaching and learning, including technology. Teachers who serve not only as dispensers of knowledge (the proverbial "sage on the stage") but also as facili-

tators alongside their students (the “guide by the side”) form true learning communities best supported by the technology-based resources that become part and parcel of their curriculum.

The Taxonomy for the Technology Domain provides the Teacher-as-Expert with the theoretical foundations and practical applications to infuse and integrate technology into the scope and sequence of their everyday instruction.

Teacher-as-Scholar

Quality teaching requires significant knowledge of subject matter and teaching strategies, and the tools to acquire that knowledge. Professional teachers continuously pursue the depth and breadth of pedagogy and content through such activities as professional reading and writing, professional interactions with peers and others, professional study, and active participation in professional organizations to ensure that their teaching is engaging, dynamic, imaginative, contemporary, functional, and of useful substance to students (University of Oklahoma, 2003).

Quality teaching requires the technical skill to investigate sources of and solutions to classroom problems. Professional teachers are expected to possess the research skills to diagnose student learning performance, reinforce what supports and remediate what impedes movement toward successful educational outcomes for their students.

The Taxonomy for the Technology Domain offers the Teacher-as-Scholar the requisite research support at each proposed classification level. Research Implications are made available in the key expository chapters while a more comprehensive investigation of the taxonomy is considered in the final chapter.

The Taxonomy for the Technology Domain is provided here for consideration by all educators according to their focus throughout their educational careers, either as a Teacher-as-Learner, Teacher-as-Expert, or Teacher-as-Scholar.

Foundations and the Taxonomy for the Technology Domain

The foundations of education provide the critical underpinnings for the new Taxonomy for the Technology Domain. The first four chapters are particularly important for the Teacher-as-Learner as well as those who need a refresher in the domains of teaching and the psychologies of learning.

The popular schemata for organizing classroom objectives are presented in Chapter 1 and include an examination of the cognitive, affective, and psychomotor domains. Learning objectives in the cognitive domain encompass the “recall or recognition of knowledge and the development of intellectual abilities and skills.” The affective domain takes in individual “changes in interest, attitudes, and values, and the development of appreciations and adequate adjustment.” The psychomotor domain embraces physical skills and the performance of actions involved in learning described as “the manipulative or motor-skill area” (Bloom, 1956).

Chapter 2 explores behavioral psychology and how human activities change as a result of extrinsic motivators such as incentives, rewards, and punishments. Behaviorists advocate influencing behavior through the systematic adjustments of stimulus-response reinforcements. Cognitive psychology holds that information is more likely to be acquired, retained, and retrieved for future use if it is learner-constructed, relevant, and built upon prior knowledge. Humanist psychology focuses on individual growth and development and stems from the theory that learning occurs primarily through reflection on personal experience, and as a result of intrinsic motivation.

Taxonomies and their effectiveness as teaching strategies are explored in Chapter 3. Simply put, a taxonomy is a classification system. Benjamin Bloom created what is arguably the most famous classification for educators when he presented the Taxonomy of Educational Objectives. In his landmark exposition, Bloom developed a series of six progressive steps of cognitive development. In that single manuscript, he offers educators a rubric for developing instructional objectives at increasingly advanced levels of higher order thinking. Following in his footsteps, Krathwohl and Kibler completed the then-known domains of education with their affective and psychomotor taxonomies.

As a teaching strategy, the taxonomy uses the behavioral learning objective, constructed to embody the characteristics of an observable task, measurable learning condition, and established standard of performance. A properly constructed learning objective involves a *task* that the student must perform to demonstrate mastery of a particular goal. There must be little doubt as to the *conditions* (i.e., specific activities) under which the learning is to occur. Lastly, learning objectives must stipulate what constitutes successful learning; *standards* are used to authenticate successful learning.

Chapter 4 connects the critical relationships between technology and the foundations of education described in previous chapters. The domains, psychologies, and taxonomies of education provide the essentials upon which the Taxonomy for the Technology Domain is built and uncovered in subsequent chapters. It provides a foothold for further exploration in order to reveal the true impact and effect of this newest classification system for teaching and learning.

Applications and the Taxonomy for the Technology Domain

With the foundations of education firmly established, the Taxonomy for the Technology Domain is introduced and the text expands upon the six levels of the new classification scheme from the perspectives of the teacher, learner, and administrator and sets forth successful applications of technology for teaching and learning.

Chapter 5 establishes the latest taxonomy for teaching and learning — the Taxonomy for the Technology Domain — and is the “heart” of the book. Each of the six levels that comprise technology is introduced, as well as its impact on education and historical evolution. Literacy, collaboration, decision-making, infusion, integration, and technology incorporate a new set of skills and competencies into a curriculum that better reflect the demands of everyday learning in today’s classroom and corporate training environment.

The central chapters in the text (Chapters 6 through 11) are divided into three key elements. Please note the “headline” that precedes these sections both below and throughout the text. The banner graphic provides a visual cue for the theoretical foundations, practical applications, and research implications for the Taxonomy for the Technology Domain.



Theoretical Frameworks

Chapters 6 through 11 begin with the theoretical foundations of technology and education by providing a concise definition and historical framework, pertinent standards, and an examination of the domains and psychologies of teaching and learning at each level of the new taxonomy. The Theoretical Foundations of the Taxonomy for the Technology Domain are:

- **Definition and Historical Origins.** The textbook definition establishes each level of the taxonomy followed by a brief perspective of how the level came to fit into the overall classification of technology.
- **Standards.** Successfully integrating technology is realized only by adopting a common set of standards, lesson plans, and learning environments based on knowledge, application, problem solving, and the ethical use of technology. In the chapters that follow, each stage of the new taxonomy is connected with the technology skills and competencies established by international, national, state and professional organizations and local technology programs.

Research has found that standards for technology often embrace universal issues surrounding its access and use to enhance learning across the curriculum, such as: application of technology to enhance teaching, planning, assessing, reporting, and personal professional development; use of appropriate technology to enhance planning, communication, financial management, and the flow of information within an organization; formulating and implementing a strategic plan for technology; and, the effective assimilation of technology change (ISTE, 2003). Achieving each of these goals is essential to technological competency.

- **International and National Levels.** In a unique partnership with teachers and teacher educators, curriculum and education associations, government, businesses, and private foundations, ISTE developed a comprehensive set of educational technology standards as part of a National Educational Technology Standards (NETS) Project. At the international and national levels, ISTE has published standards addressing teachers National Educational Technology Standards for Teachers (NETS*T) and students (NETS*S), and administrators. And, the Collaborative for Technology Standards for School Administrators provided the technology tasks appropriate for administrators (Collaborative for TSSA, 2003).
- **State Level.** At last count, some 45 states have adopted, adapted, or referenced ISTE NETS standards in their in state-wide technology plans, teacher certification, administrative licensure, curriculum and student learning assessment plans, or other official state documents pertaining to the integration of technology for teaching and learning.
- **Professional Organizations.** ISTE provides the implementing standards for teachers and students for this examination. The Collaborative for Technology Standards for School Administrators (TSSA) developed a national consensus of what K-12 administrators should know and be able to do with respect to the effective use of technology. These standards are indi-

cators of effective leadership for technology and schools and are used in the development of the taxonomy.

- **Local Level.** SUCCESS is a comprehensive, integrated, education-focused program for the infusion of technology into the curriculum and teaching strategies of a school (Tomei, 2003). In Year One of the SUCCESS program, participants create their own technology-based instructional lessons and use them in their classrooms under the observation of the school principal. In Year Two, participating schools integrate technology into their K-12 curriculums. Each participating school receives a set of technology skills depicting the competencies desired from students beginning in kindergarten and progressing through secondary school. In Year Three, networking adds the principles and concepts of teaching at a distance to their growing bank of technology-based instructional teaching strategies.

Together, the international, national, state and professional organizations, and local standards form the foundation for the Taxonomy for the Technology Domain. How they are eventually applied for teaching and learning is the purview of domains, psychologies, and lesson design.



Practical Applications

Foundations are followed by an historical development of learning objectives from the perspective of three major domains: cognitive, affective, and psychomotor. Next, a host of new action verbs and ample illustrative learning objectives comprising the practical applications of the taxonomy for classroom teachers and instructional technologists.

- **The Domains of Teaching.** As the text continues to unfold into the six levels of the taxonomy, the new classification system fine-tunes itself to take full advantage of the various strengths of each domain. In simplest terms, the cognitive domain concerns itself with mental activities and the

process of understanding information. The affective domain concentrates on attitudes, values, and beliefs. And, the psychomotor domain involves aspects of physical skills and motor processes.

- **The Psychologies of Learning.** In a similar manner, behaviorism, cognitivism, and humanism provide insight into how teachers teach and learners learn. Behaviorism relies on objective behavior as evidence of understanding stemming from a response to an observable motivation. Cognitivism prefers to understand learning by examining mental constructs – how knowledge is represented and committed to memory. Humanism emphasizes the self-perception and the meaning attached to personal experiences. Likewise, the Taxonomy for the Technology Domain finds varying degrees of each psychology, so important to the uses of technology for teaching and learning, in its six classification levels.
- **Appropriate Technologies and Action Statements.** To help students, teachers, and administrators develop their host of skills and competencies, each of the six chapters compiles an inventory of appropriate technologies and recommended action statements used in creating technology-based learning objectives. Each chapter presents selected lesson plans demonstrating how these technologies operate at that level with respect to actual classroom learning.

The technologies identified offer an inventory of resources appropriate for addressing teaching and learning at each level of the taxonomy. The recommended action verbs assist in designing and developing learning objectives lessons (or units of instruction with technology integrated into the curriculum) to ensure effective learning.



Research Implications

The results of an initial inquiry into the use of the new taxonomy for preparing technology-based classroom applications is shared to establish quantitative sup-

port for the use of the taxonomy in real-world learning environments. A significant number of actual lesson plans were uncovered and their learning objectives categorized according to grade level (i.e., early childhood, elementary, middle school, and secondary) and by core academic content areas (i.e., mathematics, science, social studies, language arts, and other). The results of the research are presented as each level of the taxonomy unfolds.

Investigations into the Taxonomy for the Technology Domain

Since the advent of the mainframe computer in the 1950s, a technological revolution in education has been underway, providing a growing inventory of tools with the potential to facilitate students' thinking, problem solving, and learning strategies (Rowe, n.d.). By 1956, taxonomies developed by Benjamin Bloom and his colleagues had become a major influence in the analysis, design, development, implementation, and evaluation of technology-based lessons. Their classification systems for learning in the cognitive, affective, and psychomotor domains have impacted the way teachers teach and students learn.

In 2001, the case for a new taxonomy for the technology domain was introduced and a new course set for teaching and learning in the 21st century (Tomei, 2001). Research confirms that lessons consciously prepared in the cognitive, affective, and psychomotor domains using a taxonomy for encouraging higher-order thinking produce a higher occurrence of successful student learning outcomes. Taxonomies simply do a more thorough job of matching teaching strategies with student learning (Whitton, 1996).

Chapter 12 expands upon the preliminary data-gathering research (provided as Research Implications under each of the six levels of the Taxonomy for the Technology Domain). This subsequent investigation was to determine *relationships* between the levels of the Taxonomy for the Technology Domain most commonly addressed in technology-based lesson plans and the grade levels and academic content areas they represented. In sum, the investigation sought to establish the viability of the taxonomy as a classification scheme and the legitimacy of technology as its own domain for learning.

The research used an analysis of variance to determine if grade levels or academic content areas exhibit a correlation to the levels of the Taxonomy for the Technology Domain. In other words, the study examined the relationship between the levels of the taxonomy and grade level, looking to find whether objectives created for the lower levels of the taxonomy were predominant at lower grade levels. It also scrutinized whether a correlation exists between certain taxonomy levels and particular academic content areas.

In general, the investigation found evidence of correlation between the taxonomy *within* the grade levels represented by the data. It did not, however, find a link between the levels of the taxonomy *among* grade levels. Most instances of technology-based objectives were found at the lower levels of the taxonomy across grade levels. Even at the secondary level, the predominance of objectives were at the Literacy Level 1.0 of the taxonomy.

The study found a relationship between the taxonomy and *certain* subject areas, although the connections varied considerably in intensity. Specifically, the correlation was strongest in the core academic subject areas of science, math, language arts, and social studies.

Transition

The initial chapters of this text provide the underlying theories and principles that set the stage for the Taxonomy for the Technology Domain. Examinations of the cognitive, affective, and psychomotor domains establish a foundation in the principles of teaching that apply directly to teaching with technology. The review of the traditional psychologies of behaviorism, cognitivism, and humanism laid the necessary groundwork for technology as its own learning style. Together, the domains of teaching and the psychologies of learning form the pillars necessary to couch instructional technology as a teaching strategy and learning style in its own right. It comprises a theory worthy of further investigation.

It is the intent that the Taxonomy for the Technology Domain serve as a desktop reference guide during the analysis, design, development, implementation, and evaluation of new technology-based instructional materials. Too much teaching of technology has already occurred at the lower ends of the taxonomy. While several reasons can be offered, the most serious is probably the lack of teacher understanding of technology as both a content area in and of itself as well as a tool for learning. The Taxonomy for the Technology Domain addresses these shortcomings by exploring how technology should be applied considering both grade level and content area. Teachers would do well to consider the taxonomy whenever creating new learning objectives that incorporate technology in order to take better advantage of their own teaching strategy as well as the various learning styles of diverse student populations.

It is hoped that the Taxonomy for the Technology Domain will advance the disciplines for teaching and learning and provide further foundation upon which to evolve the technology domain.

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