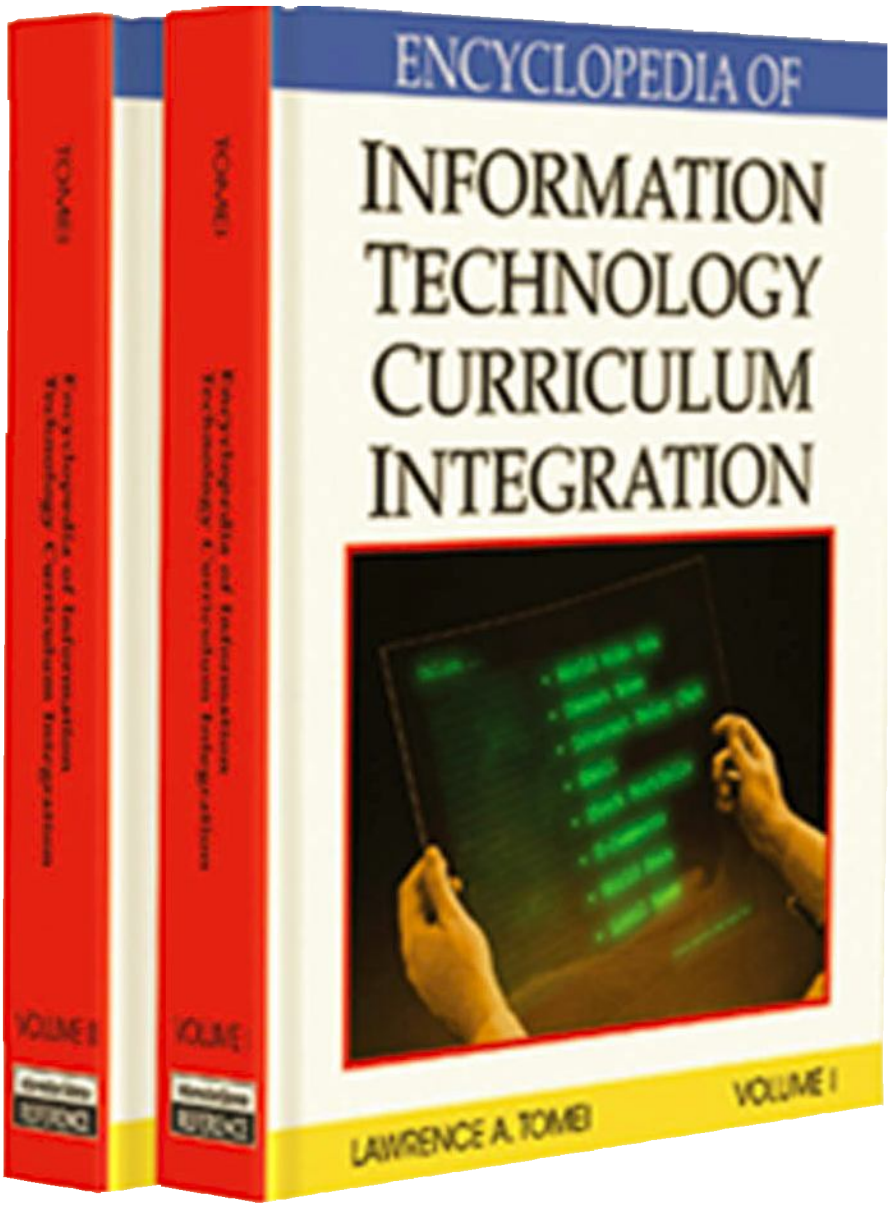
ENCYCLOPEDIA OF
INFORMATION TECHNOLOGY CURRICULUM INTEGRATION
LAWRENCE A. TOMEI
VOLUME I

Encyclopedia of Information Technology Curriculum Integration

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Preface

INTRODUCTION

Information technology continues to be one of the most rapidly changing disciplines, and nowhere is that reflected more than in the classroom. New technologies and concepts are introduced daily, and new ways of utilizing technologies for teaching and learning are constantly unveiled. In such an ever-evolving environment, teachers, researchers, and professionals of the discipline need access to the most current information about the concepts, issues, trends, and technologies in this emerging field. Towards that end, the ***Encyclopedia of Information Technology Curriculum Integration*** provides comprehensive classification, coverage, and definition of the most important issues, concepts, trends, and applications of technologies for the classroom.

This important new publication is distributed worldwide among academic and professional institutions, and will become instrumental in providing researchers, scholars, students, and professionals with access to the latest "best practices" with respect to the integration of information science and technology curricula.

The ***Encyclopedia of Information Technology Curriculum Integration*** provides a compendium of terms, definitions, and explanations of concepts, processes, and acronyms. This volume features a host of highly selective articles authored by leading experts in the field of information technology education, and offers in-depth descriptions of key terms and concepts related to worldwide issues and trends in teaching and learning with technology. It employs an organizational structure grounded in a classification system introduced by the editor in his 2005 publication, **The Taxonomy for the Technology Domain.**

The taxonomy offers a methodology for using technology to enhance student learning. Research shows that a classification scheme is an excellent tool for categorizing learning outcomes. For our purposes here, the *Taxonomy for the Technology Domain* is employed to stratify the encyclopedia and organize its 150-plus manuscripts by literacy, collaboration, decision making, infusion, integration, and technology (Tomei, 2005). As with most taxonomies, each step offers educators a wealth of practical applications of increasingly multifaceted student learning outcomes at each level of activity.

LITERACY

Literacy Defined

The encyclopedia entries subsumed under Literacy reflect the lowest level of technology-based learning. At this level of the taxonomy, literacy is defined as "the minimum degree of competency expected of teachers and students with respect to technology, computers, educational programs, office productivity software, the Internet, and their synergistic effectiveness as a learning strategy" (Tomei, 2005). Literacy entries found here discuss basic technology skills necessary for the technological learner.

Technological literacy is a foundation for learning now as commonplace as the historically traditional skills of reading, writing, and arithmetic. As society responds to this technological revolution, it also faces major challenges. Society has changed rapidly in recent years and international economic competition is booming. Success depends on the ability to acquire new skills quickly in response to new technologies. Realization of corporate goals demands the attainment of innovative knowledge in order to become a contributing member of our high-technology educated citizenry.

Contributions of the Encyclopedia

Literacy demands a level of skill and competency in the use of technology for personal application. At the outset, the list of required abilities appears daunting. It involves an understanding of technology at its most basic roots; an appreciation of a growing inventory of technological hardware media; and, the operation and application of complex operating system, office productivity software, and basic software utilities (e.g., paint and draw, virus protection, communications, and entertainment).

The encyclopedia offers a host of contemporary manuscripts that deal with research projects and practical applications. From the demands placed on education by the No Child Left Behind legislation to the magic of wireless technology, literacy presupposes that the learner is able to communicate with instructors, fellow students, and peers using state-of-the-art technology and terminology.

The articles classified under Literacy represent the gamut of technologies and offer the reader reviews of topics including, but not limited to, wireless, local- and wide-area networks; technology literacies, competencies, and skills; computer security, copyright, and fair use laws; discussion groups, chat rooms, and e-mail for teaching; and, primers on database, spreadsheet, and electronic textbook software.

Assistive Technology for Individuals with Disabilities (also called "adaptive technology") explains the delicate balance between the weak and strong areas of learning for students with disabilities.***Cognitive Informatics*** discusses the emerging discipline that studies the natural intelligence and internal information processing mechanisms of the brain, as well as the processes involved in perception and cognition. ***Critical Literacy and Technology*** employs text, images, voice, and video to enhance learning and social equity. ***Cyber Academy*** introduces the APEC Cyber Academy, a networked learning environment originally designed for K-12 students to address specific characteristics in pedagogy essential for supporting international collaboration among primary and secondary school learners. ***Cyber Charter Schools*** presents the alternative school model for delivering curriculum and instruction while minimizing the use of personnel and physical facilities.

Database in Computing Systems offers readers a primer on database models and the terms "table," "record," "field," "entities," and "attributes." ***Desktop Publishing in Education*** explores the creation of digital files for desktop or commercial printing such as newsletters, brochures, posters, flyers, name cards, and other projects that use page-layout software. ***Digital Literacy Research*** examines the ability to distinguish between content and presentation; evaluate a wide variety of content from different sources; demonstrate search skills; filter messages and use Internet agents; create a personal information strategy; operate in a community of practice; define problems and develop questions; judge the completeness of information; plus, much more.

Discussion Groups introduces techniques in facilitating discussion groups based on common issues, challenges, and the principles of instructional design that encourage meaningful discussion leading to student critical reflection. ***Distance Learning Specialists*** defines many of the roles of these instructional professionals as designer of the educational experience, facilitator and cocreator of a social environment and subject matter expert. Providing access to instructional materials and resources is important for any type of learning to occur.

Educational Accessibility to Technology investigates students who may not have access to the resources necessary for them to complete projects, perform research, retrieve data information, and communicate with others, and the resulting impact on learning. ***Electronic Textbook Technology in the Classroom*** looks at e-books, devices approximately the size of a traditional paperback that hold digital forms of printed material that can be downloaded and read at will, and sport advantages and uses that are seemingly endless in a school setting.

Ergonomics is defined as the science of designing working environments for maximum health and safety and maximum work efficiency, as well as the study of human physical characteristics and needs. This article describes major considerations when integrating technologies into the classroom or the work place.

Fair Use and the Digital Age provides a close-up look at key elements of both copyright and fair use laws, as well as critical factors in assessing personal adherence to these laws and recommendations and cautions for operating in a technology environment. ***Information Literacy*** is integral to the development of many of the capabilities important to survive *in the 21st Century.* Nine standards, developed by the American Library Association and the Association for Educational Communications and Technology, are highlighted in this article for consideration.

Internet Citizenship presents the design of an actual course that focused on how the Internet[1] may be used as a medium for discovering information about citizenship, in general, and for advocating and practicing citizenly conduct, in particular. ***Keyboarding and When to Teach It*** argues that typing can be exciting and rewarding when approached as a content area to be taught, learned, and mastered as a skill set necessary to raise computer use to its fullest potential. ***Local Area Networks*** provides a primer for one of the most popular technologies in both the consumer and enterprise markets. LANs have be-

come a ubiquitous resource as the Internet and personal computers matured in size, speed, capabilities and features, and use, making this an important contribution to the encyclopedia. ***Neural Informatics*** chronicles the development of classical and contemporary informatics as the cross fertilization of knowledge between computer science, systems science, cybernetics, computer/software engineering, cognitive science, neuropsychology, knowledge engineering, and life science.

President George W. Bush signed the *No Child Left Behind Act of 2001*(NCLB) on January 8, 2002. The article, ***No Child Left Behind,*** discusses the main ideas and key features of accountability, flexibility, proven education results, and school choices for parents, and shares some initial results of how information technology has contributed to its success so far. ***Online Mentoring in Education*** considers the importance of using technology-enhanced communication to form mentoring relationships between educators and their students. When distance and time are factors impeding effective mentorship, online tools often help improve the teaching and learning processes.

Podcasts introduces the latest "voice of the people" in the form of audio files stored and uploaded to the Internet and published for targeted subscribers. ***Spreadsheets*** are multidimensional, addressable, ordered arrays of cells whose contents may be text, values, formulas, or functions, able to display and store data and evaluate expressions. For many, the spreadsheet was the first software application that made personal computers a fixed tool in the business office and a literacy of paramount importance to information technology educators.

Students with Disabilities and Technology examines how America's schools are required to meet federal laws and regulations for special education covered by the *Individuals with Disabilities Education Act*. More and more, teachers of students with disabilities are utilizing techniques, such as universal design, to make adaptations to the regular education curriculum to help them garner access and understanding. ***Teaching and Learning with Personal Digital Assistants*** relates the latest in classroom-targeted technologies in the form of small handheld devices that store documents, spreadsheets, calendar entries, games, databases, and other resources. Their relative cost and portability have endeared them to faculty and students, and have opened avenues for instruction once relegated to desktop computers and textbooks. ***Thinkquest*** introduces the worldwide competition focusing student efforts on project-based learning, and the technology that supports this style of learning. The article summarizes the accomplishments and benefits of the program's impressive array of efforts and resources, and the **interactive tools that facilitate learner-instructor and learner-learner collaboration.**

Understanding Computer Security considers the measures and controls that ensure confidentiality, integrity, and availability of information system assets including hardware, software, firmware, and information being processed, stored, and communicated. This article reviews many of the hardware, firmware, and software security features available to protect against, or prevent, the unauthorized disclosure, manipulation, deletion of information, or denial of service. A bibliography is a well-known apparatus provided by authors to document the litany of printed resources (e.g., books, articles, reports) on a given subject or topic for further study or reference purpose.

In ***Webliography,*** the citation discusses ways to search, evaluate, organize, update, and reference Web-based resources. Closely aligned are WebQuests, which have become popular tools for integrating Internet resources into existing curriculum content. Their application has expanded rapidly with the advent of multimedia-rich technology, to the point where they are presently one of the most common tools used for the integration of technology into the classroom.

Wide Area Networks examines network services distributed over large geographic areas and provides a prologue to a much broader understanding of telecommunication systems on which such distribution depends, and the growing reliance on general dependency on third-party carriers to provide these transmission services. In the encyclopedia citation, ***Wireless,*** the author looks at many implications of using wireless technology on campus or in corporate buildings, providing its users greater flexibility in movement and increased elasticity in addressing mobile job requirements. Finally, as a literacy technology, ***Wireless Computer Labs*** discusses issues of instructors and faculty, formal and informal curriculum, and funding, staffing support, and training needs associated with the introduction of wireless labs for teaching and learning.

Summary

Technological literacy involves using technology hardware and, at the same time, understanding word processing, spreadsheets, and Internet access, to the point where terminology barriers are eradicated. Lifelong learning implies the use of these powerful tools for success. The first classification of articles for the ***Encyclopedia of Information Technology Curriculum Integration*** promotes continued awareness and individualized consideration of the many technologies that make up information technology curriculum integration.

COLLABORATION

Collaboration Defined

Collaboration is defined as "the ability to employ technology for effective interpersonal interaction" (Tomei, 2005). Effective uses of interactive technologies include appropriate written and oral communication, the professional exchange of information, and interpersonal collaboration. Collaboration involves the use of telecommunications media to network with peers, instructors, content area experts, and others. Skills at this level of the taxonomy are evidenced by sharing information in written form (word processing, desktop publishing), responding to directed personal interchange (electronic mail), and participating in and interpreting interpersonal dialog (via list servers, chat rooms, and online bulletin boards).

After literacy, collaboration moves quickly to the forefront of any list of necessary competencies. Collaboration is paramount in order to work cooperatively, gather information, express knowledge held within, communicate with others in support of direct and independent learning, and pursue personal and professional interests.

Contributions of the Encyclopedia

Perhaps no other level of the taxonomy is as important to educational, personal, and professional success as collaboration. As a result, a host of important citations have been added to the ***Encyclopedia of Information Technology Curriculum Integration*** at the collaboration level.

Advancing Professional Learning with Collaborative Technologies explores the use of collaborative technologies with preservice teachers, and how the effective integration of technology into teacher education courses positively impacts school technology practices. ***Active Learning Online*** purports a widespread agreement on the definition of learning as a recognizable change in behavior as the result of experience. This article attempts to examine the relationship between active learning online and the intellectual growth and development of learners as a result of technology infusion into the collaborative component of online instruction.

In a world that is increasingly mobile and connected, the nature of information resources is constantly changing in terms of how new information is networked, the modalities in which it is delivered, and the overwhelming quantity of data. ***Anywhere, Anytime Learning Using Highly Mobile Devices*** describes how mobile devices for teaching and learning are pushing users closer to a ubiquitous computing environment. It explores the issues relevant to making a commitment to replace more cumbersome technologies with such devices. To successfully implement mobile devices takes rethinking on the part of administration and faculty regarding the role of technology in schools, and the fundamental impact this changing role is going to have on teaching and learning. ***Asynchronous Online Networking*** has been at the forefront of foreign language education at least since the early 1990s, with the goal to promote intercultural communication, and assist students in developing the construct of the intercultural communicative competence. This article presents arguments based on data gathered from the implementation of asynchronous online networking across native language and culture, the language and way of life of the target culture, and the necessary skills to mediate across them.

Blogs (short for Web log) are online journal entries, usually displayed on a Web site, that contain entries listed in reverse chronological order. These tools combine text, images, hyperlinks, and in some cases, audio, to provide information on a specific topic. This article describes a host of blog characteristics including page title, main content (or body of the post), post date, and a link that provides future access when placed in the archives. ***Chat As New Pedagogy*** introduces a new pedagogy grounded in computer information technology as a means to enhance effective collaboration. Chat as a mode of instruction provides interactive learning, meaningful instruction, enhanced communication and collaboration, and more timely assessment, especially formative assessment that instructors use to modify their teaching. ***Classroom Without Borders***

is a euphemism for non-traditional course offerings employing a variety of distance education technologies such as electronic mail, computer conferencing, two-way audio/video, videoconferencing, and satellite delivery. This article offers an introduction to classroom without borders, its dependence on distance-learning technologies, and its reliance on a global education community complete with institutional and individual stakeholders.

Computer-Supported Collaborative Learning explains how scripts for collaboration were originally developed in order to support text comprehension. They divide learning into a sequence of small steps, assigning each learner to a particular role, and offering a number of comprehension strategies such as questions, feedback, and elaboration. ***Group Collaboration in Education*** involves strategies that employ new technologies based on significantly enhanced educational platforms, while businesses often opt for collaborative tools designed to reduce costs and bring their products to market faster than the competition. Advances in technology make such paradigm shifts in group collaboration not only possible, but necessary. ***Interactive Videoconferencing*** relates how the union of once disjointed voice, video, and data telecommunication technologies, and the increasing adoption and cost-effective availability of high bandwidth network services among educational institutions, businesses, and home users, has rapidly altered the landscape of technology-mediated communications. In combination with the use of distance learning technologies, many instructional environments are adopting a blended approach to instruction that includes interactive video communications.

The participatory, collaborative, active, and interdisciplinary nature of a ***Learning Community*** and (specifically) a ***Networked Learning Community*** is posited as an approach to curriculum design requiring instructors and students to join efforts to coordinate proper courses into different programs of instruction, implement the coordinated courses, and evaluate the designed course content and learning objectives.

The term ***Netiquette*** is the combination of two common words, network and etiquette, and is used to denote proper or acceptable manners that should occur on the Internet by users conversing electronically. Netiquette comprises rules for good behavior adapted for electronic communications and shared in this important encyclopedia citation.

One of the key distinguishing draws of online education is the opportunity for instructors and students to interact via asynchronous ***Online Discussion Groups***. Offered to a varying degree in different online academic programs, online forums are used for social interaction, collaboration of assignments and other assessable work, tools for individual project groups, tutorial purposes, or as a central part of the teaching strategy. This article presents both compulsory aspects of the asynchronous format and its challenges with respect to the assessment mix. ***Online Interaction and Threaded Discussion*** represents an asynchronous form of online interaction in which electronic messages are posted, archived, retrieved, and viewed online. Participants view and respond to the posted messages and, by doing so, create a strand of responses that is better organized and more intuitively tracked. Advantages include facilitating ongoing class discussions; expanding ideas, drafts, and finished projects; and soliciting comments and critical feedback. The article, ***Online Learning Environments*****,** introduces the most popular communication formats including personal e-mail and listserv, online conferencing, chat rooms, discussion boards, and blogs, as well as many other synchronous and asynchronous forms of communication. ***Scripts for Facilitating Computer-Supported Collaborative Learning*** work by sequencing, role assignment, and collaborative strategy application, individually. Sequencing creates a number of different steps according to the order in which the task should be carried out. Assignment of roles introduces role taking theory, and often transforms learning into a more engaged and active venue.Four basic strategies supporting collaborative learning include clarifying, summarizing, questioning, and prediction.

In the article, ***Service-Oriented Architecture in Higher Education*****,** the contributor presents a framework for analyzing service structure in networked and virtual environments within higher education, while offering an approach generic enough to be applied to a host of organizational environments. From another viewpoint of network architectures, ***Shared Networks in Technology Education*** establishes the relationship between the investment on information and communication technologies, and discloses the

impact of information technologies on educational institutions by presenting a view of the key variables in a global model for measuring the value of shared networks in technology education.

In ***Synchronous and Asynchronous Learning Environments*****,** the contributor discusses the organizational and pedagogical aspects, as well as the benefits and disadvantages of synchronous and asynchronous technologies as platforms, both of which are employed equally during the creation of contemporary distance-learning environments. Synchronously, learners participate simultaneously with both the instructor and peers, with no time lag, in spite of the geographical separations. Asynchronously, the instructor and learners are separated by both time and geography, and learning is self-paced. ***Technology Support for Collaborative Learning*** introduces the reader to the time and place dimensions of online collaboration, and offers several practical examples of asynchronous and synchronous communication tools, such as audience response systems, electronic meeting systems (e.g., desktop Web cams and classroom videoconferencing), and convergence hardware (e.g., personal digital assistants (PDAs), pocket PCs, mobile phones, and other portable devices).

Telementoring takes the traditional concept of mentoring and applies collaborative technologies to student advisement and counseling via online communications tools ranging from text to video-conferencing. It prevails over barriers encountered as a direct consequence of time and geographic separation, and promotes the mentoring relationship so crucial to successful instruction. From another viewpoint, as tools to facilitate learning, comes ***Web Logs*****,** another term for text, graphics, hyperlinks, photos, audio- and/or video-based journal entries. In this citation, the author introduces the common components of a blog, to include the title, body of the log, comments, links, date/time posted, and categories or tags.

Summary

Regardless of its application, collaboration is an indispensable second level of technology competency. Technology-based communication skills are essential to information technology education (as it is other academic disciplines).

DECISION MAKING

Decision Making Defined

Technology for decision making refers to the "ability to use technology in new and concrete situations to analyze, assess, and judge" (Tomei, 2005). Before decision-making technologies can be effective, mastery of the concepts and skills from the previous two levels is assumed. Making decisions with the aid of technology requires a higher degree of technology understanding than either of the previous stages, and includes such important tools as spreadsheets, brainstorming software, statistical analysis packages, and database applications. The ***Encyclopedia of Information Technology Curriculum Integration*** offers an array of articles that address the importance of decision making to the discipline of information-technology education.

Contributions of the encyclopedia. Problem-solving skills are advanced with the aid of decision-making technology, as learners employ strategies for making informed decisions and solving real-world problems. ***Data Mining*** is the process of extracting previously unknown information from large databases or information warehouses, and using it to make crucial business decisions. As this article purports, data is plentiful while applied knowledge garnered from this data seems to be a most challenging dilemma. The common types of information derived from data-mining operations are associations, sequences, classifications, clusters, and forecasting. Mining data effectively involves the employment of algorithms and methodologies widely accepted in mathematical circles to include neural networks, decision trees, genetic algorithms, regression analysis, logistics regression, and **memory-based reasoning.** The advancement of expert ***Data Mining Software*** is the direct result of major improvements in technology applications. This article introduces many of the most popular diagnostic tools for analyzing data, and examines data gathering from different dimensions. The concepts of class relationship, clusters, logical relationships, sequential patterns, and consumer preferences are mentioned. In ***Data Warehouse Software*****,** applications that provide flexible, secure, and rapid access to critical information and intelligent reporting are reviewed. Some of its many recognized advantages, compiled over a relatively few years, include end-user access to a wide

variety of data, increased data consistency and productivity, reduced computing costs, and an infrastructure that supports data replication in operational systems. Noted disadvantages are the time-consuming demands of designing, developing, and implementing warehousing software while security issues and incidents of poorly designed software have plagued data-management applications.

Decision Support Software is classified as text-oriented, database-oriented, spreadsheet-oriented, solver-oriented, rule-oriented, compound (or hybrid). Others classify such software as model-driven, communication-driven, data-driven, document-driven, and knowledge-driven and identified three different user levels as passive, active, and cooperative. Model-driven software manipulates statistical, financial, optimization, and/or simulation models to combine information from different sources and promote effective decisions. Communications-driven software, as its name implies, fosters interaction between groups, facilitates information-sharing, and supports collaboration and coordination. Data-driven software allows users to manage data without abandoning manageability or operational integrity, while document-driven software provides solutions to archiving, retrieving, and sharing documents. Knowledge-driven support software deals with general knowledge that aids in the decision-making process. The basic ingredients of ***Decision Support Systems*** include the data management system, the model management system, the knowledge engine, the user interface, and the user. Essentially, these support systems are computer --based and promote the decision-making process. The citation explains how information is entered from the decision maker to produce output from the model that ultimately assists the decision maker in analyzing a situation. ***Decision Trees*** represent the theoretical basis of decision theory; they are excellent tools in the decision-making process. The citation introduces genetic algorithm trees, orthogonal decision trees, and hybrid decision trees, as well as practical applications of decision trees in data mining, use of decision trees in risk management, and decision trees in supply risk management.

Digital Business Portfolios are basically collections of artifacts used to validate claims made by the owner of the portfolio. Artifacts that comprise a portfolio come in a variety of formats including text documents, Web pages, graphic presentations, research papers, assessment instruments, original projects, videos, certificates of achievement, spreadsheets, databases, digital images, and more. In the realm of education, portfolios take on the nature of learning and assessment, job searches, interview showcase, and lifelong career growth portfolios. This article suggests some of the most common (and critical) artifacts for each type of portfolio, and offers some practical production tips for creating personalized artifacts.

An ***Executive Information System*** is a computer-based system that serves the information needs of top-level managers, including those of information technologists. Such systems differ from traditional management information systems in ease of use and their responsiveness to executives needs. Some of the characteristics identified in this article include personalization features, tracking options, analysis tools (e.g., status access, trend analysis, exception reporting, and drill-down capability), integration of internal and external data, user-friendliness of the interface tools, and the intuitive graphical, tabular, and/or textual presentation information. An ***Expert System***, also known as a knowledge-based system, is a computer-based application that captures human knowledge to solve problems that ordinarily require human experts. These systems are also considered as a branch of artificial intelligence that aims at making computers capable of emulating human reasoning behavior. The goal of expert systems is to ensure that scarce expertise can be utilized when a human expert is not available. This citation shares the generic architecture of an expert system.

Evaluating Online Resources is a highly thoughtful, no-nonsense guide to evaluating online Web resources. Characteristics for assessing the value of online materials include accuracy, reliability, validity, and authoritativeness of the information; relevance and appropriateness of the vocabulary and concepts presented and clarity of objectives, methods, procedures, and assessments used to attain the information; completeness of the coverage, currency of the information, and logical development of the content; motivation of the creator that establishes a confidence in the results produced; and, organization that exhibits a logical approach taken by the source.

Facilitating Technology Integration results from the diffusion, implementation, and infusion of technology within an organization. The process of technology diffusion consists of three stages. Adoption refers to the decision to use a specific technology for some intended outcome or purpose, in our case technology education. Implementation concerns itself with specific actions taken by educational institutions to meet human and environmental factors that lead to the diffusion of the technology. Integration refers to the specific practices as well as the quantity and quality of use that occurs once a technology has been implemented. Several specific models are introduced in this citation.

Group Decision Support Systems represent interactive information technology-based environments that support concerted and coordinated group efforts toward completion of joint tasks. These systems have become popular tools in aiding *decision* making in many organizational settings by combining the computer, communication, and *decision* technologies to improve the *decision*-making process. Options for employing such technologies manifest themselves as either special-purpose decision rooms, multiuse facilities, or Web-based groupware. This article explores how these state-of-the-art technologies can improve the quality of group-based experiences by minimizing the negative effects of group decision making, and maximizing the benefits of group collaboration. ***Model-Based Decision Making*** defines this special decision

making too, in the context of cardiac surgery. In medical terms, "risk stratification" means the estimation of the risk of a disease progressing or leading to complications or death. In order to do this, risk factors are recorded that are known to be associated with the progression of a disease or with the occurrence of complications. Based on the individual risk profile, tables, algorithms, or computer programs are used to determine the individual risk of the patient. While on the surface this citation might appear out of place in an encyclopedia focusing on information technology education, this article shares the fundamentals of model-based decision making sufficiently for any application.

Online Academic Advising describes the tools, trends, and challenges of making academic (or training) decisions using technology-based tools for improving academic advising practices. A host of electronic tools are presented in this citation including e-mail, online chat rooms, instructional management systems, instant messaging, listservs, blogs, podcasting, and a new technology for consideration.

Organizational Data Warehousing is a product of business need and technological advances, but has many applications in the field of information technology curriculum. As more and more administrators seek the tools to make data-driven decisions, five major elements of data warehousing are brought into play: data acquisition, data modeling and schema, metadata, data management, and data analysis. Data acquisition involves identifying, capturing, and transforming data in operational systems. Data acquisition builds and manages a data warehouse designed to extract, transform, transport, and make data available to users. Data modeling analyzes data objects to determine relationships among these data objects. Data management includes the access and storage mechanisms that support the data warehouse, and data analysis software includes a host of data-mining tools.

Software Evaluation is an important component in the process of choosing technology for learning and instruction. The author of this citation suggests the 15-minute rule, as well as some quick and easy guidelines to use for selecting software from the perspective of both learner and teacher. A simple checklist is offered for consideration.

System-Dynamics-Based Learning Environments refers to the computer-simulation-based decision support systems that target improved decision-making capabilities. The article discusses user interfaces and the role of human facilitators, and goes on to establish that the strength of these environments lie in the underlying system dynamics simulation models explored in considerable detail. Further, the article expands on investigations into the overall effectiveness of interactive learning environments, and how they will advance knowledge into the design conditions of an effective decision support system for task systems in the public sector.

Summary

Learners should grasp the ability to employ decision-making tools throughout their years of preparation and formal education. In addition to using spreadsheets for more traditional purposes, they also need experience in the many tools categorized in this section of the ***Encyclopedia of Information Technology Curriculum Integration.***

INFUSION

Infusion Defined

Technology for Infusion recognizes technology as a powerful strategy for uncovering and exploring academic content, in other words, technology for learning. This level is concerned with the "identification, harvesting, and applications of existing technology to unique learning situations (Tomei, 2005)." For purposes of the ***Encyclopedia of Information Technology Curriculum Integration***, citations at this level are further classified as either Theories and Research or Learning Applications.

Contributions of the encyclopedia. Infusion takes on an even more important role in the teaching-learning process as technology is incorporated into the curriculum. Infused technologies, offered by a knowledgeable instructor, maximize student learning options, address the diverse needs of individual students (gifted as well as special needs learners), develop higher order thinking skills, and contribute to stronger academic content throughout the curriculum. To support this level, the citations grouped under infusion are further subdivided as **Theories and Research** (which form theoretical foundations), followed by articles that share practical **Learning Applications** of successful infusions of technology.

THEORIES AND RESEARCH

For infusion to be effective, educators must determine when technology tools are most useful, and how they best address the multiplicity of tasks and problems to be encountered by the learner over a lifetime. The infusion articles found in this section of the encyclopedia offer research and best practice for consideration. The first article, ***Applying Critical Thinking Skills on the World Wide Web*****,** describes the process of critical thinking from the perspective of learning as a productive and positive activity. Information technology education comes into play with an examination of two activities related to the Internet that are particularly promising for the development of critical thinking skills: the assessment of text-based resources and the development of Web-based scenarios. The primary objective of a ***Computer-Based Assessment*** is to save instructor time by using technology to assist in the more mundane aspects of student feedback (e.g., scoring and tallying). The citation introduces formative assessment, an evaluation designed to help students gain an understanding of content knowledge and the development of good learning habits. It goes on to examine ways in which assessments might be implemented using software in light of the needs and concerns of the learner as well as the institution. Finally, the article presents an assessment model used to evaluate and track increases in learner knowledge and skills. ***Differentiated Instruction and Technology*** is based on the premise that successful instructional approaches vary and adapt to individual and diverse needs of students in classroom. When teachers engage in differentiated instruction, they address a multitude of student interests, ability levels, and learning profiles. Many of the concepts utilized in differentiated instruction are used in special education to meet the needs of those students that are on the ends of the ability spectrum. Differentiated instruction extends the concept of individualizing to meet the needs of all students in the class, whether they are below average, average, or above average ability, through the implementation of learning profiles, learning contracts, interests, and, of course, technology. Technology-driven differentiated instruction is affected by many issues; the citation discusses privacy, collaboration and communication skills, organization, learning styles, and authentic learning.

Generative Learning Model to Teach Adult Learners addresses the needs of adult learners to actively participate in the learning process by generating meaningful relationships and transferring learning to new situations. This model also addresses the many needs of adult learners regarding new technologies, and how such technologies make for a more active learning process, aid adults in assuming a greater degree of control and responsibility for their own learning, link prior experiences to new learning, facilitate the transfer of learning activities to personal situations, and promote higher order thinking skills..

Immersive Learning Theory encompasses four essential learning elements: immersive, engagement, agency, and risk. The aim of this relatively new theory is to employ a learner-centered approach that includes direct and implement interactive activities. It typifies the central tenet of the cognitive-constructivist approach, where learners come to know and understand the world not by transmitting knowledge, but by interacting with it. This article explores how immersive learning is implemented with great success in higher education, and some of the more practical lessons with respect to active and interactive learning. ***Learning Styles in Online Environments*** reinforces the debate concerning the extent to which teaching methods are matched with student learning styles. This citation presents the results of researchers who found a strong relationship between learning styles and attitudes towards technology-assisted instruction, as well as other investigations suggesting just the opposite, that is, no such relationships exist. The article identifies key issues to be considered in relation to navigation, assessment, collaboration, and the use of online systems.

Mechanics Dynamics examines the use of personal computers in the educational sector; specifically, how they have changed the learning environment of higher learning institutions, and how they have addressed various learning styles. The article introduces several concepts directly related to teaching and learning in the classroom, at all levels of education and training. The concept of discovery learning is posited as an inquiry-based learning and multimedia tool for learner experimentation. Case study as a problem-solving environment is presented along with coach-based virtual discovery learning environments and solving engineering problem using a multimedia approach.

Multiple Intelligences explains Gardner's multifaceted theory of intelligences of linguistic, musical, logical-mathematical, spatial, bodily-kinesthetic, intrapersonal, interpersonal, and naturalist. The main thrust of the citation, however, is the technology-based examples that frame real-life problem-solving situations involving multiple intelligences. A few of the technologies reviewed include WebQuest, multimedia, online collaboration, discussion board, blog, chat room, and netiquette. ***Pedagogical Characteristics Affecting Student Learning*** discusses the many student attributes affecting learning, such as basic knowledge background, academic performance, exposure to modern educational technologies, and personal learning styles. In addition, the citation provides an abbreviated history of learning styles, with particular attention to Kolb's Learning Style Inventory (LSI), Honey & Mumford's Learning Styles Questionnaire, and the Felder-Silverman Learning Style Model. The paper goes on to discuss pedagogical characteristics affecting student learning, the extensive use of learning style measurement instruments, and their importance in the evaluation of computer-based learning and instruction.

Promoting Cooperative Learning relates to human interaction from the perspective of traditional classroom instruction as well as Internet-connected technologies. The effectiveness of online collaborative learning has been confirmed by various studies, many of which are offered in this citation. For example, online activities, intragroup cooperation, intergroup cooperation, interclass cooperation, and global cooperation technologies were studied. The number of hits and messages posted, evidence of shared dialogue and inquiry, and student feedback were examined ,as students were asked to participate in a focus group meeting regarding their opinions on cooperative learning.

Technology-Assisted Problem Solving brings into focus the combined benefits of problem-based learning and technology-assisted problem solving. Problem-based learning begins with an often ill-defined problem definition for student consideration typically framed in the format of a scenario or case study. This citation orients the reader to the process of problem-based learning as a series of steps that begin by organizing previous knowledge on the subject, posing additional questions, and identifying areas in need of additional information. The article moves quickly to a definition of technology-assisted problem-solving packages, describing them as specialized computer programs developed to work as stand-alone or Web-based servers to augment student learning. These technology-rich packages include the use of the computer to deliver instruction such as tutorials, questioning, feedback, analysis, and testing. The article concludes with a discussion of learning scenarios, knowledge representation, and the difference between domain knowledge and pedagogical knowledge.

Towards a Dimensional Model of the Stages of Online Learning offers a look at how technology has matured to become increasingly pervasive in shaping the context of learning. The citation encourages the reader to consider pedagogic strategies that effectively integrate the use of technology into learning, and introduces a model for online learning that includes five distinct stages: access and motivation, online socialization, information exchange, knowledge construction, and development. Each stage is defined and references presented before sharing the results of an investigation into the use of a commercial blogging tool to encourage students to develop reflective skills throughout the delivery of an undergraduate module. The case study presented provides an example of how students progress through the five stages of online learning. ***Transformative Learning*** introduces three types of reflection and seven levels of transformative learning. The types include content reflection as the examination of the content or description of a problem; process reflection that examines problem-solving strategies; and premise reflection that probes the process of questioning the problem. The seven levels of reflectivity include (general) reflectivity (an awareness of a specific perception, meaning, behavior, or habit); affective reflectivity (awareness of how the individual feels about what is being perceived, thought, or acted upon); discriminant reflectivity (the assessment of the efficacy of perception, thought, action, or habit); judgmental reflectivity (making and becoming aware of value judgments about perception, thought, action, or habit); conceptual reflectivity (self-reflection that might lead to questioning of whether good, bad, or adequate concepts were employed for understanding or judgment); psychic reflectivity (recognition of the habit of making percipient judgments on the basis of limited information); and, theoretical reflectivity (psychological assumptions that explain personal experience from the perspective of seeing, thinking, or acting).

Vygotsky and the Zone of Proximal Development describes the span between what a learner can do independently and what he or she is capable of accomplishing with more expert assistance. Technology enters the picture when instructional design, student attitude and achievement, learner motivation, and choice are added to the mix. Effective development is most likely to occur within the zone when the instructor organizes the teaching experience to take full advantage of such interactions. This article discusses how learning situations should be structured as didactic drill and practice sessions or as media-enhanced independent research activities. Technology enhancements should be intentionally integrated into guided learning opportunities that offer technology-assisted situations in which students are supported in the construction of relevant understanding within an authentic context.

LEARNING APPLICATIONS

Infusion involves recommending materials such as DVD, video, laser, CDROM, and so forth, to the receptive learner. It would be best if teachers would model classroom infusion, demonstrating personal use of technology to research and evaluate information along with its relevance, suitability, comprehensiveness, and bias with respect to real-world problems. Towards that end, ***Active Learning and Its Implementation for Teaching*** offers a model of learning that suggests all learning activities involve some kind of experience or dialogue. Many elements of active learning are derived from principles of the constructivist approach that, this citation purports, is concerned with learning and knowledge suggesting that human beings are active learners who construct their knowledge from personal experiences in an attempt to give meaning to these experiences. Some techniques for implementing active learning are suggested in the article; some geared toward implementation in face-to-face courses, others can be implemented in computer-mediated courses. ***Blended Learning*** involves more than one delivery system for instruction. In most cases, educators discuss face-to-face learning and online learning in

some combination when they use the term "blended learning" in a technological context. The citation offers several forms of blended learning, including face-to-face, synchronous online and/or videoconference, asynchronous online, prerecorded video, DVD, television, and podcasting. Its benefits are shared as well, specifically, flexible scheduling, decreased classroom space demands, academic adjustment strategy, multiple instructional methods, multiple learning styles, and increased literacy skills.

Communities of Practice share common context, goals, and expectations while actively working to help one another learn. They involve situations in which teachers structure realistic problems or tasks, and encourage their learners to activate previous knowledge while applying this common knowledge towards a process-based solution. Infusing technology into a community of practice often extends the traditional educational settings into broader family dynamics, corporations, and other social contexts. This article discusses certain traits shared by successful communities of practice, traits such as how the role of teacher is shared between learners and instructors; the importance of activities that reflect the process of learning; increased collaboration between members of the community essential for the creation of new understandings; facilitative environment that encourages reflective practices and collegial debates and critiques via discussions, cooperative learning activities, peer tutoring, reciprocal teaching, and cognitive apprenticeships; and, the use of authentic tasks to prompt learners to use what they already know and determine what they need to find out. ***Experience-Based Learning*** has been touted as an approach that allows the learner to experience the complexities of real-world problems and gain practical experience in a simulated environment. Such learning takes many forms. While it can vary considerably in the type of problems it entertains, involvement of the instructors, use of supporting materials, impact of student learning outcomes, and nature of assessments, the one element that seems to remain constant is the idea that problem-centered learning is fundamentally an approach that presents the problem first. The citation shares the results of an independent study to identify differences in two approaches and compare the learning outcomes, assessments, and experiences of the learners.

Fundamentals of Learning Theories offers a short introduction into the different interpretations of learning theories and different beliefs about how people learn. As described in the citation, the goal of any learning theory is basically the same; that is, to explain the conditions under which a learner's growth and development occurs. The article offers an inventory of the most well-known theories and theorists, including Thorndike's Connectionism, Pavlov's Classical Conditioning, Guthrie's Contiguous Conditioning, Skinner's Operant Conditioning, Hull's Systematic Behavior Theory, Tolman's Purposive Behaviorism, Gestalt Theory, and Freud's Psychodynamics. In addition, the article goes on to explain how learning theory leads to effective learning through personal involvement and self-initiation, and more.

Gagne's Nine Events of Instruction identifies the cognitive processes that occur in learning derived by the theorist from his observations on information processing and cognitive mapping. The acquisition of intellectual skills is based on five taxonomies of learning: verbal information, intellectual skills, cognitive strategies, attitudes, and motor skills, and classifies cognitive processes into nine instructional events including gaining attention (reception), informing learners of the objective (expectancy), stimulating recall of prior learning (information retrieval), presenting the stimulus (perception), providing learning guidance (encoding), eliciting performance (responding), providing feedback (reinforcement), assessing performance (assessment retrieval), and enhancing retention and transfer (generalization). In turn, these "nine events" serve as the basis for designing instruction and selecting appropriate media. This citation goes on to explain how each of the events functions in the process of learning.

Individual Differences in Web-Based Learning presents a comprehensive review of the influences brought to bear by specific factors (specifically, gender, prior knowledge, and cognitive styles) on Web-based learning. The article recognizes gender as an important variable that influences computing skills, and presents the results of an investigation into student navigation styles with a particular emphasis on gender bias. Other findings presented herein show that experts and novices differ in their performance depending on content structure and the importance of a learners' prior knowledge when designing effective content structure. Experts were noted to profit most from a learning system that provides flexible paths, whereas novices seem to benefit more from a learning system that is more structured. Field dependency (as a key cognitive style) specifically affects learners. Field independent learners are more individualistic with less reliance on external help when processing information. They represent the majority of abstract learners, and are not easily influenced by others or overly affected by the approval or disapproval of superiors. Field dependent learners, however, have greater social orientation, tend to seek out external guides for processing and structuring their information, are more readily influenced by the opinions of others, and are affected by the approval or disapproval of authority figures.

The field of ***Innovations in Learning Technology*** has a long history of new products and ideas continually developed and introduced into the workplace. Innovations come in a variety of forms, and many of the most well-known educational innovations have been technology-based (e.g., personal computers, smart boards, digital projectors, virtual reality simulations, etc.). This article describes certain characteristics by which innovations are described, including dimensions of change, form, scale, sequence, and intentionality. The field of innovation in learning technologies, according to this citation, faces

two major challenges in the future. The first is to find the proper balance between innovation and stability. The second is to ensure that the human element of learning does not take a back seat to the technological element.

Integrating ERP into the Curriculum offers a variety of benefits and challenges when considering a business school curriculum. One of the most important benefits is the ability of ERP systems to help students understand underlying business processes that serve as a focal point for integration of knowledge across functional areas. Other important benefits for students include exposure to real-world business processes; enriched curriculum in which students obtain a broader perspective of the organization; exposure to technology with which they will work in their careers; stronger knowledge of company operations and substantially less training; ability to contribute to assigned projects; ability to translate requirements for meaningful applications; a higher level of confidence; and, less whining when the going gets tough. The final aspect of the article provides a proactive four-phase approach to ERP implementation in business curriculum.

An ***Internet Field Trip***, also known as a virtual field trip, is a journey taken via Web sites without making a trip to the actual location. The citation suggests a number of identifying features that should be considered when designing an effective Internet field trips, such as clearly stated focus or learning objectives, infusing the virtual trip into classroom curriculum, a pretrip orientation with hands-on activities, a facilitator to guide students through the field-trip site, a postfield activity with follow-up activities and sharing, and valid assessment methodology. The review of the literature presented offers the TIED Model (target, implementation, evaluation, and development) for classroom teachers to design and develop, successfully, these unique technology-based experiences.

Learning With Laptops documents the process of generating content for a highly successful project entitled, One Laptop Per Child. The article describes the process of generating best-practice content especially designed to engage the minds of underprivileged children around the world. The project sought to provide a laptop with flash memory for each child at a relatively low cost, and a process for updating curriculum content at a relatively low cost. The article presents the Simple English Wikipedia, originally intended for use by English-speaking learners and teachers and, now, available in several other languages such as Spanish and Portuguese. Researchers found it possible to download, update, and reload material at participating schools linked to the Internet. The citation leaves issues of curriculum integration for future investigation, but does identify guides containing lessons to help children (and teachers) learn how to navigate and search.

Maslow in the Digital Age offers a new perspective for personal growth and its challenges in a digital world. The difficulty of balancing individual needs with the needs of others and society create conflicts based on the concepts of privacy, ownership, and personal need; conflicts exacerbated in recent years with the intrusion of so many technological innovations. As the virtual world expands, the impact of these experiences will likely more directly affect real-world relationships. This article begins with a primer on the Hierarchy of Human Needs, Maslow's humanistic theory that forms the third leg of psychology and an alternative view of learning to the behavioristic bent of Pavlov and Skinner as well as the cognitive perspective of Piaget and Rogers. Maslow's theory of human motivation, published in July 1943, described human motivation in terms of physiological needs, safety needs, love and belonging needs, esteem needs, and self-actualization needs. This citation brings to bear Maslow's hierarchy of needs with the impact of technology, for example, safety needs and anonymity, as well as belonging, love, and virtual communities. ***Piaget's Developmental Stages*** has left a lasting impression on the theoretical as well as practical aspects of how child development is viewed. This citation guides the readers though an understanding of the four stages that include Sensorimotor stage (birth to 2 years of age), Preoperational stage (2 to 7 years of age), Concrete operational stage (7 to 11 years of age), and the Formal operations stage (11 years of age and beyond). Then, the article discusses technology as a venue for increasing the opportunities for learning at each cognitive stage. ***Situated Learning*** examines how humans have historically looked to situations in which they interact with one another to inform ideas about culture, morals, and ambition. Combining constructivist and social leaning theories, situated learning maintains that learning and cognition rely upon social interaction and authentic activity to enhance the learning environment. Situated learning generally occurs unintentionally (rather than deliberately), and is dependent upon an authentic context, culture, and real-world activities. Schools have increasingly come to rely on technology to enhance, supplement, and, stimulate curricula. This article cites many issues of instructional design and delivery related to situated learning, and how technology-based activities provide increasing opportunities for the construction of new understandings in the classroom.

Hundreds of software applications exist for use in the mathematics classroom. Many of these packages were developed with academic standards in mind, but several other applications exist that are useful in both academic and non-academic settings. ***Technology and the Standards-Based Mathematics Classroom*** explores the considerable research conducted to date that examines the effectiveness of technology as an instructional tool and various applications that address the different learning styles. In this citation, the contributor offers studies on the effects of simulation and high-order thinking technologies, use of multimedia software to decrease student anxiety, technology that supports the often-spoken challenge for students who simply do not perceive math as being relevant to everyday life, computer software that aids learners in solving multistep math problems, and mathematics software that helps learners retain their math skills longer than traditionally taught students.

Technology Assignments Using Team-Based Learning outlines key principles and practices that demonstrate how team-based learning is applied in developing technology-oriented team assignments and why this learning application consistently produces a variety of learning outcomes rarely achieved with other approaches of small-group assignments and activities. Practical examples are employed throughout the citation, especially in the areas of management of information systems and business curricula. The article goes on to explain the four essential principles for team-based learning, which include group formation and management, students accountability (individual and group work), student feedback, and attention to team assignments that promote both learning and team development. Finally, the article posits effective implementation of team-based learning as meeting certain conditions, to wit, significant problem, same problem, specific choice, and, simultaneous report.

Summary. Information technology at this level of the taxonomy offers numerous strategies that encourage learning by infusing technology into the curriculum. The successful infusion of technology includes the myriad of resources described in this section of the *Encyclopedia of Information Technology Curriculum Integration,* and will guide the reader towards an understanding of how instruction is effectively delivered using the theories and application presented herein.

INTEGRATION

Integration Defined

Technology for Integration represents "the creation of new technology-based materials, combining otherwise disparate technologies to teach (Tomei, 2005)." Appropriate technologies are identified and harvested (similar to the previous level). However, at this level, the objective of integration is to develop new, previously non-existent, innovative instructional materials to enhance the teaching experience. In the (non-technical) past, curriculum began with content materials gathered from chapters of a textbook, clips of a movie or audiotape from the library, or maps from a contemporary atlas. At this level of the taxonomy, information technology-based components create new materials. Many of those resources are described in this section of the ***Encyclopedia of Information Technology Curriculum Integration*** based on theories and research; lesson design, development, and implementation; and assessment and evaluation.

Contributions of the Encyclopedia. The host of advanced technologies makes them powerful tools for teaching in the 21st century, and the theories that are adopted to integrate that technology cannot be underestimated. As described earlier, the Taxonomy for the Technology Domain employs, as one of its premises, the concept of hierarchal order; in other words, learners and teachers must move up the taxonomy from literacy to collaboration, decision making, and infusion, before tackling integration and the development of original content materials. Digital cameras, scanners, CD-ROM burners, digital audio and video media players, and personal computers, equipped with state-of-the-art word processing, graphics presentation, and Web-editing applications have made student- and teacher-generated infusion of instructional materials not only possible, but promising technologies for teaching.

THEORIES AND RESEARCH

Malcolm Knowles defined andragogy as the art and science of helping adults learn, based on the premise that adults learn differently than children (pedagogy). ***Andragogy and Technology*** posits that adult learning (especially with technology) is best viewed from the combined perspectives of culture and technology. As such, this citation begins with a look at andragogy and how various cultural aspects impact group dynamics for individual learners. Online education, the article suggests, has the potential to revolutionize traditional models of learning, teaching, and sharing information. While cultural differences will continue to exist between countries, the reader gains an appreciation for how adult learners, in particular, can use technology to understand real-world situations and create new value for societies. With more and more educational institutions worldwide offering distance learning as an option, the demand for an understanding of andragogy and technology makes this an important article for the *Encyclopedia*.

Behavior Analysis and ICT Education presents an overview of the instructional technology associated with programmed instruction and interteaching in general and, specifically, its applications for teaching the Java programming language. The citation begins with a look at the history and success of programmed instruction as a technique that provides structured textual information in small units for study and mastery. Interteaching is derived from the application of a personalized system of instruction developed by a behavioral psychologist. The key aspect of this system is its emphasis on the student

as a responsible "knowledge expert." This article reviews technology-enhanced behavior analysis by examining a program of study at the university level that has adopted programmed instruction and interteaching components of a Java programming language course. The practical examples provided will enhance the reader's understanding of this important theory of integrated technology.

Constructivists take a different perspective on teaching. They believe that knowledge emerges as a direct result of how learners construct meaning from information they receive and from their participation in the learning activities. They gain knowledge from their interaction with the learning environment and from interacting among themselves. Technology enhances those opportunities and is the focus of the article, ***Constructivist Learning Framework and Technological Application.*** Constructivist learning principles have emerged as ideal foundation knowledge for implementing technology-based instruction. Some of the tactics discussed in this citation include electronic instructional plans as text-based resources that incorporate sound, video, movie, static images, motion clips, and animation; technology-rich learning environments that offer robust environments where students are physically and mentally immersed in the learning process; and, multimedia-enhanced instruction (DVDs, video CDs, flyers, motion pictures, still pictures, movies, animation, and posters) that support and reinforce visual learning. Collaborative learning activities (discussion boards, chat rooms, e-mail, etc.) are highlighted where technology can help students share ideas inside and outside the classroom.

Distance Education and Learning Style introduces the reader to a host of researchers who have provided practical insights into learning styles. The reader of this article can review Dunn's learning styles, which focus on environmental, emotional, sociological, physiological, and psychological strands that affect individual learning. Gregorc's "style delineator approach" is based on studies into the functions of the left- and right-brain hemispheres. As the citation explores the roles of faculty in support of the three most common learning styles of visual, auditory and tactile as another view of learning, the author moves to an investigation into the effects of technology with Grow's study of faculty roles in accommodating learning styles four stages ranging from dependent to self-directed learning. Wang's Model of Learning Styles and Teaching Methods examines other factors that determine instructors' roles and teaching methods. The article finishes with the mission of distance education to help students develop a positive attitude toward lifelong learning, acquire skills to be self-directed, and achieve self-actualization by taking responsibility for their own lives.

E-government is the application of the information technology tools and techniques to the work of government. These tools and techniques are intended to serve both the government and its citizens and include such technologies as wide-area networks, the Internet, and mobile computing. E-government is a form of e-business that includes the processes and structures related to delivering electronic services to the public (citizens and businesses), collaborating with business partners, and conducting electronic transactions within organizational entity. In this article, ***Integrating E-Government into the Business Curriculum*****,** several options are presented for consideration by business schools pursuing programs to incorporate e-government concepts and topics into their business curriculum. The first option discussed is to have a dedicated track/emphasis on e-government. The second option would be to integrate e-government concepts and topics into several existing foundation courses.The third option available to business schools is to develop a specialized course(s) in e-government that students can take as electives, incorporating both theory and best practices. This citation is a good starting point for business schools interested in incorporating e-government as a part of their curriculum.

The digitization of primary source items and their availability via the Internet has resulted in the exponential growth of information over the last decade. As the result of this process, access to these primary sources is no longer limited to people physically present at the libraries. The ease of accessibility through the Internet creates an opportunity for educators to integrate these digital primary sources into the curriculum. The article, ***Integration of Digital Primary Sources*****,** discusses research on primary sources, defines primary source-based instruction (PSBI), connects practices used in PSBI to higher-order thinking skills, and offers examples of PSBI practices. The citation describes these practices and provides examples of each while linking the entire discussion to Bloom's Taxonomy of Educational Objectives. Specifically, illustrations consider the use of primary sources as examples to document an event or some fact for students; association deepens student understanding by developing content ideas and concepts related to a specific event or topic; utilization demonstrates student to develop greater contextual understanding of an event or topic; examination explores inquiry and analysis; incorporation integrates content knowledge gains into a new understanding and explanation of a topic or event; and, interpretation establishes a deeper level of understanding that extends beyond the initial content and context of a given event or topic.

The ***Learning Activities Model*** is a theoretical framework for an analytical tool that assists designers of learning events based on categories of activities that serve as subdivisions of the learning process and matched to techniques, technologies, and methods as part of the design process. The first category of the model consists of activities concerned with the provision of materials, including the voice of the presenter or facilitator, visual aids, printed materials, and other media. Interactions play a key role in the model and expand the provision of materials by addressing interaction with materials, with the facilitator, and between learners. The citation goes on to suggest that, while the first four categories of the Learning Activities

Model describe the learning process as consisting of provided materials, interactions with materials, interactions with the facilitator, and interactions between learners, this is not a complete description of all learning activities. The final category of activities that can be planned and undertaken in order to facilitate learning include activities such as informal reflection; reflective practice; critical thinking; refining ideas, opinions and attitudes; and, comparing new to existing knowledge and experiences. Finally, the five categories described are brought together to form the Learning Activities Model as a theoretical framework of learning activities that has theoretical and practical applications, several of which are shared in this article.

Learning Object-Based Instruction shares the recent history of this digital resource starting from its earliest beginnings in the 1990s when the field of instructional technology began its struggle to develop models that fully take advantage of the vast potential that new technologies afford. Since then, and thanks in large measure to the boom of multimedia-capable hardware in the mid-1990s, a vast repository of digital materials has been accumulated consisting of instructional videos; interactive multimedia exercises; links to Web sites, reading exercises, recorded interviews with experts, interactive graphs, charts, diagrams, photographs, and maps; and a host of other forms of digital instruction. These materials were intuitively organized according to academic standards, instructional objectives, and specific topics addressed and -- learning object-based instruction was born. This article acknowledges the strong support from instructional designers and technologists who currently embrace the possibilities associated with learning objects. It also identifies the obstacles that have been placed in the way of a more general implementation of learning objects in curriculum design. He states that a learning object is any digital resource that can be reused to support learning.

Mental Models are important constructs used by educators to fashion processes such as learning, critical thinking, and problem solving. They are often best understood within a context of a relevant task. Mental models change shape with their application to specific situations. For example, mental models are discussed in relation to organizational management. In cognitive psychology, they are tools for the internal symbolic representation of the mind and how an individual interacts with and adapts to the external world. This article purports the need for clearer understanding and appreciation of a mental model in the design and development of concepts, learning objects, and (in our case) technology-rich learning applications. Application of mental models leads to the development of learner concepts and schemas, while supporting development of their mental modeling capacity.

System Theory is a recognized paradigm for dealing with abstract models of real processes in such a way as to accurately capture salient underlying dynamics while keeping mathematical tools manageable. In this citation, four general-purpose approaches to system theory are presented. First, a methodology for solving critical problems by selecting the most salient variables is offered. Next, the rule induction method is described, with a bent toward extracting underlying rules and implying conjunctions and/or disjunctions between identified salient variables. Thus, a first idea of their even non-linear relations is provided as a first step to design a representative model, whose variables will be the selected ones. A third approach is the Adaptive Bayesian Networks used commercially in database tools. Finally, a simple linear approximating model is introduced for the reader's consideration.

LESSON DESIGN, DEVELOPMENT, AND IMPLEMENTATION

Activity Theory for Studying Technology Integration in Education serves as a starting point for both technologists and educators, aiding in the understanding of the complexity of technology integration and how activity theory can help. The citation offers five ways in which new technologies can be used to bring exciting curricula based on real-world problems into the classroom; provide scaffolds and tools to enhance learning; give students and teachers more opportunities for feedback, reflection, and revision; build local and global communities; and, expand opportunities for learning. Technology offers opportunities for learner control, increased motivation, connections to the real world, and data-driven assessments tied to content standards that, when implemented systematically, enhance student achievement as measured in a variety of ways, including, but not limited to standardized achievement tests. There are many benefits of using activity theory for studying the effectiveness of technology integration in classrooms. First, activity theory provides a framework to study the impact of technology integration. Second, it offers a holistic method for explaining technology integration. Third, it helps conceptualize the characteristics of technology integration activities in terms of interactions as well as social, cultural, and historical characteristics of the target population.

Classical conditioning, Connectionism, the Laws of Effect and Exercise, positive and negative reinforcement, computer-assisted learning, and other psychologies of teaching form the thesis for ***Behavioral Theories that Guide Online Course Design.*** The first of three interrelated articles explore the three most widely accepted schools of educational psychologies (the others being cognitivism and humanism) included in this ***Encyclopedia of Information Technology Curriculum Integration*** as they impact teaching with technology. The citation moves quickly into the crux of the article with examples of behaviorist theories used when designing online courses, specifically, Social-Cultural Model of Learning, Mastery Learning, Simulations, Direct Instruction, Theory of Elaboration, and Traditional Instructional Design Theory.

As luck would have it, ***Cognitive Theories that Guide Online Course Design*** follows directly on the heels of its predecessor, behaviorism, both historically and alphabetically. Here, the citation on cognitive theories and theorists encourages the reader to consider how teaching with technology helps the learner process information in ways that are meaningful to the individual on their way to becoming independent learners. Jean Piaget, Lev Vygotsky, Erik Erikson, and David Ausubel are mentioned by name, as well as key theories from the school of cognitivism that include the Theory of Multiple Representations, Cognitive Flexibility Theory, Bruner's Three-Form Theory, Dual-Coding Theory, Gagne's Conditions of Learning, Merrill's Instructional Transaction Theory, and Moore's Theory of Transactional Distance.

Logic courses are an intrinsic part of many university programs of study. ***Computer Technologies in Logic Education*** discusses the use of computer software for logic courses and traces its history before launching into an expose of the variety of software programs that have been developed to assist teachers and learners in introductory and advanced logic courses. Modern educational logic software helps learners in such areas as natural deduction, syllogistic logic, visual argument representation, and various techniques in modal logic. Logic software is explained in general and, in particular, in terms of logic and relational databases, logic in data-mining applications, and a futuristic look at logic and artificial intelligence.

Educators involved in the application of distance-learning technologies need to develop a sound understanding of learning theories and instructional strategies. Since teaching strategies are as diverse as learning styles, ***Distance Learning Essentials*** provides the necessary refresher citation into learning theories, learner characteristics, and instructional strategies that will guarantee technologies are brought into play to prevail over the challenges caused by the reality that no two people learn in exactly the same manner and no two teachers, online or traditional, deliver instruction alike. It is imperative that distance-learning educators become familiar with learning theories and widely accepted instructional approaches in order to ensure that learning occurs reliably at a distance.

Educational Geotrekking is an instructional design model supporting the creation of engaging learning opportunities and promoting the integrated development of geographical, mathematical, cultural, scientific, and other literacies, including geographical literacy (understanding the earth and its natural and cultural features), mathematical literacy (the ability to deal with the quantitative aspects of life), cultural literacy (the ability to function in the dominant culture), technological literacy (the ability to apply technology in everyday life), and scientific literacy (the ability to problem solve and communicate with respect to the world around us). In addition, this article discusses the relatively new concepts of portable geotreks, fixed-location geotreks, virtual geotreks, and transforming geotreks. Finally, the reader is introduced to **Geotrekking.net,** a Web site that has been established as a resource for educators interested in developing or sharing educational geotreks.

Rounding out the trilogy of schools of educational psychology, ***Humanistic Theories that Guide Online Course Design*** establishes the theories and theorists from the school of humanism that focus on the learner's affective needs (i.e., feelings, emotions, values, and attitudes). Applied to teaching with technology, Abraham Maslow, Carl Rogers, and Lawrence Kohlberg represent the most well-known humanists, while the phenomenal field theory, self-actualization theory, theory on nondirective teaching, theory of moral development, theory of immediacy and social presence, and cooperative learning theory account for the greatest research and literature focus areas for this school.

Cognitive learning theories dominate contemporary ***Instructional Design*** practices. With the growing number of older adults per total population, this article focuses on the growing discussions regarding the cognitive learning needs of older adults. As an increasing number of older adults remain in the workforce longer and participate more and more as lifelong learners, instructional designers must become more aware of the learning needs of older adults. Older adults will continue to demand a different brand of training and education, and new technologies will serve as both the focus of these training curricula and tools for lifelong learning in all content areas. This citation considers the steps in analyzing adult learners, their cognitive learning strategies, and their common and unique blend of learning needs. The article goes on to identify common barriers to cognitive learning in older adults including not physical problems, cognitive matters, self-esteem and self-actualization issues, and social factors. The article posits that adults can overcome these and other barriers to cognitive learning with properly designed training programs, flexible training schedules, and employer education and recognition of their learning needs. Through standardization and the integration of technology into the nursing education process, nursing informatics is taking its rightful place within the nursing sciences. Against this background, ***Integrated Curricula in Nursing Education*** questions the process of transferring necessary knowledge between the theoretical side of nursing sciences and applied nursing, the training of practicing nurses, and the area of nursing informatics. The citation asks two vital research questions: How is knowledge produced and transformed within the profession? and, From where do researchers and practitioners obtain their inspiration for their research activities, and to whom do they disseminate their knowledge? The article continues with an in-depth discussion of the role of nursing informatics, the process of knowledge transfer via ICT, the necessary integration of ICT into education, and the development of nursing informatics professions.

Interactive Multimedia addresses the use of interactive multimedia in the field of engineering, and explains key features, potential benefits, and recognized shortcomings of these integrating teaching tools from an educational perspective.

The article presents a recap of works that explore the issues surrounding the role and benefit of interactive multimedia courseware. The results are important new knowledge for educators and instructional and multimedia designers in the use of multimedia technology to enhance engineering education. Key attributes of multimedia (multiple media, delivery control, and interactivity) are discussed and the four levels of multimedia interactivity (reactive, coactive, proactive, and transactive) are presented. Finally, text, audio, video, graphics, and animation are considered as the multimedia of choice for engineering applications. Closely aligned to interactive multimedia is the realization that the Microsoft Office suite has built an impressive following as the application of choice in many classrooms, K-12, higher education, and corporate training. The ***Interactive Power Point Lesson*** is a self-paced, student-controlled, individualized learning opportunity embedded with assessment used to provide individualized instruction as well as immediate feedback to learners. This article presents a nine-step process (following Kemp's Model for Instructional Design) for creating an interactive lesson using PowerPoint. A menu of options and features are examined that PowerPoint a viable graphics development and presentation tool. Four features are held up as the key commands that make the interactive lesson possible; they include action buttons, hidden slides, the kiosk browser, and assessment slides. The structured format for designing these technology-rich lessons will be of particular interest to readers of the ***Encyclopedia of Information Technology Curriculum Integration*** responsible for teaching lessons in a formal multimedia classroom, computer lab, or a student's home computer.

A lesson design model for differentiating teaching and learning of technology is offered in the ***K-A-RPE Model*** citation for those developing comprehensive technology programs. Knowledge, application, and research, practice, and evaluation offer the necessary distinctions among instructional technology programs for undergraduates, graduates, and doctoral programs of study with respect to technology skills and competencies. Similar to other more well-known taxonomies, the K-A-RPE Model is hierarchal, progressive, and assumes mastery and competency at all preceding levels. The knowledge level of the model describes technologies as personal learning tools. The application level integrates technology-based skills for inclusion into everyday instruction; research, practice, and evaluation discusses how new technologies apply technology for purposes of investigation, real-world preparation, and assessment. Examples of typical application outcomes at the undergraduate, graduate, and postgraduate level are included in the article.

Mobile Learning is one of the newest technologies pushing lesson design, development, and implementation towards increased access to learning. M-learning is still an emerging concept as educators continue to explore how mobile technologies impact the teaching and learning environment. This article describes several unique features of mobile technologies that could enhance the learning experience, including privacy issues; the potential to support learners with preferences for textual, audio, and video presentation of material; immersion techniques; data capture; and user control. For special application in this encyclopedia, this citation addresses six learning theories relevant to mobile technologies; specifically, behaviorism, constructivism, situational learning, collaborative learning, lifelong learning, and teaching support. The paper finishes its exploration of mobile learning with a look at some of the positive contributions promised by this technology, specifically, in the areas of improving basic skills; encouraging independent and collaborative learning; identifying learner weaknesses; bridging the gap between mobile literacy and communication technology literacy; engaging learners and maintaining their interest; and retention and focus issues.

Online Curriculum Development stimulates discussion of how content can be made more interactive with the integration of technology. Throughout the development process, it is important that curriculum developers remain focused on the core benefits of the technology as they pertain to their particular learning or administrative needs, and in ways that add value to effective existing processes. The process of rethinking how curriculum can be stored, restructured, and delivered is the key theme of this citation offered principally to curriculum authors, teachers, and ICT support staff. The paper examines technical aspects of online development, development from a cost perspective, and the impact of redesigning curriculum for online applications from the human resources side of the equation.

Pedagogical Agents in Online Learning focuses on the use of pedagogical agents in e-learning to provide information on their strengths and weaknesses; share research relevant to their instructional role in teaching; provide examples of their current use in lesson design, development, and implementation; and suggest possibilities for future implementation. The citation presents the perspective of the instructor's roles as expert, motivator, and mentor, and how these agents serve as tools to impact learning. Of particular note, for purposes of this encyclopedia, is the interaction of pedagogical agents and technology and dealings with the adult learner who brings a wealth of experience to the instructional environment. Some of the experiences shared in this article describe deterrents to learning performance; others may increase learning. Pedagogical agents, combined with technology, have the potential to create personalized learning experiences that approach the student as an individual, and to reach farther than any living instructor.

The key advantage in the use of ***Simulation in Teaching and Training*** centers around how simulations allow the learner to interact with systems that often cannot be explored in real life because they are not readily available, they are too expensive, they would be too dangerous for the learner (e.g., making mistakes would endanger the environment or the learner),

or they simply do not exist in real life. In this article, three different approaches to simulations are uncovered. Interactive modeling comprises simulations where, in the process of training the learner, somehow interacts with safe, challenging, and as close to real-life environment as possible. Character simulations offer virtual agents who interact with the learner, provide help and advice, and support and accompany the learner through the instructional process. Finally, demonstrative simulations replicate the environment, situation, behavior, or other persons (such as a patient or the learner). The integration of technology into simulations has raised the bar for instructional content, application of learning theories, and treatment of teaching strategies in the use of simulations.

To use information technology to its potential in ***Software Engineering Education*****,** a systematic approach is necessary. This article explores a myriad of strategies for integrating IT in engineering, strategies that involve necessary alternatives in the classroom; interactive classroom experiments; new horizons opened by the application of technology, communication, and collaboration; dissemination of course content; rich course content; reuse of knowledge; exploration of future careers; rich course assignments; and reducing duplication. Following alphabetically in order, ***Software Engineering in e-Learning Systems*** examines the role of software engineering in the evolution of e-learning systems. Several methods and techniques for incorporating software engineering in the design and development of e-learning software are introduced, including the software production process, reference architecture, software and process patterns, learning design approach, component-oriented design, and refactoring as real world examples of this discipline in action at the program level.

Taxonomies for Technology familiarizes the reader with several of the most popular systems for classification and organization. There have been a number of attempts to classify or organize learning technologies and while their classification frameworks are logically sound, they have not always been developed to assist in the design of learning events that use technology in the most effective and efficient manner. This citation compares and contrasts the Taxonomy for the Technology Domain with its six hierarchal levels of literacy, collaboration, decision making, infusion, integrationn and tech-ology; the Taxonomy of Learning Technologies classifying technologies as Representational or Collaborative (with its subcategories of "dialogic" and "productive"); the Media Classification Scheme for Human-based Systems classifying information technology according to Print-based system (books, manuals, workbooks, job aids, and handouts), Visual-based system (books, job aids, charts, graphs, maps, figures, transparencies, slides), Audiovisual-based system (video, film, slide-tape programs, live television), or Computer-based systems; and, finally, Bruce and Levin's Media Taxonomy, divided into media for inquiry, media for communication, media for construction, and media for expression. ***Taxonomy of Collaborative E-Learning*** places a different bent on a conceptual framework for teaching online. In this citation, the levels of collaboration are introduced, along with a review of various collaborative methods and descriptive examples of their approaches. Collaborative e-learning focuses on e-learning and collaborative learning, and offers a framework for planning, organizing, and assessing curricula, courses, projects, and learning activities. Five levels of collaboration are discussed: dialogue (encourages incisiveness and creativity and brings coherence to seemingly fragmented and unrelated ideas); peer review (process of critique and feedback between participants); parallel collaboration(where assignments are completed by a group of learners and components of the assignment allocated among participants); sequential collaboration (when assignment are organized into a series of progressive steps and results combined into a single collective result); and synergistic collaboration (where a group of learners work together to plan, organize, and complete the assignment). Each level of this taxonomy is progressive (a common characteristic of most educational taxonomies). Additionally, no single level is considered better than the previous step; however, one level may be better than another in relation to established learning goals, the make-up or social maturity of the group, timing, or other issues.

The final citation in lesson design, development, and implementation is the ***Virtual Tour*****,** a Web-based teaching strategy that presents multisensory, multimedia instruction appropriate for individual student exploration and group learning experiences. Similar to the previous citation on the Interactive PowerPoint Lesson, the virtual tour is also designed using an instructional systems design model; in this case, the ADDIE Model. A unique feature of the virtual tour is the integration of 1 of 14 front doors that serve as the facade for the lesson, and categorized as concrete or abstract; behavioral, cognitive, or humanistic; and, technically easy, challenging, or difficult. Six front doors are explained in greater detail, along with practical examples of how this technology-rich format is used to teach special-needs children.

ASSESSMENT/EVALUATION

Integration of technology at this stage of the taxonomy calls for a high mastery of teaching skills. Teachers are asked to design, develop, implement, deliver, and assess appropriate instructional technology-based materials to support the diverse needs of their learners. Towards that end, ***Evaluating Technology-Based Instruction*** examines the nature and quality of hardware and software used to assess the quality of the learning environment in which technology pedagogical processes, instructional software, and the physical environment of technology-based instruction. The article goes on to consider the

various stakeholders in the evaluation process: those who have interest in the learning outcomes as well as those who fund it. These interest groups include students, teachers, evaluators, technical support staff, and those funding the evaluation.

Learning Through Projects is arguably one of the oldest instructional methods in existence. It has taken several forms since enjoying considerable popularity in the beginning of the 20th century, and fell from favor in most academic disciplines (except for career and technical education) until its resurgence as a technology-rich teaching environment with the integration of information technology in the new millennium. This paper introduces the project method, originally intended to produce actual objects, maturing to include a variety of assessment tools such as portfolios, research projects, exhibits, performances, and creative writing assignments. Project-based instruction represents a second methodology for teaching, guided by the instructor to ensure that learners master subject area competencies through real-world (or in the case of technology, realistically simulated) experiences.

Student Response Systems for Active Learning explains the many applications of student response systems, also known as personal response systems, clickers, audience response systems, electronic response systems, classroom performance systems, and group response systems. These increasingly interactive tools promote audience learner participation during lectures, presentations, and classroom discussions by submitting immediate responses to questions using hand-held devices or specially designed response pads. With some training, practice, and lesson design, instructors will preplan questions throughout a lesson to conduct formative assessment of the content. Student response systems are also used to take attendance, ask questions, increase active learning, poll for student interaction, administer quizzes, and assess overall comprehension. This citation describes how these devices assist instructors in engaging the attention of students, making students actively participate in the learning process, and provide both the student and the instructor with immediate feedback on student understanding of material. Specific examples provide the reader with ideas for gathering information on students' understanding of course concepts, and for developing opportunities to adjust course activities.

The final article in both this section, as well as this level of the Taxonomy for the Technology Domain, summarizes nicely the ***Varieties of Authentic Assessment*****,** designed to reflect real-world situations (with the aid of integrated technologies) that reflect skills and competencies that learners develop and apply. Although there are a variety of authentic assessment methods, this article offers an assortment of methodologies that encourage connections between classroom experiences and real-world applications. Of particular value to readers of the Encyclopedia of Information Technology Curriculum Integration is the review of authentic assessment criteria that include consideration of consequences, fairness issues such cultural bias, validity and reliability, cognitive complexity, content quality and completeness, meaningfulness of the required tasks, and cost effectiveness.

Summary

In addition to producing instructional materials, integration includes other applications of technology important to the teaching-learning process. Integration involves the application of theory and research; lesson design, development, and implementation; and, a variety of effective assessment and evaluation strategies.

TECH-OLOGY

Tech-ology Defined

Tech-ology is a contraction of "tech" (technology) and "ology" (the study of); therefore, the final stage of the taxonomy addresses the study of technology. The ***Encyclopedia of Information Technology Curriculum Integration*** introduces a number of related issues that consider the effect of technology on the individual learner, the educational institution, the community, and society as a whole.

Contributions of the Encyclopedia. In addition to education, tech-ology is impacted by concerns raised by biotechnology (agriculture, cloning, genetics, health, medicine, reproductive technology); convergence (coming together of communication, computers, information, the Internet, and television); creativity (arts, intellectual property, piracy); affect on multiculturalism (including concerns with potential harm to customs, language, religion, social interaction); e-conomics (and the changes in business and e-commerce); equity matters (including the digital divide and global technology parity); government and politics (with online campaigns, fundraising, and advocacy); innovations such as artificial intelligence, cryotechnology, and robotics; and, certainly, national security fears such as cyberwarfare, information security abuses, and chemical and biological terrorism.

Computer fraud can take on different activities; it can be internal or external. ***Combating Computer Fraud*** involves a thorough understanding of who commits computer fraud, and why someone would engage in this type of criminal activity. There are several possible reasons for this type of conduct and this article categorizes computer fraud into one of several categories that include altering input, copying input, theft of computer time, software modifications (i.e., modifying, deleting, and/or copying licensed software), phishing (e-mails that direct users to other Webs sites), parming (which includes copying individuals keystrokes, poisoning, and theft of personal information), and identify theft. The citation goes on to describe various forms of protection against computer fraud, such as firewalls, authentications, virus software, and spyware.

Digital Storytelling in Teacher Education is a concept that is growing in popularity, offering considerable versatility as a technology-based instructional tool. This citation presents information and ideas to facilitate learning, productivity, and creativity through a variety of digital storytelling classroom uses. This article proposes three primary categories in which a digital story may be categorized. Personal digital stories use pictures, video, or other media to tell a story, visually depicting personal history or personal observations of an incident or historical account. Historical storytelling shares accounts of time-bound events, and presents a multimedia digital story vs. the traditional research paper. With easier access to multimedia tools with every system upgrade and each new software release, an emphasis on learning to use and integrate technology in teaching and learning move reflective digital stories into the instructional domain of more instructors. Using software that combines photos, text, music, and narration, learners create their own digital stories.

E-commerce is the largest growth area of today's economy, and is predicted to be the leading growth sector for many years to come. It now incorporates significant portions of business transactions that only a few years ago were still in the domain of traditional businesses. ***E-Commerce Models and Consumer Concerns*** introduces several of the most typical types of applications currently running in the World Wide Web, including internal e-commerce activities such as business-to-business (B2B) e-commerce, and business-to-consumer (B2C) e-commerce. Some external e-commerce activities are also discussed in this article. They include consumer-to-consumer (C2C) e-commerce, mobile commerce (m-Commerce) and location commerce (l-Commerce), business to business to consumer (B2B2C), customer to business to consumer (C2B2C), and peer to peer (P2P) e-commerce. Even government has become enthralled with e-commerce and its various forms, including government-to-business (G2B) and government-to-citizen (G2C)

Embedding Ubiquitous Technologies shares the realization that a third wave of instructional technology in education is upon us. Technologies that use sensors, wireless networks, and seamless learning environments are making their way into higher education, elementary and secondary classrooms, and training rooms with increasing frequency. Ubiquitous technologies are defined as tools employing, for the most part, Internet-connected wireless computing machines, personal technology devices, and handheld systems for use both in the classroom, at home, and at work, not shared with others. This citation discusses key issues associated with embedded systems, such as the urgency of learning need, initiative of knowledge acquisition, mobility of learning setting, interactivity of learning process, situating of instructional activities, and the integration of instructional content.

The agent concept provides a focal point for accountability and responsibility for coping with the complexity of software systems both during design and execution, and ***Exploiting Agent Technology*** makes an excellent citation for readers of the Encyclopedia of Information Technology Curriculum Integration, particularly at this level of the Taxonomy for the Technology Domain. Collaborative agents, interface agents, reactive agents, mobile agents, information agents, heterogeneous agents, and economic agents are introduced, and a project that includes a sequence of major steps is presented. The study, which resulted in the design of the Pyramid Model of the Project, describes grid construction, lab design, client/server model definition, definition of the interface of functional units, agent-based architecture construction, a module language for program refinement, and architecture specification.

Impact of Technology considers how technology impacts modern society, in general, and education, specifically. This citation begins by describing both a narrow and broad view of the terms *technology* and *impact*. A narrow view of technology limits discussion to specific technological artifacts, while a broad view of technology would include a discussion of the sociotechnical impact as well as the theoretical and applied knowledge needed to develop and use the artifacts; perfect for placement in this section of the Encyclopedia. Impact, too, is defined narrowly as increased test scores or improved attendance rates; more broadly as the transfer of learning into behavior. The article goes on to explain the difficulties in assessing impact of technology due to the inherently complex and interconnected nature of technology, interaction between instructional methods and media, and the lack of well-designed, long-term research studies reported in the literature. Even with these barriers, the article suggests some tentative conclusions.

Industrial Technology Pedagogy provides a particularly targeted citation for those readers of the Encyclopedia of Information Technology Curriculum Integration responsible for corporate and/or vocational training. Some of the key skills taken directly from industrial technology pedagogy discussed in this article include prevalent inadequacies in manual training, the importance of human relations skills in industrial technology, and integrating human relation skills into industrial

technology pedagogy. Industrial technology produces information technology managers and supervisors; as a result, this citation offers the reader an understanding of how to delegate instructions and authority successfully, how to work in a team environment, and how to work towards accomplishing the goals of that industry or business. Moreover, the article embraces technology to assist with everyday problem solving and leadership challenges in industry as well as common human relations skills.

Intellectual Property is the right to protect the published or unpublished works that include patents, trademarks, designs, and copyrighted materials including literary, dramatic, musical, artistic, and certain other intellectual works. In this article, a dynamic version for the support of intellectual property and organizational management to protect such data is offered in the Digital Model for Education. Other tools used in the business sector for researching knowledge management are presented, including digital dashboards, data warehouses, data mining, virtual reality modeling, and distance learning-based "just-in time" training. Educational organizations, it is suggested by this citation, need to keep pace with advancements in intellectual property trends, knowledge management, technology innovation, distance learning, and global political relationships.

Forensics is the application of sciences that help to seek out, examine, and answer questions about certain characteristics. ***Investigating Computer Forensics*** examines the short history of Computer forensics that has evolved into its own field of learning within the Information Technology discipline. Computer forensics is used to investigate these computer crimes, and a host of other possible criminal activities. To withstand court challenges, computer forensics science investigations must employ methodology that evidences rigor, detail, and logic conducted in measured steps that adhere to widely accepted practices and procedures. For successful prosecution, explained in this citation, computer evidence must be built around core legal requirements of evidence handling that include issues of admissibility, authenticity, completeness/ thoroughness, reliability and validity, and believability. The article concludes with several thought-provoking predictions such as the continued growth of computer forensics to help combat criminal activity from both an organizational as well as law enforcement perspective; rising sophistication of cybercriminals will offer increased challenges to uncover deleted logs, modified access attempts, altered data, and so forth; and, computer forensics must continue to mature into a more multidimensional discipline, covering behavioral as well as increasingly technical characteristics.

Multicultural Education and Technology Integration describes the foundations of multicultural education, and depicts how certain multicultural instructional strategies lend themselves to technology. According to this citation, the integration of technology is vital in education; however, the use of technology to implement multicultural education has scarcely been addressed by the academic community. Properly applied technologies enable instructors to introduce diversity into the classroom using the Internet and multimedia, in particular, to provide varying viewpoints from varied backgrounds. Technology such as electronic media, simulations, and Web sites facilitates multicultural teaching by infusing cultural issues into the curricula. A review of literature revealed in this article calls for proponents of multicultural education to conduct more research that assesses how technology can facilitate multicultural instruction to better assist educators.

The ***Net Generation*** refers to the cohort of individuals born from 1976 to 2001, considered the first generation to grow up in an Internet culture and a multimedia driven environment. This article relates some of the collective philosophies of this generation, both cultural and social, that emerged during the formative years of this era. The Net Generation is the first age group to be immersed into Internet culture; they view the Internet as their primary source of information and major communication resource. The rise of interactive multimedia technologies provides a plethora of visual cues with less reliance on manual or textual instructions to learn or conduct business. Trends in digital media (e.g., music, film, research, and other materials) are transforming the foundations of educational practices, social interactions, and cultural attitudes. The information-age mindset of this generation influences the ways in which we learn and work, and develop future initiatives. Readers of the Encyclopedia of Information Technology Curriculum Integration will gain valuable insight into widely recognized mindset of the 21st century learner.

Online Course Settings describes contributing factors experienced by a focus group of participants in an advanced degree instructional technology program with respect to online course setting, and the barriers these predilections place on students. Both extrinsic and intrinsic barriers are introduced. Examples of extrinsic impediments include an inherent fear of using new technologies, financial circumstances, technical problems and (closely related), sufficient training, academic skills, time management, writing and communication skills, and general technology experience. Intrinsic barriers cited in this article that discourage participants include aspects of racism (cultural bias), feeling of unworthiness when working in groups, lack of belonging, shyness and cautiousness, and a minority status within the class. Categorized into two key areas, this citation found social limitations related to academics, financial, and technical problems, as well as intangible aspects of racism evidenced by a sense of isolation and belonging and feelings of inferiority and unworthiness.

Plagiarism and the Classroom provides an overview of plagiarism in the classrooms, and discusses the important roles awareness and education play in detecting and preventing such violations of academic integrity. Advice for educators is included in this citation, along with recommendations for detection software and Web sites. Particular attention is paid

to issues of awareness, consistent and continuous emphasis on academic integrity, aggressive and consistent policies and enforcement, unambiguous instructions to students regarding assignments, and appropriate modeling by the instructor.

Reexamining the Digital Divide investigates the perceived differences in opportunity and achievement caused by economic and social disparities that limit access to technology. As presented in this article, the concept represents the recognized disparities caused by a lack of access to technology as it advances within society, leaving some sectors of society behind with respect to opportunities and abilities. Technology use is examined in terms of income, geographic location, gender, race, education, and age. Specifically, some contributing factors to the lessening effects of the digital divide involve the declining cost of technology, improvements to overall technical literacy skills (primarily as a result of schools and their technology programs at all levels), reduced cognitive requirements to master technology (i.e., user-friendliness of the hardware and software) , reduced fear and anxiety associated with pervasiveness of technology, greater willingness to regularly use technology, and, finally, the expanding ubiquitous nature of technology.

Spyware is an unauthorized software program that monitors system activities without the knowledge or consent of the user. Typically, spyware collects personal information from the targeted hard drive and sends this data through the Internet to the perpetrator. The presence, scope, and potential damage of spyware make this citation one of the most important articles in the Encyclopedia of Information Technology Curriculum Integration. Often disguised as freeware or shareware applications, an unsuspecting user is often duped into tracking, recording, and dispatching their online behavior. This article offers clues to the presence of security breeches, as well as possible solutions, consequences, and legal implications of these applications.

Technology and Student Achievement begins with an introduction to the No Child Left Behind (NCLB) Act of 2001 and its impact on education in the United States. The citation presents a synopsis of a considerable body of research attempting to link student achievement with the presence of technology. The purpose of the study offered in this article was to investigate a possible correlation between the computer to student ratio and standardized student achievement test scores. The research paired math and reading scores with student to computer ratios, as well as math and reading scores with the number of computers able to access the Internet. Contrary to many articles, this project did not find a correlation between student achievement scores and the ratio of students to computers. No indication was found that established current inequities in terms of academic achievement among school-age learners with respect to instructional technology in general and computers specifically.

Technology in the Cities presents current and future applications of technologies to be used in cities throughout the world in relation to intimate, sociocultural instructional design, research, and evaluation considerations. The purpose of this article is to promote discussion and dialogue within the field of education as it is impacted by the exponential growth of technology and rapid advancement in cities and cultures throughout the world. The future predictions referenced in this article provide a primer for educators and researchers in their investigations of the pedagogical changes and developments that will be needed to meet the creative opportunities, challenges, and demands resulting from the development of future technologies.

Within the past decade, a growing body of evidence supports the ever-widening technological gap among members of society, with the greatest disparities in computer and information technology found among individuals in rural and urban locations and along socioeconomic lines. ***Use of Technology in Urban Populations*** describes a number of trends that indicate those with means have become information rich while the poor and working class lag further behind. Similar to the previous article on the digital divide, this citation reveals more of the disparities in information, communication, technology access, and utilization and its impact on income, education, and race. The article covers a variety of related topics including the adoption and use of technology in urban schools, defining the urban learner, urban education academic underachievement, adoption of technology in urban schools, educational technology can influence student academic performance, educational technology can develop higher order thinking and metacognition skills, educational technology can improve student motivation, attitude, and interest in learning, and educational technology can address the needs of low performing, at-risk students.

Summary

The impact of technology must be considered in many of the peripheral areas of information technology education, areas that include the teacher, career development, teaching as a profession, and the future of education as a discipline. This section of the *Encyclopedia of Information Technology Curriculum Integration* provides the reader an orientation to some of the key social and educational issues associated with information technology education as it enters the 21st century.

CONCLUSION

Literacy, Collaboration, Decision Making, Infusion, Integration, and Tech-ology offer a unique perspective for integrating information technology into the classroom. The complete Taxonomy for the Technology Domain is shown in the Appendix to this Preface, and serves as a guide for exploring the subsequent sections and article citations in this ***Encyclopedia of Information Technology Curriculum Integration***.

ACKNOWLEDGMENT

The design and development of a publication that encompasses the breadth of a discipline as wide and varied as Information Technology Curriculum Integration cannot be successful without the aid and assistance of many contributors. To the authors and coauthors of the 150-plus citations that now comprise the Encyclopedia of Information Technology Curriculum Integration, my sincere appreciation for your attention to detail and your willingness to work closely on your manuscripts, editorial revisions, key words, index templates, acquisitions library form, checklists, and much more. To the members of the editorial review board–a dozen truly dedicated, expert, and technically astute professionals who read each of the submissions and offered their advice and counsel–your contributions made this publication possible when it was aground on several occasions. To the IGI staff, your involvement brought this project to fruition and you should be very proud of your skills and perseverance. To all who had a hand in producing this digest for the information technology education discipline, well done.

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Figure 1. Taxonomy for the Technology Domain (Tomei, 2005)

Taxonomy Classification	Defining the Level of the Technology Taxonomy
Literacy  **Understanding Technology**	**Level 1.0** The minimum degree of competency expected of teachers and students with respect to technology, computers, educational programs, office productivity software, the Internet, and their synergistic effectiveness as a learning strategy.
Collaboration  **Sharing Ideas**	**Level 2.0** The ability to employ technology for effective interpersonal interaction.
Decision-Making  **Solving Problems**	**Level 3.0** Ability to use technology in new and concrete situations to analyze, assess, and judge.
Infusion  **Learning with Technology**	**Level 4.0** Identification, harvesting, and application of existing technology to unique learning situations.
Integration  **Teaching With Technology**	**Level 5.0** The creation of new technology-based materials, combining otherwise disparate technologies to teach.
Tech-ology  **The Study of Technology**	**Level 6.0** The ability to judge the universal impact, shared values, and social implications of technology use and its influence on teaching and learning.

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