

## Preface

First electronic computer was developed in 1940s, and internetworking research was started in 1960s. Personal computers came to market in 1980s, and the Internet became popular in 1990s. In the past decade, with the evolution of Web 2.0 and wide use of smartphones, it becomes very easy for everyone to publish his/her personal contents via a variety of social media tools, such as SNS, blog, and micro-blog. User-generated contents produced and increased continuously. Now more digital bits (binary 1s and 0s) have been created in the digital space than stars in the physical universe. The Internet and Web have become the source of information, quarry of knowledge, and fount of wisdom.

First try to use computers to aid instruction, which is called CAI (Computer Aided Instruction), was taken place in mid-1950s to early 1960s by Stanford University and IBM. Since then, many innovative paradigms, technologies and support systems and standards, such as Computer Supported Collaborative Learning (CSCL), Web Based Learning (WBL), Blended Learning, Game Based Learning or Edutainment (Educational Entertainment), Learning Management System (LMS), Shareable Content Object Reference Model (SCORM) and IEEE LOM (Learning Object Metadata), have been proposed, developed, and applied in academic institutions and industrial organizations. Technology-enhanced distance learning has evolved from e-learning (provision of learning and education across time and distance), to m-learning (Mobile Learning, provision of learning and education at anytime and anywhere to anyone, with the means of mobile devices and communication networks), to u-learning (Ubiquitous Learning, provision of learning and education at the right time and the right place to the right person, with the means of ubiquitous/pervasive networking and context/situation aware computing technologies). The dramatic progress and wide utilization of information and communication technologies has greatly changed the way people work, live, play, and learn. With the emerging of distance education technologies and technology-enhanced learning paradigms, learning and education have been undergoing a big revolution.

This volume, grouped categorically into four sections, offers some of the latest advances in distance education technologies and new research achievements: newly developed methodologies, emerging support environments, and promising software systems.

Section 1, including the first five chapters, is called *New Frameworks and Architectures*. This section establishes the fundamentals of the most recent research into design and methodology behind distance education and learning, containing contributions from authors across the world.

Chapter 1 (*Collaborative Learning in Dynamic Group Environments* by Kamen Kanev, and Shigeo Kimura) is dedicated to Computer Supported Collaborative Learning (CSCL) employing dynamic groups, where at different stages students work independently, interact with each other in pairs, and conduct joint work in larger groups with varying numbers of participants. Their study features blended learning taking place in a face-to-face collaborative environment, where all students in the same room can move

freely around and interact with each other while using digitally enhanced printed materials with direct point-and-click functionality. Flexible and efficient support for dynamic group management is ensured through the adopted Cluster Pattern Interface (CLUSPI) technology.

Chapter 2 (*A Systematic Framework of Virtual Laboratories Using Mobile Agent and Design Pattern Technologies* by Yi-Hsung Li, Chyi-Ren Dow, Cheng-Min Lin, Sheng-Chang Chen, and Fu-Wei Hsu) details a framework that aims at designing and implementing an agent-based virtual laboratory in a systematic way enhanced with design patterns, and by wrapping the existing CAI tools without reverse engineering the source codes. The authors' work has demonstrated that the feasibility of their proposed framework in several applications, including virtual digital circuit and signal processing laboratories.

In Chapter 3 (*A Computer-Assisted Approach for Conducting Information Technology Applied Instructions* by Hui-Chun Chu, Gwo-Jen Hwang, Pei-Jin Tsai, and Tzu-Chi Yang), a new model for conducting information technology applied instructions is proposed, which can assist teachers in designing information technology applied course content based on the features of subject materials and the learning status of the students. The proposed approach has been evaluated in a Chemistry course that is designed based on the model at a junior high school to show its effectiveness.

Chapter 4 (*A Highly Scalable, Modular Architecture for Computer Aided Assessment E-Learning Systems* by Krzysztof Gierłowski and Krzysztof Nowicki) proposes a novel e-learning system dedicated strictly to knowledge assessment tasks. It utilizes Web-based technologies, but its design differs radically from currently popular e-learning solutions which rely mostly on thin-client architecture. They employ a loosely-tied distributed system architecture of high scalability and modularity. The versatility of their work has been proved in classroom, distance, and blended learning environments.

Chapter 5 (*Recent Contributions to a Generic Architecture Design that Supports Learning Objects Interoperability* by Sotirios Botsios and Dimitrios A. Georgiou) concentrates and classifies recent research work and notices important points that can lead to an open, modular and generic architecture of a Learning Management System based on widely accepted standards. It offers an overview on adaptive navigation, presentation and content retrieval in a variety of e-learning systems, concerning the adaptivity parameters and standards. It further proposes a generic architecture based on the adaptivity parameters such as cognitive style, learning style, learning behavior (motivation), and knowledge level.

Section 2, which contains chapters 6-10, is titled *Promising Support Mechanisms and Technologies*. As the name suggests, the chapters in Section 2 describe support mechanisms for the frameworks and architectures proposed and detailed in Section 1, and move into technologies that advance distance education and learning.

Chapter 6 (*Statistical Inference-Based Cache Management for Mobile Learning* by Qing Li, Jianmin Zhao, and Xinzhong Zhu) proposes a statistical caching mechanism which makes use of prior knowledge (i.e., statistical data) to predict the pattern of user movement and then replicates and migrates the cache objects among different proxies. They further develop a statistical inference-based heuristic search algorithm to accommodate dynamic mobile data access in the mobile learning environment. Experimental studies show that this algorithm can obtain good performance on caching mobile data with an acceptable complexity.

Chapter 7 (*A 3D Geometry Model Search Engine to Support Learning* by Gary K. L. Tam, Rynson W. H. Lau, and Jianmin Zhao) investigates two important issues, namely, feature analysis that affects the general usage of a distance learning system for the construction of 3D geometry models, and the speed that affects the number of concurrent users. The focus in this work is on deformable models, i.e., similar

models that may have different poses, and the method offers a mechanism to extract, index, match and efficiently retrieve stable features from these models.

Chapter 8 (*Supporting Interoperability and Context-Awareness in E-Learning through Situation-Driven Learning Processes* by Stefan Dietze, Alessio Gugliotta, and John Domingue) proposes Situation-Driven Learning Processes (SDLP), which describe learning processes semantically from two perspectives: the user perspective that considers a learning process as a course of learning goals which lead from an initial situation to a desired situation, and the system perspective that utilizes Semantic Web Services (SWS) technology to semantically describe necessary resources for each learning goal within a specific learning situation. Consequently, dynamic adaption to specific learning contexts as well as interoperability across different metadata standards and application environments can be achieved.

Chapter 9 (*A New Process Phase Diagnostic Technique: Visualized Interface for Diagnosing Learning Progress* by Pi-Shan Hsu and Te-Jeng Chang) details a new diagnostic technique combining measures of a learner's learning effort with associated performance in order to compare the efficiency of learning condition in a dynamic, real-time, and non-interfering instructional process. In the approach, the learning effort curve represents the quantitative value of the learning effort of each instruction unit, assessed by the proposed measurement technique.

Chapter 10 (*A FCA-Based Cognitive Diagnosis Model for CAT* by Yang Shuqun and Ding Shuliang) introduces a theoretical model of CD-CAT (Computerized Adaptive Testing with Cognitive Diagnosis) based on FCA (Formal Concept Analysis). It further describes the technology of item bank construction, item selection strategies in CD-CAT, and estimation methods, to design and implement a systemic CD-CAT, which diagnoses examinees on-line and offers remedial measure for examinees in time.

Section 3, called *Development of Practical Systems* and containing chapters 11-14, departs from the first two parts by adding a layer of pragmatism to the technologies and methodologies being developed. While the first two parts detail research and hypothesize about future goals and research directions, Section 3 describes what may be more practical in terms of developing new systems by utilizing promising distance learning techniques.

Chapter 11 (*Adaptivity in ProPer: An Adaptive SCORM Compliant LMS* by Ioannis Kazanidis and Maya Satratzemi) presents a Learning Management System (LMS) called ProPer, which conforms to SCORM specifications and provides adaptive hypermedia courses. ProPer manages and delivers SCORM compliant courses and personalizes them according to a learner's knowledge, goals and personal characteristics. In addition, the system monitors learners' progress and behavior, and gathers useful feedback, which is analyzed and used to improve course effectiveness.

Chapter 12 (*The Construction of an Ontology-Based Ubiquitous Learning Grid* by Ching-Jung Liao, Chien-Chih Chou, and Jin-Tan David Yang) attempts to incorporate adaptive ontology into ubiquitous learning grid to achieve a seamless learning environment, which uses ubiquitous computing environments to infer and determine the most adaptive learning contents and procedures in anytime, anyplace, and any device. A prototype of Ontology-Based Ubiquitous Learning Grid (OULG) has been constructed. Experimental results show that the proposed OULG is feasible and effective in supporting and facilitating ubiquitous learning.

Chapter 13 (*A Rule-Based System for Test Quality Improvement* by Gennaro Costagliola and Vittorio Fuccella) presents a rule-based e-testing system that assists tutors in obtaining question items of good quality through subsequent test sessions. After each test session, the system automatically detects items' quality, and provides the tutors with advice about what to do with each of them: good items can be re-

used for future tests; among items with lower performances, some should be discarded, while some can be modified and then re-used. The proposed system has been experimentally verified.

Chapter 14 (*An Understanding Information Management System for a Real-Time Interactive Distance Education Environment* by Aiguo He) proposes a so-called RIDEE-UIM system, an Understanding Information Management system for Real-time Interactive Distance Education Environment), for the lecturer to collect understanding information from each participant in real time distance education activities. Basic concept, design and implementation issues are discussed. Experimental use and analysis result show the usefulness of the proposed RIDEE-UIM system.

Finally, Section 4, called *Empirical Study: Evaluation and Assessment*, contains the final five chapters of the book, and details some of the latest research findings in terms of distance learning evaluation and assessment, offering hints and suggestions for present implementation and practical utilization and future research opportunities.

Chapter 15 (*The Effects of Communicative Genres on Intra-Group Conflict in Virtual Student Teams* by Jung-Lung Hsu and Huey-Wen Chou) explores the question of whether the collaborative interaction of the virtual teams has any effect on the conflict and network structure of virtual groups in the learning situation. A total of 150 participants were invited and randomly assigned to 30 groups with each group of five subjects. Through genre analysis and social network analysis, nine communicative genres most frequently used in the collaborative groups were identified. Results of correlation analysis suggested that it was the communicative genres (not the network structure) that were associated with intra-group conflict of virtual group.

Chapter 16 (*Effect of Teaching Using Whole Brain Instruction on Accounting Learning* by Li-Tze Lee and Jason C. Hung) details the experimental design involving the applications of the whole brain instruction, based on the 4MAT teaching model, an eight step instrument developed in 1980 by synthesizing Dewey's experiential learning, Kolb's four learning styles, Jung's personality types, as well as Bogen's left mode and right mode of brain processing preferences. It reports the experimental results in an accounting course at three vocational high schools by examining students' academic achievement, attitude, and retention.

Chapter 17 (*Using S-P Chart and Bloom Taxonomy to Develop Intelligent Formative Assessment Tools* by Wen-Chih Chang, Hsuan-Che Yang, Timothy K. Shih, and Louis R. Chao) describes a new approach that integrates Sato's Student-Problem Chart (SP Chart) with their proposed online assessment system, where teachers are able to analyze each learner easily and efficiently. It further details the system architecture and implementation method, and shows test item diagnostic and analysis with concrete examples and interface snapshots of the proposed system.

Chapter 18 (*A Study of English Mobile Learning Applications at National Chengchi University* by Pei-Chun Che, Han-Yi Lin, Hung-Chin Jang, Yao-Nan Lien, and Tzu-Chieh Tsai) reports a case study of English mobile learning in a Taiwan university, which investigated the response of the participants to a mobile learning platform called NCCU-MLP in order to improve the students' English ability as well as to update the teachers' understanding of how to use the technology. Their finding indicates a positive response from the participants regarding the content and procedures involved in the activity.

Chapter 19 (*E-Learning Practice and Experience at Waseda E-School: Japan's First Undergraduate Degree-Awarding Online Program* by Shoji Nishimura, Douglass J. Scott, and Shogo Kato) offers a review on the history, curriculum, administration, and management structure, and system of the Waseda e-School, the first undergraduate degree-awarding full online e-learning program in Japan. Waseda e-School has many features that contribute to its success. This chapter also reports on the current status

of the courses by analyzing the results of a questionnaire survey conducted after one year from their establishment and the state of credits registered and earned by students.

As Chapter 19 concludes the book, the volume is wrapped up with a fruitful discussion and conclusion about the future of distance learning and education, setting a model for similar institutions around the world to emulate. In all, this text offers a broad range of research, design, critical theory, design, implementation, assessment, and analysis of distance education technologies and emerging support systems. It should prove to be a vital resource to teachers and students, as well as instructional designers and administrators of distance learning and education.

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