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Part I

Mobile Technologies in Engineering Education (II)

Guest Editors

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A. A. Economides and N. Nikolaou	3–13	Evaluation of Handheld Devices for Mobile Learning

Many educational organizations have started using handheld devices for learning. The aim of this paper is to identify the current status of handheld devices and their appropriateness for mobile learning. First, this presents a framework for evaluating handheld devices in relation to mobile learning. Then, it evaluates current handheld devices using the evaluation criteria and records of the state of the art. Finally, it identifies the strengths and weaknesses of current handheld devices and suggests technical specifications appropriate for mobile learning.

Keywords: communications; evaluation; handheld device; mobile device; mobile learning; requirements; usability; quality; technical specifications

R. Chompu-Inwai and T. L. Doolen	14–22	The Impact of Mobile Wireless Technology on Student Attitudes in Higher Education Classrooms
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Our research employed both quantitative and qualitative research methodologies to explore the impact of mobile wireless technology (MWT) on student attitudes. This study provided empirical evidence that in higher education classrooms where MWT was used on a regular basis, the robustness of supporting infrastructure played an important role in positively or negatively influencing student attitudes. In classrooms where MWT devices were used for special purpose applications, perceived MWT value, as well as the relationship between MWT usage and grades, was found to impact on student attitudes. This study also found that previous MWT experience did not necessarily impact on student attitudes towards MWT and MWT usage.

Keywords: mobile wireless; student attitude surveys

M. Onat	23–31	Developing a PC- and SMS- μ C-based Stepper Motor Drive Set
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This paper describes a PC- and SMS- μ C-based Stepper Motor Drive set developed at Marmara University for use in graduate and undergraduate studies. The drive set presents an environment utilizing GSM service, in which students implement stepper motor real-time driving applications, readily get familiar with short message service SMS AT commands with an interface program and learn driving fundamentals through an animation program. Additionally, they can develop and implement different driving algorithms for the stepper motors in this environment.

Keywords: PC- and SMS- μ C-based stepper motor drive; GSM; SMS AT commands

A. Istanbulu	32–39	Mobilim: Mobile Learning Management Framework System for Engineering Education
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This paper introduces the implementation of a Mobile Learning Management System (Mobilim) designed for m-learning environments. The Mobilim system has been developed to provide educational contents through the Internet using mobile phones for engineering educators and students. System features have been evaluated by instructors and students. The system evaluation shows that Mobilim is a useful m-learning environment. Initial results of the system are encouraging for the further development of the system. In addition, the use of open software for the development of this system makes it cost-effective. Mobilim pages can be accessed by mobile phones that have the XHTML browser feature.

Keywords: mobile learning; m-learning management system; mLMS; mobile technologies

S. Aydin and H. Kaptan	40–45	Computer-Aided Mobile GPS Education Set
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This paper describes the design of a computer-aided educational mobile GPS (Global Positioning System) set. By means of this set, use of a GPS receiver and GPS connectivity with mobile devices can be taught more effectively. In addition, students can develop related GPS applications supported by mobile technologies like GSM, GPRS or Bluetooth. This mobile education set enables students to send location information via SMS or compare GPS receivers' data in different locations via GPRS etc. This set consists of a GPS module, an antenna, an 8051-based microcontroller, a monitor ROM for embedded applications, a portable computer and an application software that communicates with the hardware. Educational materials prepared by Macromedia Flash and Java Programming Language have been added to the GPS education set in order to design an efficient student-oriented system.

Keywords: GPS; mobile technology; computer aided; communication; education set

This paper presents an initial design of a pilot wireless Classroom Communication System (CCS) used for continuous and interactive engagement of students aiming at enhancing student critical thinking, extending attention span and enabling better student assessment. The system was designed mostly for engineering students and is intended to be used in lectures, tutorials or laboratories. The design should ultimately enable students to use, amongst other software, standard engineering packages such as MATLAB, PSpice, or Electronic WorkBench to construct designs, perform simulations and obtain answers to design problems using just wireless handheld pocket PCs. The system is based upon a CSCW system originally designed to be used anytime during lectures or tutorials and may involve the guidance and personal intervention of a lecturer or tutor. It is intended to support several modes and allows group or one-to-one personal tutoring. The system may also serve as a means of assessing individual student performance and in assisting lecturing staff with other tasks.

Keywords: wired classroom; handhelds; pocket PC; assessment

J. M^a Gutiérrez, S. Otón, L. Jiménez and R. Barchino

56–61 M-learning Enhancement Using 3D Worlds

As mobile-learning evolves, it needs an increasing amount of information to be displayed in the device screens. Also, to develop applications to be currently used by a wide range of users, the target devices must be the mobile phones rather than PDA or bigger devices. As the phone screen is very small and many different contents must be shown, a new approach is needed to join both requirements. This paper presents a proposal for the use of 3D worlds to enhance the interface of mobile-learning applications. Some specific test results are shown for every component available to construct 3D worlds. The result is an expanded interface where more information is displayed in the same space related to the subjective 3D perspective.

Keywords: mobile learning; m-learning; PDA; 3D technologies

K. K. Tan, E. B. Tay, K. C. Ong and C-Y. Leong

62–73 Mobile Real-Time Feedback System for Education

The development of mobile real-time feedback systems is discussed along with their application to scenarios in education when some feedback from students is necessary to better direct the delivery of specific teaching materials, lesson planning or the use of an appropriate teaching approach. The requirements to be met by one such system are considered along with implementation and the field data collected from a variety of application scenarios.

Keywords: mobile system; student feedback; mobile system applications

J. Z. Zhang, M. Teslow and P. Sander

74–78 An 'Engineering-Health Science' Interdisciplinary Approach to Promoting Mobile Technology for Multidisciplinary Applications

This is a progress report on our ongoing interdisciplinary project to promote mobile technology for multidisciplinary applications. The project consists of collaborative efforts between engineering and health science faculty and students in using mobile techniques to collect, transmit, analyse and store health data. Main techniques of wireless data acquisition and transmission, as well as key issues such as privacy and data security are addressed through joint course instruction sessions and laboratory experiments. The project is initiated via a Health Science Health Care Informatics course and an engineering Wireless Communications and Systems course. Health science students are to learn engineering techniques of effective use of wireless communications systems, while engineering students are to gain knowledge of applications in health sciences. Upon successful implementation and further improvement, this model can be further expanded into other areas such as natural sciences and business administration where the same concepts can be applied using different datasets. The interdisciplinary approach of using mobile technology will result in a revolutionary and exciting learning environment with truly multidisciplinary applications.

Keywords: mobile technologies; multidisciplinary applications; health science

A. Tretiakov and Kinshuk

79–83 Towards Designing m-Learning Systems for Maximal Likelihood of Acceptance

So far, in the field of m-learning the issue of technology acceptance has been largely overlooked. We apply the Technology Acceptance Model to consider the requirements for a generic m-learning system that would maximize the likelihood of its acceptance, and conclude that such a system should rely on the existing infrastructure and mobile device ownership. We back this conclusion by conducting a survey on m-learning acceptance targeted at educators and by developing a system prototype and evaluating it in a simulated classroom environment. The results speak in favour of introducing low cost, low maintenance m-learning systems targeting average, budget conscious educational institutions, with SMS technology being the most appropriate technology under present conditions.

Keywords: technology acceptance; mobile learning

M. Milrad and M. H. Jackson

84–91 Designing and Implementing Educational Mobile Services in University Classrooms Using Smart Phones and Cellular Networks

In this paper we report the results of our ongoing activities regarding the use of smart phones and mobile services in university classrooms at Växjö University. The purpose of these trials was to explore and identify which content and services could be delivered to the smart phones in order to support learning and communication in the context of university studies. The activities were conducted within the MUSIS (MULTICasting Services and Information in Sweden) project where 41 students from two different courses at Växjö University participated during a period of three months. Generally, the services integrated transparently into students' previous experience with mobile phones. Students generally perceived the services as useful to learning; interestingly, attitudes were more positive if the instructor adapted pedagogical style and instructional material to take advantage of the distinctive capabilities of multicasting. To illustrate, we describe a number of educational mobile services we have designed and implemented at Växjö University. We conclude with recommendations for increasing the potential for successful implementation of multicasting mobile services in higher education, including the importance of usability, institutional support and tailored educational content.

Keywords: mobile learning; educational mobile services; smart phones

B. Ramaswamy, Y. Chen and K. L. Moore

92–100 Omni-directional Robotic Wheel—A Mobile Real-Time Control Systems Laboratory

A mobile laboratory was developed for students of the ECE5320 Mechatronics and ECE7750 Distributed Control Systems courses at Utah State University. A serial server was connected to the microcontroller of a stand-alone omni-directional robotic wheel assembly. This enabled communication between the wheel and any remote computer, via a wired or wireless Internet connection. A telepresence control system and a prototype networked control system (NCS) were developed and tested. This system was suitably modified to accommodate the needs of the course laboratories, thereby enabling students to design, debug and test their laboratory project in real-time from the comfort of their own locations.

Keywords: mobile laboratory; robotics; NCS; mechatronics

Applications of mobile technologies for engineering education can be found in the literature, but, many of the reported applications are aimed at the online (wirelessly), on-campus, synchronous and proximal use of mobile technologies. Mobile technologies in engineering education can encompass more than the proximal teaching and learning environment—they can be offline, asynchronous and at a distance from the classroom. This paper reports on the initial application of ‘podcasting’ in a wholly online engineering study unit. It presents the rationale for, technical development details of, and, limited evaluation of this initial podcasting trial.

Keywords:

W-H. Wu and W-F. Chen

107–114 Effect of Varied Types of Instructional Delivery Media and Messages for Engineering Education: an Experimental Study

In a Digital Signal Processing course, students received two different types of instructional delivery messages (online text only and text along with a simulation tool: MATLAB) via two different types of instructional delivery media (desktop PC and personal digital assistant (PDA)). An experimental study was designed to investigate the potential main effects and the interaction of these two independent variables: instructional delivery message and instructional delivery media. Results showed that students expressed a significantly higher intention to learn in a desktop PC environment than in a PDA environment ($F[1,21]=17.31, p < 0.05$). We also found that students who used a MATLAB simulation tool performed significantly better on an achievement test than those who did not use it ($F[1,21]=10.96, p < 0.05$).

Keywords: Mobile learning; digital filter design; instructional science; multimedia learning; e-learning

J. Chen, Kinshuk, N-S. Chen and T. Lin

115–126 Student Profile Transformation between Desktop PCs and Mobile Phones

To meet the learning needs of various types of students, various adaptivity features are being implemented in computer-based learning systems to personalize education for every student. Recent developments in mobile technology have made the computer-based learning systems also accessible through mobile devices such as mobile phones. It is, therefore, becoming necessary that the students can also receive personalized learning through mobile devices. This research looks into various student preferences on different devices and how these preferences change when students move from one device to another to access learning content. Two surveys have been conducted in this research to investigate difference in various preferences of students while using personal computers (PCs) and mobile phones. A prototype computer-based educational system, accessible both from PCs and mobile phones, was also developed for this study to provide real experience of both type of interaction to the participants of the surveys. A student profile template is then designed on the basis of survey findings, which resulted in the student profile transformation framework. The framework is the first step towards content development guidelines to serve students on different types of learning devices.

Keywords: adaptivity; learning styles; mobile learning; profile transformation; user model

Part II

Contributions in: Control Engineering, Hydrologic Engineering, Telecommunications, Assessment, Humanitarian Engineering, University-Industry Cooperation, Manufacturing

V. Cerone, M. Canale and D. Regruto

127–136 Loop-shaping Design with Constant Magnitude Loci in Control Education

This educational contribution introduces the sensitivity peak beside the complementary sensitivity peak as indices of relative stability in the loop-shaping approach design of SISO control systems, through the use of an Extended Nichols Chart (ENC) which displays constant magnitude loci of the sensitivity function along with the well-assessed constant magnitude loci of the complementary sensitivity. The advantages of using the ENC in an educational context will be shown in the control design of an unstable laboratory process.

Keywords: control education; control system design; frequency-response methods; Nichols chart

A. Elshorbagy

137–143 Accuracy and Uncertainty: A False Dichotomy in Engineering Education. A Case Study from Civil Engineering

Predictive uncertainty is an important concept that civil engineering students should understand. The students need to realize that uncertainty is inevitable in spite of the efforts made to make models, algorithms, and analysis techniques as accurate as possible. In this paper, the issue of uncertainty is addressed through an illustrative example from the field of surface water quality management. The example demonstrates that simple probabilistic analysis can be effective for both walking the students through the issue of uncertainty and realistically quantifying the uncertainty for real-life civil engineering applications.

Keywords: uncertainty; probabilistic analysis; hydrologic engineering; design accuracy; water quality management

A. N. D’Andrea, F. Giannetti, G. Manara, M. Michellini and P. Nepa

144–152 A Virtual Educational Laboratory for Telecommunications Engineering

We present a virtual educational laboratory that allows the simulation of communication systems, equipment, devices, and measuring instruments, developed by using the software environment LabVIEWTM from National Instruments. The system, which fulfills the need for a flexible and low-cost educational tool for laboratory practice, is being used in the Laboratory of Telecommunications and Applied Electromagnetics of the Engineering College of the University of Pisa, Italy.

Keywords: Communication engineering education; e-learning; virtual laboratories

P. Gibbins and L. Brodie

153–161 Assessment Strategy for an Engineering Problem-solving Course

The operational aspects of an assessment strategy for an Engineering Problem-Based Learning (PBL) course initially involved an audit of existing and varied student skills and competence to facilitate their effective deployment into well-balanced teams. This balance encourages effective mentoring within and between teams. The strategy included summative and formative assessment, the former being tailored to individual students’ existing skill levels. Throughout, the emphasis is on advancement of skills and competence rather than simply achieving a minimum standard. The strategy provides the flexibility for equitable assessment of students with different initial skills and competency, which proves particularly relevant to students studying in the distance mode who may have considerable professional experience and advanced skills and competence in some areas. By tracking progress, students develop an individual portfolio of achievements that can be continued throughout their study programmes and professional lives.

Keywords: problem-based learning; engineering education

B. M. Moskal, C. Skokan, D. Muñoz and J. Gosink 162–174 Humanitarian Engineering: Global Impacts and Sustainability of a Curricular Effort

The Humanitarian Engineering program at the Colorado School of Mines seeks to prepare engineering students for careers that will interface with and benefit the underserved global community. Through an interdisciplinary collaboration, a sequence of courses has been designed and implemented to support engineering students in developing an understanding of the ethical, cultural, historical and technical dimensions of engineering work applied to community development in the United States and abroad. This article discusses the analysis of several indicators of the local and global impacts of the program and the sustainability of this project beyond the period of funding.

Keywords: global engineering; humanitarian engineering; undergraduate curriculum

P. L. Fox, W. L. Worley, S. P. Hundley and K. Wilding 175–184 Enhancing Student Learning Through International University–Industry Cooperation: The GO GREEN Course

This article describes a partnership between a US institution, a German institution, and several German industries for the purpose of teaching an interdisciplinary, international course which emphasizes sustainability, globalization, and different cultures and their integration into the engineering and engineering technology curriculum. The course, entitled GO GREEN (Green Organizations: Global Responsibility for Environmental and Economic Necessity), employs experiential learning activities that would be impossible if not for the cooperation and generosity of the German industry partners. A conceptual framework for the course is presented; reasons for involving German industry partners in teaching sustainability and globalization are explained; course development and planning processes are discussed; delivery and implementation strategies are highlighted; and the evaluation framework is articulated. Issues and considerations for course replication are included at the conclusion of the article.

Keywords: International; industry-education cooperation; globalization; multicultural; sustainability; undergraduate research

F. Amini and S. Rahman 185–198 A Systematic and Structured Outcome Assessment Plan for a New Engineering Program

Little is known about the program outcome assessment processes and requirements for new engineering programs. Traditional assessment techniques do not consider the unique situation of newly created engineering programs: the lack of historic assessment data, the need for implementation of improvements in a very short time, the lack of faculty in place at the start of the program, and the administrative issues are some of the factors that influence the assessment plan of a new engineering program. This paper presents a systematic and structured assessment plan for a new civil engineering program that addresses these challenges. Lessons learned and suggestions for implementation of an effective and meaningful assessment plan are presented.

Keywords: assessment; outcomes; engineering; education

C. W. Ziemian and M. M. Sharma 199–210 Adapting Learning Factory Concepts Towards Integrated Manufacturing Education

The Learning Factory (LF) concept integrates a practice-based engineering curriculum that strives to balance analytical and theoretical knowledge with learning enhancements through hands-on fabrication experiences. We have completed a project based on adapting key components of the original LF model, strategically expanding manufacturing-related education within a small mechanical engineering department. The implementation includes equipment installation, development of hands-on learning opportunities in materials processing and inspection, strategic formation of a lab infrastructure that creates course linkages and provides complementary coverage of fabrication principles within core courses, the integration of manufacturing research and education and the implementation of K–12 outreach activities.

Keywords: Active learning; manufacturing equipment; laboratory development; educational modules