# A SOFTWARE DEVELOPMENT CAPSTONE COURSE AND PROJECT FOR CIS MAJORS

**ROBERT J. MILLS**
Utah State University
Logan, UT 84322-3515

**KARINA HAUSER**
Utah State University
Logan, UT 84322-3515

**JEAN A. PRATT**
University of Wisconsin-Eau Claire
Eau Claire, WI 54702-4004

## ABSTRACT

Accreditation and curriculum development are critical tasks at every university. This paper describes a comprehensive two-level framework for information systems curriculum design, assessment and improvement. The two-level framework utilizes both a macro- and a micro-level approach to real-world problem solving. The macro level provides a general framework for overall course development and ensures that course topics, goals and assessment methods are related to each other. The micro level provides a framework for individual lesson design. The micro level uses activation, demonstration, and application to guide students through increasingly complex sub-problems. Both the macro and micro level of the framework incorporate a final phase of reflection for continual improvement. Application of the comprehensive two-level framework can provide benefits to all stakeholders in the education system: deans and department heads, faculty members/instructors, students and employers.

**Keywords:** accreditation, assessment, IS curriculum design, problem-based learning

## INTRODUCTION

Many business colleges are facing accreditation renewal or application. Accreditation associations emphasize, among other things, ". . . high-caliber teaching of quality and current curricula" [2]. Curricula and student assessment form an essential and critical core to program accreditation. A primary goal of the Association to Advance Collegiate Schools of Business International (AACSB) is to ensure students have the knowledge and skills appropriate to their earned degree [2]. Unfortunately, education is often criticized for failing to properly prepare students to solve problems in their field of study [14, 30, 50]. Too often curriculum is driven by teaching facts using lecture-and-memorize methods [47]. As a result, graduates are often unprepared to enter a challenging, problem-based work environment. "Thus, the need for enhancing learning process effectiveness and efficiency is urgent in both the academic and business environments" [4, pp.160]. One approach to increasing learning effectiveness is via problem-based instruction.

Problem-based instruction is a familiar concept in business school curricula. For instance, the American Accounting Association [1] recommended "educational experiences for students that require them to be active, independent learners and problem solvers rather than passive recipients of information" (pp. 187). A growing body of research in information systems (IS) [27, 39, 44] focuses on instructional innovations and design prescriptions to improve the overall quality of information systems curricula. Designing curricula that focuses on problem-based learning helps students use thinking skills of a higher order than those associated with typical lecture instruction [47].

Educational researchers emphasize the importance of preparing students to use their skills to solve real-world problems [23, 37, 47]. The learning-by-doing approach is fundamental to problem-solving because it "strikes at the heart of the basic memory processes that humans rely upon" [47]. Pedagogical approaches that include real-world problem solving are used in corporate education [37] and encourage in applied academic disciplines such as information systems and accounting [23]. Designing problem-based instruction requires instructional planning based on proven theoretical principles.

Real-world problem solving is at the core of many instructional theories and models [25] including first principles of instruction [35]. Merrill [35] derived the first principles of instruction from a comprehensive review of instructional theories and models. His goal was to define core principles underlying effective instruction, regardless of philosophical orientation or instructional theory. As such, first principles of instruction bridges differing pedagogical approaches and provides a common ground for developing effective, problem-based instruction.

The purpose of this paper is two-fold: (a) illustrate how integrating accreditation guidelines (assessment), curriculum models (course design), and educational theories (lesson design) can provide a comprehensive framework for IS curriculum design, assessment and improvement and (b) define research and application propositions regarding the impact of the two-level framework on IS education stakeholders. This paper is organized as follows. First we review accreditation issues related to curriculum design, identify relevant IS curriculum models, and describe pertinent educational theories. We then introduce a two-level framework for designing, assessing and improving information systems curricula. We illustrate the effectiveness of this proposed two-level framework by describing its application in an existing systems analysis and design (SAD) class. We conclude the paper by defining future research and application propositions related to use and testing of the two-level framework.

## LITERATURE REVIEW

The literature review is divided into three sections related to the proposed framework. The first section identifies the importance of accreditation and assessment for universities and how they relate to curriculum design. The second section describes relevant information systems curriculum issues. The third section reviews a specific instructional design model, namely, first principles of instruction [35].

### Importance of Accreditation and Assessment

Accreditation is very important in higher education to ensure program standards and quality. At least two types of accreditation impact information systems programs. AACSB accredits business

schools (where most IS programs are located) and the Accreditation Board for Engineering and Technology (ABET) accredits IS programs. AACSB is the premiere accreditation association for business schools, with 540 educational institutions having earned its accreditation designation as of March 2007 [2].

The AACSB guidelines for curriculum development are used widely by educational institutions and other academically professional organizations. The AACSB guidelines governing curriculum and student assessment and continuous improvement are of specific relevance to this paper. AACSB Assurance of Learning Standards 9, 12, 13,15 and 16 (Appendix A) specifically address the need for faculty members and schools to demonstrate continued achievement in goal-driven curriculum development and assessment, faculty development and assessment, and learner assessment.

AACSB [2] specifies two reasons why assessment is of utmost importance in the learning process: accountability and continuous improvement. IS programs are held accountable via assessment to ensure that students have the knowledge and skills appropriate to their earned degree. Assessment can also be used as a baseline for continuous improvement efforts. The two reasons for assessment are closely related: assessment is an integral part of curriculum development and improvement.

AACSB guidelines focus on curriculum assessment. However, AACSB guidelines are silent regarding how to teach, what content to teach, and how to conduct individual student assessment. The two-level framework provides a prescriptive approach to both course and lesson design. Although our specific focus is on IS curriculum design and assessment, this two-level framework is applicable to any program seeking a structured approach for curriculum design, assessment and improvement (regardless of their accreditation status).

## Issues in IS Curriculum Design

Information systems educators face an especially difficult challenge in keeping their curricula updated to meet accreditation guidelines. The IS curricula has to be updated frequently to provide students with current, marketable knowledge and skills [6, 21, 29, 30, 33]. Additionally, the dynamic nature of IS makes it necessary to balance fundamental and emerging knowledge and skills [31]. IS educators must constantly update their own knowledge and skills, incorporate the new knowledge and skills into their courses, and continue to teach fundamental IS topics. IS-related professional organizations provide guidance through various curricula models [12].

The most widely adopted model is the IS 2002 model curriculum [22] which is endorsed by the major professional organizations in the IS field. It is based on over 1,000 fundamental topics derived from the general IS body of knowledge. These topics are organized into 126 learning units which are then grouped into 10 required and 1 elective course [22]. The learning units are sequenced according to an instructional design methodology from Gagné, Briggs and Wager [20], pioneers in the field of instructional technology.

The IS 2002 model curriculum appears to be aligned to various degrees with current IS curricula at most universities. In a recent survey of undergraduate programs in the United States, Kung et. al. [28] examined IS curricula for seven core IS courses indicated in the model curriculum. Systems analysis and design was offered by 94% of universities, database by 92%, programming by 88%, telecommunications by 71%, introduction to IS by 61%, IS capstone course by 47% and operating systems by 16%. Similar results have been found in earlier studies [21, 33, 48].

The IS 2002 model curriculum is a guide — a suggested architecture that IS educators can use to develop their curricula. The ultimate responsibility and decision for how to apply the model to their particular program, however, lies with IS educators. Few documented approaches to effective implementation appear in the literature. Denton et. al. [17] proposed applying Quality Function Deployment (QFD) and the House of Quality (HoQ) to IS curricula design. QFD and HoQ are industrial quality management tools designed to incorporate customer requirements at each stage in the development process. Future employers represented customers of the student products of the resulting IS curriculum. Denton et al. [17] used HoQ to identify what customers wanted and how to provide it from a curriculum and course perspective. Daigle et al. [16] used a mapping technique to evaluate how well their existing courses covered the specified IS 2002 learning units. By evaluating possible coverage of each IS 2002 learning unit in each course, educators were able to provide accreditation documentation of curriculum quality while simultaneously noting gaps in the curriculum.

The IS 2002 curriculum model and the various approaches to its implementation stop short of providing IS educators with a means of implementing the curricula at the base level: the lesson plan. A serious gap exists between modeling a curriculum or course and modeling the actual interaction between faculty and student. We propose a pedagogically sound framework to fill that gap.

## Review of First Principles of Instruction

The two-level framework for IS curriculum design, assessment and improvement extends the first principles of instruction [35]. First principles of instruction [35] summarizes the common underlying principles of a wide variety of design theories, including both constructivist and objectivist designs. The strength of first principles of instruction is in its lesson design. It has been used in prior MIS and computer science research [7, 44] and by multinational corporation training departments [15]. The problem-based approach used in first principles of instruction seems to be especially relevant to an applied science like IS. First principles of instruction focuses on the following five prescriptive design principles [35]:

- *Learning is facilitated when learners are engaged in solving real-world problems*. At the heart of first principles of instruction is a purposeful effort to engage students in solving real-world problems. Instruction using a problem-based approach should include a very simple to very complex progression of problems to solve [35]. This increased problem complexity allows learners to engage successfully in activities before progressing to more complex problems to solve, thereby ensuring that students are introduced to problems at an appropriate level of difficulty.
- *Learning is facilitated when existing knowledge is activated as a foundation for new knowledge.* Cognitive processes such as accommodation and assimilation [8] are related to activation of memory. The activation principle encourages instructors to assist students in recalling, relating, describing and applying knowledge from relevant past experience, which can then be used as a

basic foundation for acquiring new knowledge [35]. Activation allows learners to draw on past experiences and link existing knowledge to the new knowledge being acquired [5].

- *Learning is facilitated when new knowledge is demonstrated to the learner.* "The demonstration must be consistent with the learning goal: (a) examples and non-examples for concepts, (b) demonstrations for procedures, (c) visualizations for processes, and (e) modeling for behavior" [35]. This consistency is important to address in order to ensure that the demonstrated knowledge is at an appropriate level for students to solve the identified problem.
- *Learning is facilitated when new knowledge is applied by the learner*. The application principle encourages students to use their new knowledge or skill to solve a variety of related problems. The application should include an authentic task where the learner is given ownership of the process used to develop a solution that supports and challenges the learner's thinking [35]. Assessment is consistent with the specified learning objective: recognize concepts; perform activities, identify entities, or predict outcomes. Instructional support decreases as student mastery increases.
- *Learning is facilitated when new knowledge is integrated into the learner's world*. Integration and transferring new knowledge and skills into the workplace is critical and often part of evaluating the effectiveness of a successful training program. Many companies use Kirkpatrick's four levels of evaluation where effectively transferring training represents a Level Three evaluation [8].

First principles of instruction is a strong model at the lesson-design level. However, it lacks an integrated component for continual improvement. Further, it is not directly applicable to curriculum development. The two-level framework extends first principles of instruction to fill this gap.

## COMPREHENSIVE TWO-LEVEL FRAMEWORK

Accreditation guidelines define how the learning outcome is measured and documented; model curricula define the material to be taught; instructional design theories define how the material is best taught and student learning assessed. Each of the three components mentioned are vital to IS curriculum design, assessment and improvement, but currently no comprehensive framework exists that combines the three.

The two-level framework proposed in this paper consists of two interrelated models: a macro level model for overall curriculum design, assessment and improvement and a micro level model for individual lesson design and improvement. On the macro level the phases of the model are performed only once per semester; whereas on the micro level an iteration of multiple phases are performed.

Table 1 illustrates the major components of the models and guidelines described previously in comparison with the proposed two-level framework.

### Macro Level Design Model

The macro level model is designed primarily for overall course layout and is arranged to address the following critical questions:

- What core problem and associated sub-problems will the students solve?
- What goals will solving these problems achieve?
- How will student performance be assessed?
- How can students integrate the new knowledge/skills in everyday life and work experiences?
- How can the course be continuously improved?

Answering these questions helps to create a high quality learning experience for students while simultaneously serving as a comprehensive tool for assessment and accreditation purposes. The five components of the macro level model include the core problem, goals, assessment, integration, and improvement (see Figure 1); they are described in detail in the next section. Sample questions instructors can review to help apply the five components are provided in Appendix B.

The macro level model must be performed every semester the

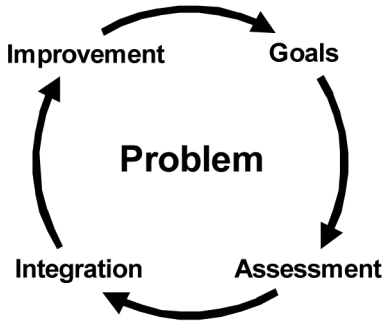



**Figure 1: Macro Level Model**

| | How to teach | What to teach | Lesson Improvement | Student Assessment | Curriculum Assessment | Curriculum Improvement |
|---|---|---|---|---|---|---|
| Instructional Design Theoriesx | x | | | x | | |
| IS 2002 Model Curriculum | | x | | | | |
| AACSB Guidelines | | | | | x | x |
| ABET Guidelines | | x | | | x | |
| Proposed Framework | x | x | x | x | x | x |

**Table 1: Comparison of Instructional Design/Curriculum/Assessment Guidelines**

course is offered to ensure that continuous improvement takes place.

*Problem*

The central component of the macro level model is the identification and definition of a challenging real-world, up-to-date problem. The first step is to identify a comprehensive core problem that addresses all the content covered in the course. If the definition of a real-world problem is not possible, detailed scenarios can be used to create a realistic environment for students. Examples of comprehensive core real-world problems include the development of a website for a web design or web-programming course, the development of software system for a programming course, ERP projects incorporating business processes [43], and the development of a database and related queries for a database course [26]. The core problem can then be broken down into smaller sub-problems. The individual sub-problems are grouped by topic area. This grouping accommodates the traditional layout of textbooks and allows for easier student assessment, since testing most often occurs at the topic area level.

*Goals*

Course goals are the second component of the macro level model and can be used in course syllabi. The important element of this phase is that the course goals are linked directly to the identified sub-problems created in the prior phase (Figure 2). Besides the course goals (CG) set by the instructor, goals can include common department or college goals (AG) to prepare for accreditation as well as learning unit (LU) goals identified in national curriculum models such as IS 2002 and OSRA 2004. The mapping of sub-problems to goals ensures that all goals, both those identified by the instructor and departmental/college goals like good communications skills, are covered in the class. The connection between sub-problems and goals is not a one-to-one relationship; some goals (such as working in teams) may apply to several of the identified sub-problems for the course.

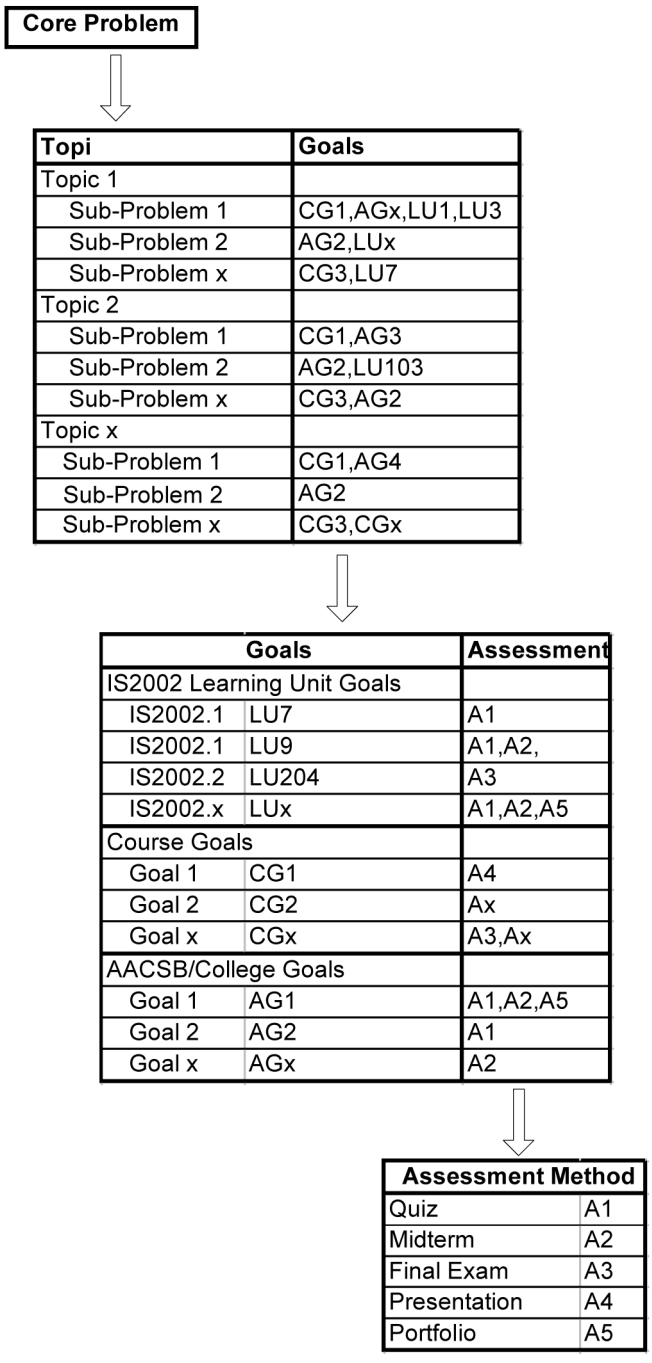
*Assessment*

Assessment at the macro level provides an opportunity to determine the best approach to evaluate students' comprehension of the knowledge and skills. Assessment can include common tools like homework, quizzes, exams, presentations, projects, and activities, or more innovative approaches, like learning software that provides immediate feedback and study suggestion [38]. Appropriate assessment methods (A*x*) are linked to the identified goals (Figure 2) from the second phase of the model. The purpose of including assessment is to provide evidence students have the desired knowledge and skills taught in the class and provide faculty with real-time feedback for tailoring the instruction to ensure student learning. Smith et. al. [49] distinguished between outcome-based measures (result oriented–multiple-choice exams, individual case analysis, etc.), behavior-based measures (process oriented–class participation, utilization of office hours, etc.) and hybrid measures (result and process oriented–group paper, reworked student assignment, etc.) for assessment. The appropriate method or methods need to be defined for each goal. The mapping of assessment methods to goals also ensures that the college goals are included in the assessment method. This guarantees that sufficient documentation is available at time of accreditation or renewal.

Assessment methods should also consider the needs of the students. An overall college goal should be that students have a wide variety of projects to incorporate into their interview portfolios. Since goals are designed around real-world problems, and assessment is linked to goals, the development of meaningful portfolio pieces should be relatively easy.

*Integration*

Integration is an important and often overlooked element of designing curriculum. Regardless of how much is learned in the




| Topi | Goals |
|---|---|
| Topic 1 | |
| Sub-Problem 1 | CG1,AGx,LU1,LU3 |
| Sub-Problem 2 | AG2,LUx |
| Sub-Problem x | CG3,LU7 |
| Topic 2 | |
| Sub-Problem 1 | CG1,AG3 |
| Sub-Problem 2 | AG2,LU103 |
| Sub-Problem x | CG3,AG2 |
| Topic x | |
| Sub-Problem 1 | CG1,AG4 |
| Sub-Problem 2 | AG2 |
| Sub-Problem x | CG3,CGx |

| Goals | | Assessment |
|---|---|---|
| IS2002 Learning Unit Goals | | |
| IS2002.1 | LU7 | A1 |
| IS2002.1 | LU9 | A1,A2, |
| IS2002.2 | LU204 | A3 |
| IS2002.x | LUx | A1,A2,A5 |
| Course Goals | | |
| Goal 1 | CG1 | A4 |
| Goal 2 | CG2 | Ax |
| Goal x | CGx | A3,Ax |
| AACSB/College Goals | | |
| Goal 1 | AG1 | A1,A2,A5 |
| Goal 2 | AG2 | A1 |
| Goal x | AGx | A2 |

| Assessment Method | |
|---|---|
| Quiz | A1 |
| Midterm | A2 |
| Final Exam | A3 |
| Presentation | A4 |
| Portfolio | A5 |

**Figure 2: Mapping of Goals to Topics, and Assessment Methods to Goals**

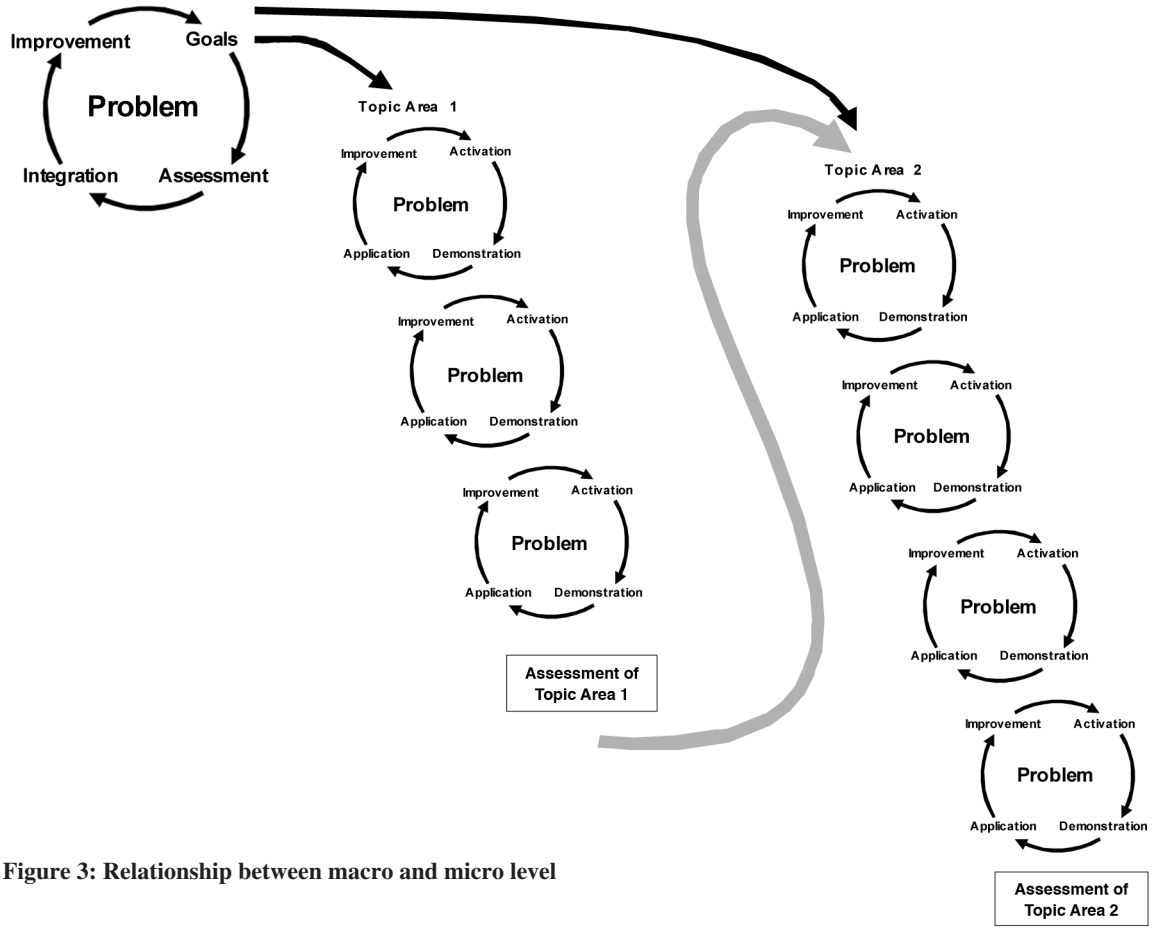



**Figure 3: Relationship between macro and micro level**

classroom, students need to transfer this knowledge and skills into everyday life and work experiences. Integration is included at the macro level of our framework because integration strategies can be implemented before, during, and after the classroom experience [11]. Discussions, demonstrations, guest presentations, and goal-setting are all simple methods to improve integration. Advanced integration methods such as action planning is also recommended. The general purpose of an action plan, often considered to be the most effective transfer tool, is to help students identify specific areas where change can be implemented in the workplace or real-world situation [18]. Specific details on how to organize and implement an action plan are readily available [11, 19, 24].

*Improvement*

A strategy for continuous course and instructor improvement must be developed for each course. Toyota found that standardization is the basis for continuous improvement [32]. Improvement can only be made when the current process is known and measurable. Therefore, the first step in continuous improvement is to document and measure the current processes. The macro model is an ideal tool for this step. The process of mapping the sub-problems to the goals and then the goals to the assessment methods helps to organize the overall course outline and to immediately recognize if something is missing or not aligned, e.g., a sub-problem is not linked to a goal or a goal has no assessment method. Any shortcomings found during the mapping process can be incorporated into an improvement plan.

Once the current process has been documented and measured, then methods of improvement need to be identified. IS instructors are continually faced with the challenge of staying abreast of emerging technologies and incorporating them into their courses. Such ongoing learning and course refinement requires much planning. Resources available to the instructor include online news and discussion groups, journals focused on the course topic or pedagogical innovations, and published IS cases studies and teaching materials.

Instructors should also consider course improvements in the relationship with other courses and the overall curriculum. Emerging topics which are first integrated into an existing course may later merit their own course listing, as determined by the curriculum committee.

**Relationship between Macro Level and Micro Level**

Figure 3 shows the relationship between the macro and micro levels. The sub-problems identified in the macro level become the bases for the individual lesson designs of the micro level. The sub-problems progress in an iterative or waterfall method using a scaffolding approach to instruction. That is, the instructor provides a large amount of support and correct-answer feedback in the beginning as students start with fairly simple sub-problems. The instructor methodically decreases support as students assume increased responsibility for learning and demonstrate proficiency in solving increasingly complex sub-

problems. The result is student ownership of learning skills and demonstration of content mastery, both of which are transferable to the workplace.

Each iteration of the micro level consists of an activation, demonstration, application and improvement phase, all centered on an individual sub-problem. The sub-problems are grouped into different topic areas, each with its own time and method for assessment. Student assessment is conducted at the macro level after completion of a set of micro-level lessons covering a given topic area.

**Micro Level Design Model**

Once the macro level is complete and the sub-problems to be solved have been identified, the micro level model is arranged to address the following questions:

- How can I activate students' past experiences to help solve this new sub-problem?
- What is the best way to demonstrate the material?
- How will students apply what they have learned?
- What were the problems and how can this lesson be improved?

The micro level model consists of the following phases: sub-problem, activation, demonstration, application, and lesson improvement.

The micro level includes pedagogical guidelines for the individual lesson design. The problem, activation phase, demonstration, and application phases are consistent with the original first principles of instruction model. We added a reflection/lesson improvement phase to ensure continual improvement. Each of these phases is described briefly below:

*Problem*

The specific sub-problems identified in the macro level become the center of each lesson. An effective instructional strategy enables students to solve the sub-problem and achieve the associated goals related to the sub-problem. The instructor will want to work through the sub-problems at the micro level in order to determine in detail every step required to solve them. This often includes creating additional sub-problems and challenges to solve the core problem.

*Activation*

Once a sub-problem has been identified, the instructor can determine a strategy on how prior knowledge can be activated to solve that problem. The first step is to identify what knowledge students already possess about the topic, either from prerequisite classes, prior work experiences or topics already covered in the current class. The activation phase illustrates the importance of faculty knowing what is taught in other classes and encourages faculty to work together to create a curriculum that is logical and organized. Instructors also need to be aware of students' backgrounds and work experiences and build those experiences into the activation phase. Using students' existing knowledge to help introduce and bridge to new knowledge is an effective design strategy for creating IS curriculum.

*Demonstration*

The demonstration phase includes strategies on how the knowledge associated with the sub-problems can be presented to the students. Common demonstration techniques include lecture, guided discussions, in-basket techniques [8], demonstration-performance methods using examples and non-examples, and case studies. The demonstrations must be consistent with the instructional goals. The demonstration principle does not necessarily require the instructor to lead the demonstration. For instance, Savery and Duffy [46] describe supporting and challenging the learner to think and to provide a supportive learning environment to complete a task without specifically requiring an instructor-guided demonstration. Demonstration elements could include access to relevant materials and/or resources rather than a lecture.

*Application*

The application phase includes making decisions on what activities would be appropriate for students to apply their knowledge. Application of new knowledge can include activities such as projects, presentations, papers, and simulations. The application phase should also prepare the students for assessment. The application and assessment instruments must be consistent. Students must have the opportunity to apply their knowledge at the same level they will be assessed.

*Improvement*

The lesson improvement phase is the final phase in the micro level model. The purpose of the lesson improvement phase is to engage in active reflection for the express purpose of increasing lesson quality. Instructors can identify areas of the lesson that were effective, areas that need to be improved, and areas that need to be removed. While the macro level improvement focuses on important areas such as staying current with the changing field of IS, the micro level lesson improvement looks for practical ways to increase lesson quality and make the instruction more effective and appealing to the students.

## EXAMPLE: DESIGN OF SYSTEMS ANALYSIS & DESIGN CLASS

A systems analysis and design (SAD) class was used as an example of how to design and teach a class using the two-level framework developed in this study. The SAD class was selected because of its importance in IS. The IS 2002 curriculum model [22], the Organizational Systems Research Association curriculum model [41], and ABET's core material requirements [3] all include SAD as a required core course. In a survey about IS undergraduate programs in the United States, Kung et. al. [28] reported that 92% of public and 96% of private universities included SAD in their IS curriculum. The course described here serves as a capstone course (class size capped at 25 students) for all information systems students.

**Macro Level: Overall Course Design**

We designed the course based on the macro level model components of the framework: problem, goals, assessment, inte-

| **Topic Area**<br>***Problems*** | **Goals** |
|---|---|
| Introduction to SAD | LU72,LU116,CG2,CG5 |
| Planning | LU80,CG1,AG1,AG2 |
| *Setting goals and securing commitment* | LU74, LU86,LU114 |
| *Feasibility analysis* | LU77 |
| *Develop requirements gathering* | LU74,LU86 |
| Develop Gantt chart | LU94,LU114,LU105,CG4,AG4 |
| Analysis & Design | LU75,LU80,LU96,LU100,LU101,CG1,CG3,CG4,AG1,AG2,AG4 |
| *Use-case modeling* | |
| *Structural modeling/traditional data modeling* | |
| *Behavioral modeling/traditional process modeling* | |
| *Human computer interaction layer design;* | |
| *Physical architecture layer design* | |
| *Network model, hardware/software specifications* | |
| Implementation | LU80,LU94,LU117,CG1,AG1,AG2 |
| *Programming* | LU98,LU100 |
| *Testing* | LU98,LU103 |
| *Installation and Operations* | LU94,LU97 |
| Project management soft skills | LU106,CG6 |
| *Change Management* | |
| *Leadership and motivation* | |
| *Diversity in project teams* | LU113 |
| *Communication* | |
| Special Topics in SAD | CG5,AG3 |

**Table 2: SAD Topics with Mapped Goals**

gration and continuous improvement. Each is discussed below.

*Problem*

The core problem for the class was to design, develop, document and implement an information system for a real-world company. Some of the projects were provided by the instructor whereas others were initiated by the students. Most projects consisted of a small database infrastructure connected to a web-based user interface using HTML, Dreamweaver™, Flash™, or JavaScript™. Most groups used either Visual Basic.NET™ and Access™ or PHP™ and MySQL™; the programming languages and database skills are taught in prerequisite classes. The projects were developed in small teams of three to five team members.

The course topics followed the traditional four phases in SAD (planning, analysis, design, and implementation). Project management was added as an additional topic area, since project management had not been covered in any other class. After determining the sub-problems for each of the topics, the project management topic was split into project planning and soft skills required for project management. The project planning topic was combined with the SAD planning topic. Also, the analysis and design phases were combined into one topic. These topic areas created a natural progression of problems as recommended by first principles of instruction. The topics and individual problems are itemized in the Column 1 of Table 2. The associated goals (learning unit, course, college/accreditation) are listed in Column 2.

*Goals*

The IS curriculum in which the SAD class is taught does not strictly follow the IS 2002 model curriculum; therefore, the SAD (partially) covers topics from four different classes of the model curriculum. The learning unit goals, course goals and college/accreditation goals that were identified for this class are identified in Table 3. The mapping of the goals to the sub-problems is included in Table 2. Some of the goals are the same for all sub-problems within a specific topic (e.g., planning) and were assigned on the topic level, whereas others were more specific and were assigned on the sub-problem level (e.g., feasibility analysis).

*Assessment*

Five different assessment methods were used in the class: hands-on group projects, group presentations, homework assignments, quizzes, and individual presentations. The assessment methods are listed in Table 4.

The hands-on group project was the primary means of student assessment. Group presentations were used for general assessment of the planning, analysis/design phase and the implemen-

| Goals | | Assessment |
|---|---|---|
| **IS2002 Learning Unit (LU)** | | |
| to present necessary concepts to provide the skills necessary to do the analysis, modeling, and definition of information systems problems | LU72 | A3,A6 |
| to show how to collect and structure information in the development of requirements and specifications | LU74 | A8 |
| to show how to develop a logical design, and develop and analyze alternatives involving implementation using packages, tailoring of packages, constructing software, or CASE tools | LU75 | A8 |
| to show how to assess risks and feasibility | LU77 | A7 |
| to demonstrate and analyze small group dynamics as related to working with users | LU80 | A11 |
| to discuss the importance of finding synergistic solutions with team and clients | LU86 | A11 |
| to provide an opportunity to develop and use project management, project standards, and a system implementation plan, and to implement a documentation plan | LU94 | A11,A1,A3 |
| to provide opportunity to develop functional specifications for an information system, develop a detailed information system design, and develop information system application controls | LU96 | A7 |
| to show how to develop a conversion and installation plan, develop a hardware systems and environmental plan | LU97 | A8 |
| to show how to develop detailed program specifications, develop programs, set up system test parameters, install, and test the new system, implement the conversion plan, employ configuration management | LU98 | A9 |
| to show how to present a system design, test plan, implementation plan, and evaluation, in written and oral form | LU117 | A7,A8,A9 |
| to develop skills in analysis, design, and development of application software using a programming environment | LU100 | A2,A5,A11 |
| to identify differences between a structured, event-driven, and object-oriented application design and explain the implications of these approaches to the design and development process | LU101 | A2,A5 |
| to be able to develop program tests and system tests | LU103 | A11 |
| to ensure attitudes necessary for successful team behavior including empathetic listening, consensus negotiation, conflict resolution, and synergistic solution finding, and to apply the concept of commitment and rigorous completion | LU113 | A11,A4 |
| to ensure goal setting and alignment of team activities with project obligations | LU114 | A7 |
| to describe and explain life cycle concepts, and apply them to the course project | LU116 | A3,A11 |
| to ensure skills needed to design a project development and implementation plan | LU105 | A1,A3,A11 |
| to further develop and practice essential project management skills | LU106 | A1,A3,A11 |
| to develop skill in use of project management tools and methods within the context of an information systems project | LU107 | A1,A3 |
| **Course Goals (CG)** | | |
| Develop real-world information system | CG1 | A11 |
| Introduce students to different software development methodologies | CG2 | A6 |
| Develop UML skills | CG3 | A2,A5,A11 |
| Develop MS Project and Visio skills | CG4 | A1,A3,A5,A11 |
| Introduce students to emerging concepts in SAD and project management | CG5 | A10 |
| Develop project management soft skills | CG6 | A4 |
| **AACSB/College Goals (AG)** | | |
| Develop students oral and written communication skills | AG1 | A7,A8,A9,A10,A11 |
| Provide students with portfolio | AG2 | A11 |
| Lifelong learning | AG3 | A10 |
| Use of up-to-date IT tools | AG4 | A1,A3,A5 |

**Table 3: Goals with Mapped Assessment Method**

| Assessment Method | |
|---|---|
| Homework 1 | A1 |
| Homework 2 | A2 |
| Project Management Quiz 1 | A3 |
| Project Management Quiz 2 | A4 |
| UML Diagrams Quiz 3 | A5 |
| Final Exam | A6 |
| Group Project Presentation 1 | A7 |
| Group Project Presentation 2 | A8 |
| Group Project Presentation 3 | A9 |
| Individual Presentation | A10 |
| Hands-On Group Project | A11 |

**Table 4: Assessment Methods for SAD Class**

tation phases of the project. Homework and quizzes were used to assess important components, e.g., UML diagramming techniques that needed to be assessed on an individual basis. Individual presentations of related, up-to-date material were used to assess students' ability to acquire, analyze, synthesize and present new knowledge. Their presentation had to identify how the new knowledge related to topics already covered in class.

Because the described SAD course is considered the capstone course, it represents, in part, a reflection of the effectiveness of the departmental program. The completed information system could be used as part of the departmental assessment. Users and other stakeholders of the systems could be surveyed about the quality of the project (to assess technical skills) and the interaction with the team (to assess communication skills). The completed project, including documentation, also serves as a portfolio piece for the students.

*Integration*

Determining how to encourage students to integrate (transfer) and realize the importance of what they have learned can be a challenge. To address this final element, the instructor had former students (currently working full-time) and industry speakers visit the class and share their experiences related to how they had integrated into their careers the current topic under study. The classroom visits proved to be a valuable experience for students and provided an excellent opportunity for students to network with people in industry. Additionally, alumni guest presenters provided faculty with a more in-depth means of assessing the level to which former students had integrated academic learning into their careers than was possible via the traditional alumni survey of IS skills and knowledge used in the workplace [51].

*Continuous Improvement*

The instructor of the SAD course used the Computerworld e-mail newsletters (www.computerworld.com) as an effective resource for getting information about new developments in SAD and project management. New technologies/methodologies in SAD or project management are incorporated into the class each semester. Additionally, each student makes a 10-minute class presentation on one of the topics identified by the instructor in the class. Requiring students to research independently topics not included in their textbooks and then present that content to the class helps prepare students for future work experiences where they will be required to conduct and present independent research on emerging technologies and processes. The student presentations and current events (e.g., successful/failed projects, trends in the job market related to SAD, etc.) initiated stimulating class discussions.

In addition to incorporating new topics into the class content every semester, the instructor continuously updates the class by incorporating new developments, like new versions of UML, and new, real-world examples. This approach has proven to be very effective; the instructor consistently reaches above-average student evaluations.

**Micro Level: Topic design**

The problems identified in the macro level phase (Table 2) were used to design the individual lessons using the micro level model. To illustrate how the elements of the micro level can be applied, we present an example of one lesson: the development of structural models, namely, use case description and a use cases diagram. Application of each phase of the micro-level model as applied to this lesson is described below.

*Problem*

The sub-problem for this lesson was to develop use case descriptions and a use case diagram for the information systems on which the teams were working.

*Activation*

Prior knowledge was activated by having the students describe the steps involved in buying something online. Online shopping was selected because the majority of IS students had purchased something online before. Special attention was directed to the checkout process in order to prepare students for the issues of relationships between use cases.

*Demonstration*

The instructor provided an example of a completed use case and then discussed the elements. Together the instructor and students developed a detailed use case description for a case study. Students were asked what other use cases were needed for the case study, and the relationships among the use cases were discussed. The instructor demonstrated how to create a use case diagram in MS Visio while the students followed along in practice.

*Application*

The students applied the new knowledge to their projects by developing use case descriptions and a use case diagram for their projects. The instructor assessed student knowledge and provided correct-answer feedback while working one-on-one with each team in a lab environment. This informal assessment at the micro level helped students prepare for the later formal assessment at the macro level. Formal assessment at the macro level consisted of a homework assignment and a quiz where students developed use case descriptions, among other diagrams, for a hypothetical/fictional information system.

*Improvement*

The instructor monitored student performance in the lab (including student questions) to determine common problems from which a strategy for improvement the next semester would be developed. Problems encountered on the micro level often lead to changes in the teaching approach. One example of a problem we encountered was that students struggled with the include/extend relationship among use cases. To improve lesson design and correct the problem, the instructor extended the demonstration phase and included a wider variety of examples and non-examples of use case diagrams.

## IMPLICATIONS

AACSB or ABET accreditation [13, 38] and advances in information technology [12, 50] are two major forces obliging continual curriculum and lesson design in Information Systems departments. To develop or modify a full curriculum and all supporting instructional units requires a serious commitment of time, effort and money [13, 45]. Most of the intangible costs of accreditation are associated with keeping the program current for advances in technology [13] and are borne by faculty as part of their service commitment or instructional load. However, use of the two-level framework model, with its built-in assessment linked to learning goals, would facilitate the development of required accreditation reports. Further, a learning-centered model linking lesson and curriculum design would ensure the focus stays appropriately on student learning.

This study developed a comprehensive, two-level framework for information systems curriculum design, assessment and improvement centered on solving real-world problems. The macro level provides a general framework for overall course development, including goals and assessment methods. The macro level ensures that topics, goals and assessment methods are related to each other. The micro level provides a framework for individual lesson design and course pedagogy. The micro level model encourages the use of a progression of increasingly complex sub-problems as well as ensuring appropriate activation, demonstration, and application opportunities for each problem. This approach provides benefits for everybody involved in the educational system: deans and department heads, faculty members/instructors, students and employers. In the following paragraphs we discuss stakeholder benefits and related propositions associated with use of the comprehensive two-level framework for information systems curriculum design, assessment and improvement.

### Benefits for Department Heads and Deans

As part of their accreditation preparation, deans and department heads need the ability to report assessment measures related to curriculum, departmental and collegiate goals. Program accreditation can take five to seven years and consume a vast number of resources [13]. Following the proposed two-level framework for course and lesson development would ensure that assessment would be automatically integrated and available when needed, thereby enabling deans and department heads to comply with assessment and continuous improvement requirements set by accreditation bodies such as AACSB and ABET. Therefore, we make the following proposition:

**Proposition 1a.** Deans and department heads can use the information from the macro level model as a part of the college assessment and continuous improvement plan.

Additionally, department heads could use the combined macro and micro levels of the framework to evaluate teaching performance. The current validity and reliability of student evaluations related to faculty teaching performance is debatable [40, 52]. A better approach might be to require a macro and micro level model for each class so that department heads could more easily evaluate the pedagogical approach and topics, goals and assessment methods covered in the class. Relatedly, continuous improvement associated with teaching performance could be facilitated by mapping a class to the framework, identifying weaknesses, and collaboratively developing a plan for teaching improvement.

**Proposition 1b.** Department heads can use information from the macro and micro level models as part of the faculty teaching performance evaluation and subsequent mentoring recommendations for continuous improvement.

Following the framework allows department heads and curriculum committees to get the "big picture" of their curriculum. They can easily identify what topic areas are covered in the different classes, how classes relate to each other, and if college/department goals are incorporated into classes and assessed. This overall view provides a good basis for curriculum and course improvement.

**Proposition 1c.** Department heads and curriculum committees can use the information from the macro and micro level models for overall curriculum and course evaluation and improvement.

### Benefits for Faculty Members/Instructors

Course organization is considered one of the important factors affecting student evaluation of teaching [9, 34, 42]. The macro level can be used as a guideline in the design of the overall class and the syllabus. It ensures the class goals are centered on real-world problem statements: goals are mapped to sub-problems and assessment methods are mapped to goals. Following the macro model guarantees that these elements are included in the syllabus and that a strategy for integration of new knowledge and a plan for continuous improvement are developed.

**Proposition 2a.** Faculty members/instructors can use the macro level model to develop an overall course outline, including real-world problems, goals and assessment methods.

Instructors can also use the micro level model to develop effective lessons. Brightman [10] suggests that one of the keys to improving course organization is the use of diagrams that show the material interconnectedness. Perusal of models from the current and related or prerequisite classes enables faculty members/instructors to easily determine which topics have already been covered and refer to them in the activation phase. The macro and micro level models could be shared with students to help them see how the course is organized and how the current lecture builds on previous knowledge. The improvement phase of the micro model enables faculty members/instructors to assess how well the individual lessons map onto and develop students' knowledge.

**Proposition 2b.** Faculty members/instructors can use the micro

level model to design individual lessons.

**Benefits for Students**

Because solving real-world problems is at the heart of the proposed framework, students will encounter realistic challenges that approximate similar situations they will likely face when they enter the workplace. Additionally, students can use their projects to build a valuable portfolio for potential employers.

P**roposition 3a.** Students' learning is enhanced by solving real-world problems that prepares them to face similar challenges found in the workplace.

Integrating the macro and the micro models ensures that students engage in a curriculum that has been logically organized according to clear learning goals and that those learning goals are consistent with the instruction, student activities and testing components included in the course. The structured organization of the course allows students to see how topics relate to each other and where/how the current lesson fits into the big picture. Students deserve to know the specific goals and expectations for a course. The macro level provides four specific items related to goals and expectations:

- *Identify what students will do.* The model provides specific topics and problems to be solved in the course.
- *Define why the topics and problems are relevant.* The model links overall goals and sub-problems. Linking the topics and sub-problems to department, college, and national learning guidelines such as IS 2002 helps the student understand how the course benefits their education.
- *Identify how students will demonstrate competency.* The macro model includes information on how the topics and problems will be assessed.
- *Ensure that content is current and applicable.* The incorporation of continuous improvement at the macro level ensures that students get up-to-date knowledge and skills that are marketable to employers.

**Proposition 3b.** Students' learning is enhanced through logical course organization and relevant course material.

The micro level provides support for motivating students and helping them to think critically. The activation phase provides students with an opportunity to reflect and share knowledge based on their prior experiences. Engaging students in a discussion to help them create a bridge from prior experiences to new content is a valuable strategy to motivate students. The demonstration phase encourages students to stay motivated and fosters critical thinking. Students know ahead of time they will be responsible for solving problems based on the content presented in the demonstration phase. The application phase requires students to solve problems using critical thinking skills rather than simply choosing the best option from instructor-selected solutions [47].

**Proposition 3c.** Students' learning is enhanced by participating in a learning environment that is motivating and promotes critical thinking.

**Benefits for Employers**

The center of both models is real-world problem solving. This hands-on approach ensures that students are solving meaningful problems that are similar to what they will encounter in their future workplace.

**Proposition 4a.** Employers recruiting students from colleges/departments that follow the framework can be assured that students have experience in real-world problem solving.

The application of advanced IT techniques (e.g., data warehousing, data mining, RFID) becomes increasingly important for companies to gain a competitive advantage. Employers look for students that have knowledge and skills in both IS fundamentals and emerging technologies. Since the framework puts great emphasis on improvement at both the macro and micro levels, using the framework would ensure that students get an education that has a good balance of knowledge and skills in IS fundamentals and emerging technologies.

**Proposition 4b.** Employers recruiting students from colleges/departments that follow the framework can be ensured that students have the necessary skills needed in today's job market.

## FUTURE RESEARCH

More work is needed to validate each of the above propositions. Empirical research would demonstrate the utility of this model to develop a strong IS curriculum. Additionally, use of this framework to identify weakness in the overall curriculum or specific courses may be used as justification for course-development release time.

Implementation of the framework needs to be replicated in different classes. We successfully implemented the two-level framework for information systems curriculum design, assessment and improvement in a systems analysis and design class. We encourage others to report their experiences and "best practices" as they implement this framework in other IS courses. A repertoire of curriculum/course design approaches would strengthen the entire IS field.

The framework is especially useful for IS curriculum design because the constant change of the field requires frequent updates of the topics taught. A future assessment of the framework may include applying it to other business curricula and ultimately to other disciplines. As a socio-technical field, IS is an integral part of all functional business areas (especially marketing, management, operations, and accounting). Therefore, the macro model of the framework necessarily includes integration with those fields. On the technical side, IS is integrated with computer science and software engineering concepts and must therefore consider that curricula and how it relates to the IS curricula. Future research would assess the IS-related disciplines to determine (a) how well that curricula is optimizing the integration of IS knowledge/skills and (b) what knowledge/skills from those fields we can assume students have when entering our IS courses.

Use of the comprehensive two-level framework for IS curriculum design, assessment and improvement could be used by textbook authors. Textbooks currently provide a wealth of infor-

mation on specific topics but little advice on how to teach that material. Ideally, textbook authors would address all aspects of the framework. On the macro level they could incorporate general advice and provide resources for continuous improvement (e.g., websites with links to newsgroups). On the micro level textbook authors could provide advice on how to present each phase in the classroom. For example, authors could design case studies targeted toward each phase of the micro models. They could also develop topical teaching briefs classified by model phase (e.g., a demonstration of a use case).

An additional area for future research is to study the process IS departments use to develop and organize their assessment plans and compare the existing plan with the comprehensive two-level framework. For example, one of the authors is involved with a SWOT (strengths, weaknesses, opportunities, threats) analysis in preparation for AACSB re-accreditation. Although an effective overall approach to assessment, the SWOT analysis is weak regarding individual course/lesson design and assessment. A comparative approach of identified strengths/weaknesses of the two-level framework with an existing assessment plan could help prepare programs and colleges for accreditation.

In summary, we have shown in this paper the effectiveness of extending the first principles of instruction design approach [35] into a comprehensive two-level framework for IS curriculum design, assessment and improvement. The macro and micro levels of the framework enable all educational stakeholders to benefit from instruction which is based on a sound pedagogical approach. The design and assessment of each lesson is mapped to learning, curriculum, and accreditation assessment goals. Further, the two-level framework incorporates the continuous improvement of courses and curriculum so that students are well prepared to contribute meaningfully in a workplace environment.

## REFERENCES


[1] AAA "Future accounting education: Preparing for the expanding profession". *Issues in Accounting Education* Spring 1:(1), 1986, 168-195.

[2] AACSB. (2001). Standards for Business Accreditation, accessed January 25, 2007, available at http://www.aacsb.edu/.

[3] ABET. (2004). Criteria for accrediting computing programs, accessed January 20, 2007, available at http://www.abet.org/.

[4] Alavi M. "Computer-mediated collaborative learning: An empirical evaluation". *MIS Quarterly* 18:1994, 159-174.

[5] Anderson J. R. *Cognitive psychology and its implications*. W.H. Freeman and Co., New York, NY 1985.

[6] Bailey J. & Mitchell R. B. "Industry Perceptions of the Competencies Needed by Computer Programmers: Technical, Business, and Soft Skills". *Journal of Computer Information Systems* 47:(2), 2006, 28-33.

[7] Becker K. "First principles of instruction". *Journal of computing sciences in colleges* 22:(2), 2006, 77-84.

[8] Blanchard P. N. & Thacker J. W. *Effective training: Systems, strategies, and practices.* Pearson Prentice Hall, Upper Saddle River, New Jersey 2007.

[9] Brightman H. J. Using student evaluation of instructor data to improve teaching. Las Vegas, NV, 1998.

[10] Brightman H. J. "Mentoring Faculty to Improve Teaching and Student Learning". *Decision Sciences Journal of Innovative Education* 3:(2), 2005, 191-203.

[11] Broad M. L. & Newstrom J. W. *Transfer of training: Action-packed strategies to ensure high payoff from training investments.* Addison-Wesley, MA 1992.

[12] Brookshire R. G., Yin R. L., Hunt C. S. & Crews T. B. "And End-User Information Systems Curriculum for the 21st Century". *Journal of Computer Information Systems* 47:(3), 2007, 81-88.

[13] Challa C. D., Kasper G. M. & Redmond R. "The Accreditation Process for IS Programs in Business Schools". *Journal of Information Systems Education* 16:(2), 2005, 207-216.

[14] Chen C. "A constructivist approach to teaching: Implications in teaching computer networking". *Information Technology, Learning and Performance Journal* 21:(2), 2003, 17-27.

[15] Collis B. & Margaryan A. "Design criteria for work-based learning: Merrill's first principles of instruction expanded". *British Journal of Educational Technology* 36:(5), 2005, 725-738.

[16] Daigle R. J., Longenecker Jr. H. E., Landry J. P. & Pardue J. H. "Using the IS 2002 Model Curriculum for Mapping an IS Curriculum". *Information Systems Education Journal* 2:(1), 2004, 7.

[17] Denton J. W., Kleist V. F. & Surendra N. "Curriculum and Course Design: A New Approach Using Quality Function Deployment". *Journal of Education for Business* 81:(2), 2005, 111-117.

[18] Foxon M. "Transfer of training: A practical application". *Journal of European Industrial Training* 11:(3), 1987, 17-20.

[19] Foxon M. "A process approach to the transfer of learning". *Australian Journal of Educational Technology* 10:(1), 1994, 1-18.

[20] Gagné R., Briggs L. & Wager W. *Principles of Instructional Design*. Rhinehart and Winston, New York, NY 1988,

[21] Gill G. & Hu Q. "The evolving undergraduate information systems education: A survey of U.S. institutions". *Journal of Education in Business* 74:1999, 1-13.

[22] Gorgone J. T., Davis G. B., Valacich J. S., Topi H., Feinstein D. L. & Longenecker Jr. H. E. (2002). IS 2002 Model Curriculum and Guidelines for Undergraduate Degree Programs in Information Systems, accessed January 06, 2007, available at http://www.acm.org/education/is2002.pdf.

[23] Hansen J. D. "Using Problem-Based Learning in Accounting". *Journal of Education for Business* 81:(4), 2006, 221-224.

[24] Holton E. F. & Baldwin T. T. *Improving learning transfer in organizations*. Jossey-Bass, San Francisco, CA. 2003,

[25] Jonassen D. H. & Hernandez-Serano J. "Case-Based Reasoning and Instructional Design: using Stories to Support Problem Solving". *Educational Technology Research and Development* 50:(2), 2002, 65-77.

[26] Keys A. C. "Using Group Projects in MIS: Strategies for Instruction and Management". *Journal of Computer Information Systems* 43:(3), 2003, 18-26.

[27] Koppenhaver G. D. & Shrader C. B. "Structuring the classroom for performance: Cooperative learning with instructor-assigned teams". *Decision Sciences Journal of Innovative Education* 1:(1), 2003, 1-21.

[28] Kung M., Yang S. C. & Zhang Y. "The Changing Information Systems (IS) Curriculum: A Survey of Undergraduate Programs in the United States". *Journal of Education in Business* 81:(6), 2006, 291-300.

[29] Lee D., Trauth E. & Farwell D. "Critical skills and knowledge requirements of IS professionals: A joint academic/in-

dustry investigation". *MIS Quarterly* 19:1995, 313-340.
[30] Lee S., Koh S., Yen D. & Tang H. "Perception gaps between IS academics and IS practitioners: An exploratory study". *Information & Management* 40:2002, 51-61.
[31] Lightfoot J. M. "Fads Versus Fundamentals: The Dilemma for Information Systems Curriculum Design". *Journal of Education for Business* 75:1999, 43-50.
[32] Liker J. K. & Meier D. *The Toyota Way Fieldbook*. McGraw Hill 2006,
[33] Maier J. L. & Gambill S. "CIS/MIS curriculums in AACSB-accredited colleges of business". *Journal of Education for Business* 71:1996, 329-333.
[34] Marks R. B. "Determinants of student evaluations of global measures of instructor and course value". *Journal of Marketing Education* 22:(2), 2000, 108-119.
[35] Merrill M. D. "First principals of instruction". *Educational Technology Research and Development* 50:(3), 2002, 43-59.
[36] Merrill M. D. "A pebble-in-the-pond model for instructional design ". *Performance Improvement* 41:(7), 2002, 39-44.
[37] Mierson S. & Freiert K. "Problem-Based Learning". *Training & Development* 58:(10), 2004, 15-17.
[38] Mitri M. "Using Decision Support Systems to Enhance Learning in Higher Education". *Journal of Computer Information Systems* 42:(4), 2002, 84-93.
[39] Mykytyn P. P., Mykytyn K. & Harrison D. A. "Integrating intellectual property concepts into MIS education: An empirical assessment". *Decision Sciences Journal of Innovative Education* 3:(1), 2005, 1-27.
[40] Nerger J. L., Viney W. & Riedel R. G. "Student ratings of teaching effectiveness: Use and misuse". *The Midwest Quarterly* 38:(2), 1997, 218-233.
[41] OSRA. (2004). Organizational & End-User Information Systems Model Curriculum, accessed January 24, 2007, available at http://pages.nyu.edu/~bno1/osra/model_curriculum/.
[42] Paswan A. K. & Young Y. A. "Student Evaluation of Instructor: A Nomological Investigation Using Structural Equation Modeling". *Journal of Marketing Education* 24:(3), 2002, 193-202.
[43] Peslak A. R. "Incorporating Business Processes and Functions: Addressing the Missing Element in Information Systems Education". *Journal of Computer Information Systems* 45:(4), 2005, 56-61.
[44] Piccoli G., Ahmad R. & Ives B. "Web-based virtual learning environments: A research framework and preliminary assessment of effectiveness in basic IT skills training". *MIS Quarterly* 25:(4), 2001, 401-426.
[45] Pringle C. & Mitri M. "Assessment Practices in AACSB-Accredited Business Schools". *Journal of Education in Business* 82:(4), 2007.
[46] Savery J. & Duffy T. Problem based learning: An instructional model and its constructivist framework. *Designing constructivist learning environments* 135-148. Educational Technology Publications Englewood Cliffs, NJ 1995.
[47] Schank R. C. *Designing World-Class E-Learning : How IBM, GE, Harvard Business School, And Columbia University Are Succeeding At E-Learning*. McGraw-Hill, Boston, MS 2002,
[48] Shah V. & Martin R. "Future changes in the computer information systems curriculum". *Journal of Computer Information Systems* 37:(3), 1997, 74-78.
[49] Smith M. E., Zsidisin G. A. & Adams L. L. "An Agency Theory Perspective on Student Performance Evaluation ". *Decision Sciences Journal of Innovative Education* 3:(1), 2005, 29-46.
[50] Tang H. L., Lee S. & Koh S. "Educational Gaps as Perceived by IS Educators: A Survey of Knowledge and Skill Requirements". *Journal of Computer Information Systems* 41:(2), 2000, 76-84.
[51] Tesch D. B., Crable E. A. & Braun G. F. "Evaluating IS Curriculum Issues Through an Ongoing Alumni Assessment Mechanism". *Journal of Computer Information Systems* 44:(2), 2003, 40-48.
[52] Wilson R. C. "New research casts doubt on value of student evaluations of professors". *Chronicle of Higher Education* 44:(19), 1998, A12-A14.

## APPENDIX A:
## AACSB ASSURANCE OF LEARNING STANDARDS

The following AACSB assurance of learning standards are most relevant to our proposed framework:

- Standard 9: Demonstrate how faculty members and staff fulfill the functions of curriculum development, course development, course delivery, assessment of learning
- Standard 12: The business school's faculty in aggregate, its faculty subunits, and individual faculty, administrators, and staff share responsibility to:
  - ✧ Evaluate instructional effectiveness and overall student achievement.
  - ✧ Continuously improve instructional programs.
  - ✧ Innovate in instructional processes.
- Standard 13: Individual teaching faculty members:
  - ✧ Keep their own knowledge current with the continuing development of their teaching disciplines.
  - ✧ Actively involve students in the learning process.
  - ✧ Encourage collaboration and cooperation among participants.
  - ✧ Ensure frequent, prompt feedback on student performance.
- Standard 15: Management of Curricula: The school uses well documented, systematic processes to develop, monitor, evaluate, and revise the substance and delivery of the curricula of degree programs and to assess the impact of the curricula on learning.
- Standard 16: Bachelor's or undergraduate level degree: Knowledge and skills. Adapting expectations to the school's mission and cultural circumstances, the school specifies learning goals and demonstrates achievement of learning goals for key general, management-specific, and/or appropriate discipline-specific knowledge and skills that its students achieve in each undergraduate degree program.

## APPENDIX B:
## DESIGN QUESTIONS

The appendix contains questions (adapted from [36]) that help with the implementation of the different phases of both models.

- Questions to help design the macro level problem phase:
  - ✧ What will the realistic environment include (i.e.,

real-world clients)?
  - ✧ How will this environment be conveyed to the students?
  - ✧ What topic areas need to be covered to complete the whole task?
  - ✧ What problems must be solved for each topic area?
- Questions to help design the macro level course goals phase:
  - ✧ What are the goals for the course?
  - ✧ What are the common department or collage goals?
  - ✧ What other goals does your department track (i.e., IS 2002)?
  - ✧ How do these goals map to your identified topics and problems
- Questions to help design the macro level assessment phase:
  - ✧ What assessment tools are you planning for each identified problem?
  - ✧ Are the assessment tools appropriate for the identified problems the students are solving?
  - ✧ Will students have an opportunity to create quality portfolio items?
  - ✧ Do the assessment tools used in the class satisfy AACSB/ABET assessment goals?
- Questions to help design the macro level integration phase:
  - ✧ Will students have an opportunity to reflect-on, discuss, and defend their new knowledge or skill?
  - ✧ Do students have an opportunity to publicly demonstrate their new knowledge?
  - ✧ Do students have an opportunity to observe or discuss with professionals who are already using the knowledge taught in the classroom in the workplace?
  - ✧ Will students have an opportunity to create an action plan to help facilitate the transfer of knowledge to the workplace?
- Questions to help design the macro level improvement phase
  - ✧ What journals specifically deal with this course?
  - ✧ What conferences address current trends and topics from this class?
  - ✧ Are there any discussion groups that focus on this subject matter?
  - ✧ Is my course up-to-date and consistent with current IS curriculum models?
- Questions to help design the micro level problem phase:
  - ✧ Get problem and associated goals from the Macro Level Model?
  - ✧ Work the problem to determine every step required to solve the problem
  - ✧ What additional problems are associated with main problem?
- Questions to help design the micro level activation phase:
  - ✧ What prior knowledge do students possess about the topic from my class?
  - ✧ What prior knowledge do students possess about the topic from other classes?
  - ✧ What prior knowledge do students possess related to the topic from other areas of their lives?
  - ✧ How can prior knowledge be activated?
- Questions to help design the demonstration phase :
  - ✧ How can I demonstrate the topic?
  - ✧ What examples would be appropriate?
  - ✧ Are the demonstrations consistent with the instructional goals?
  - ✧ Would media enhance learning?
- Questions to help design the application phase:
  - ✧ What are the students be expected to do?
  - ✧ Do learners have an opportunity to apply their newly acquired knowledge or skill?
  - ✧ Is the application consistent with the instructional goals, and does it involve a varied sequence of problems with feedback?
  - ✧ What is the assessment tool for this activity (from Macro level)?
  - ✧ Is this assessment consistent with the knowledge, skills, and attitudes being taught
  - ✧ Will this assessment be a valuable experience for the students (i.e., serve as a portfolio piece)?
- Questions to help design the Lesson Improvement phase:
  - ✧ What components of this lesson segment were effective?
  - ✧ What components of this lesson need to be improved?
  - ✧ What components of this lesson need to be removed?
  - ✧ How did I receive feedback related to lesson improvement?