A Framework For MIS Student Outcome Assessment And Program Review

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Introduction

Business schools and programs are under increasing pressure from accrediting bodies to develop and implement a cohesive, documented, and theoretically sound method for assessing student outcomes (Michlitsch and Sidle, 2002). For schools accredited by Association to Advance Collegiate Schools of Business, outcomes assessment and review is an integral component of the continuous improvement standard (AACSB, 2003). This paper outlines the development of a systematic and practical methodology for assessing program effectiveness and monitoring student development in the undergraduate MIS program. The model is a result of multiple needs identified during curriculum revitalization sessions and is responsive to additional issues relating to program assessment review, institutional effectiveness, and a student electronic portfolio project.

Expectations of IS Graduates – The Need to Respond to Change. Academics and industry practitioners have recognized that an "Expectation Gap" exists between the preparation of students upon completion of undergraduate MIS programs and the demands placed on them in career-track positions (Trauth, Farwell, and Lee, 1993). Several studies have attempted to define a set of requisite competencies for entering career-track positions in the IS industry. Some produce a content-oriented curriculum guide (Maier and Gambill, 1996, Davis, et al, 2002) while others focus on meta-competencies such as communication and integration skills (Yen, Lee, and Koh, 2001).

Our research agenda was to develop a model for ongoing individual student outcomes assessment and program curricular review. The following sections of this paper present a discussion of the needs of the academic, business, and student constituencies for an effective model for student outcome assessment, a description of the development and design of the framework, and practical guidelines for its implementation. We conclude by discussing the implications for curricula in higher education with regard to administration research and practice.

Traditional Outcomes Assessment. Historically, outcomes assessment in the MIS program at our university has been accomplished by conducting interviews with graduating seniors, recent alumnae, and employers of recent alumnae. Additionally, an advisory board comprised of industry practitioners provides a semi-annual review of the MIS program. While these efforts have yielded valuable input, they are, by nature, *post hoc* approaches to measuring the effectiveness of curriculum and delivery. Additionally, these inputs lack formal structure and are often subjective. With the rapidly changing content of the field, such an approach is less than optimal for maintaining currency of curriculum and assessing student preparation. The demands of changing technology are complicated by the traditionally minor role of curriculum development in rewarding faculty in higher education (Trauth, Farwell, and Lee, 1993).

In our program, efforts have been ongoing for the past three years to implement a more timely and methodical approach for measuring student outcomes and the adequacy of their preparation for the job market. One initiative was to develop and administer a web-based survey for employers and alumnae to use instead of paper surveys. More input is has been gathered as a result of this effort, but the nature and usability of the data has not changed. Based on the MIS faculty's collective desire for improvement and a perceived need to respond to ongoing university initiatives, a team of faculty from the MIS program began working toward creation of a practical and

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sound model for student development that can measure students' progress toward demonstrating their ability to employ the competencies and skills that are necessary to succeed as IS professionals.

The Portfolio Project – Documentation and Reflection. In 1999, our institution began exploring the feasibility of a campus-wide electronic portfolio system for documenting and supporting student development. Such initiatives have met with some success at other institutions (Cambridge, et al, 2001). At least one institution has built its entire student assessment system around an E-Portfolio, and no longer issues grades (Doherty, Riordan, and Roth, 2002). In this case, the E-Portfolio was a technological update of a long-held view of broad competency development as the appropriate measure of educational outcomes (Earley, Mentkowski, and Schaefer, 1980).

Our electronic portfolio initiative necessitated identification of student competencies, attainment of which could then be documented reflectively by the students and their instructors. Some competencies were non program-specific, and thus suitable for inclusion in *all* student portfolios campus-wide. The portfolio template also left open the possibility of school, program, and even individual student-level competencies that would collectively define the preparedness of graduating students. Once competencies have been defined, students and faculty work together to provide input to document progress toward competency achievement. Such input can be in multiple media formats, providing a rich channel for communicating and reflecting on learning. An example of a competency based portfolio is shown in Appendix A.

Developmental Design:
Competency Clusters And Development Phases

Implementation of an E-Portfolio template provided an opportunity to identify program-level competencies for MIS majors. Program-centered competency clusters are not new in business disciplines. The AICPA has established nationally recognized competencies for Certified Public Accountants (Briggs, 2002).

Competency Clusters. Our assessment model is built on the concept of four core competency clusters. We developed these competency clusters from the literature describing valid research into the kinds of knowledge and skills that are known to be necessary for success as a practitioner in the MIS field. Each of these clusters: *Technical*, *Analytical*, *Communicative*, and *Managerial*, consists of a set of tangible abilities that can be measured. The four competency clusters and their corresponding operational definitions are presented in Table 1.

Table 1: Competency Clusters in Student Outcomes Assessment

Competency Cluster	Operational Definition
Technical	An understanding of the mechanics of information technology and the importance of system performance in achieving organizational goals and the ability to appropriately use information technology tools.
Analytical	The ability to identify and define organizational problems and propose reasonable solutions. This includes problem framing and boundary issues as well as logical cause and effect.
Communicative	The ability to communicate orally and in writing cogently and succinctly. This includes the ability to describe a problem in business terms and to structure communications in an acceptable business format.
Managerial	The ability to coordinate and direct the efforts of others toward an organizational goal. This includes the ability to identify, state and execute goal directed plans.

Identifying core competencies relating to academic programs, careers, and life paths is not a new idea (Evers, Rush, and Berdrow, 1998). In the specific arena of academics, many efforts have been made to identify such competencies and build curricula around them (Briggs, 2002; Mikolaj and Baker, 2001). The four "Competency

Clusters" we have identified are grounded in these prior works and others, from both content and methodology perspectives.

The necessity of *technical* competence as a core program outcome is supported by many prior works investigating critical success factors for the IS professional. As MIS is considered a highly technical field, a naïve approach to outcomes assessment might include only this competency. Several researchers have studied the effectiveness of MIS programs in preparing students for professional positions in the industry (Davis, et al, 2002; Maier and Gambill, 1996). As expected, technical ability such as programming skills and the ability to appropriately use information technology tools were strongly represented in both the actual (Maier and Gambill) and desired (Davis, et al) skill sets.

The necessity for IS professionals to be able to demonstrate analytical competency is consistent with Trauth, Farwell, and Lee's (1995) observation that "analyzing business problems and finding effective IS solutions will hence become the single most important activity for IS in the future." A related construct that is frequently found in lists of desired learning outcomes is *critical thinking*. We subsume this characteristic into the *analytical* competency. Critical thinking is generally described as requiring students to "…not only master the information, but also develop an understanding of the discipline, enough to think about (and question) the information" (McEwen, 1994). Students who steadily progress in analytical ability will emerge from the program able to adapt existing knowledge to new and challenging situations.

The *communication* competency is supported by Yen, Lee, and Koh (2001) in their placement of interpersonal and organizational knowledge (among others) on a list of four critical IS skills. Parasuraman, Zeinthaml, and Berry (1985) include communication as a critical foundational skill in their general model of service quality (SERVQUAL), which has been cited in the quality research of many disciplines, including IS (Carr, 2002). Rational persuasion and personal appeal are communication skills that were identified by Enns, Huff, and Higgins (2003) as critical to CIO's ability to influence top managers.

Managerial competency, as we use it in this framework, has the broadest definition. Other competency maps assign several constructs to cover this range of behaviors. For example, Willcocks and Sykes (2000) identify IT leadership, business systems thinking, architecture planning, and relationship building, among others, as "…key in-house IT capabilities." Although leadership is often identified as a separate individual competency (Briggs, 2002), we subsume it in the managerial competency. A more specific "management of IT" competency is identified by Bassellier, Reich, and Benbasat (2001) as a critical component of business managers' IT competence. Components of this construct can be found in each of the technical *and* managerial competencies, depending on the nature of the component.

The competency clusters developed for our model were tested for acceptance using four groups. The MIS program Advisory Board, faculty, and students, as well as a group of MIS academics used as external reviewers, were polled for agreement with the four competencies as a complete framework for required skills and abilities for the IS professional. Each of the four groups positively endorsed the competency clusters as defined.

Developmental Stages. Student learning within each of these competency clusters can form a basis for a measurable continuum along which individuals progress. We believe that as students progress through the MIS program, they should achieve higher levels of competency within each of these areas. In other words, we expect that a senior-level student will be able to demonstrate higher competency in each area than when he or she was a sophomore.

Measurement of a student's achievements using these competency clusters yields considerable insight into how well prepared a student is for employment. When the achievements of all students are considered, insight can be gained into how well the curriculum is facilitating intellectual growth and actual ability. Therefore, students' progress on these competencies can, collectively, form a measure of the effectiveness of the design and execution of the degree program curriculum. Implicit to the idea of student outcomes assessment is the thought that measurement of student progress must be based upon something more robust than simple completion of the program elements (i.e.

required classes). In order for valid program assessment to be possible, the assessment must determine the degree to which learning activities lead to students' ability to demonstrate and apply appropriate skills.

A student's ability to simply complete the degree program may be indicative of some minimum standard. However, degree completion does not indicate the unique level to which each student is prepared for entry into the IS field or which of an individual's talents is either exceptional or in need of improvement. Even the student transcript falls short of providing a comprehensive review of competencies, since all courses require demonstration of multiple competencies. Nor does the transcript provide documentation of the specific abilities demonstrated by the student during the learning experience (what can they *do*?). Thus, employers typically rely on oral interviews and "faith" in a program to determine the abilities of a prospective employee/graduate.

Progress in each of the four competency clusters defined above can be measured. We have identified five developmental stages that are appropriate to describing the level of learning achieved by students as they move toward completion of the curriculum. In effect, we expect students to move from the lowest-level stages (*user*, *problem* identifier) to the highest-level (*solution implementer*) stage in each of the four competencies by the time they graduate. Each developmental stage and an operational definition of the stage is listed in Table 2.

Table 2: Developmental Stages in Student Outcomes Assessment

Developmental Stage	**Operational Definition**
User	The expected incoming competency level of students in our program. Competency building needed to reach this developmental stage will be considered remedial
Problem Identifier	Well versed in basic business skills, this individual is able to identify organizational problems (particularly information-based problems) and to state them using business terminology.
Problem Solver	Able to form potential solutions to organizational problems (particularly information-based problems) and select the most appropriate one based on organizational impact and feasibility.
Solution Implementer	Able to manage the efforts of others to plan and execute solutions to organizational problems. Able to cope with unexpected complications within a framework of priorities and constraints.

The terminal stage of "*Solution Implementer*" is conceptually consistent with prior work in student preparedness for IS careers. Trauth, Farwell, and Lee (1993), for example, propose the term "Integrator" to identify someone who can "… carry out enterprise-wide tasks". Business Process Reengineering (Hammer and Champy, 1993) is one such global task. Smaczny (2001) expands somewhat on the idea of Solution Implementer in his "Fusion" construct. An IT manager achieves fusion when IT strategies are not only successfully implemented, but implemented in concert with the organization's strategic objectives.

A half-century old taxonomy of learning objectives is still widely cited in current assessment literature. Bloom, et al (1956) proposed that the following educational outcomes adequately described the process of effective learning: Knowledge, Comprehension, Application, Analysis, Synthesis, and Evaluation. In order to more effectively utilize Bloom's taxonomy in curricular studies, Krathwohl (2002) has re-formulated it into two parallel taxonomies – knowledge and cognitive process. The cognitive process dimension is a close parallel to our stage model of professional development.

Krathwohl's (2000) cognitive processes are: Remember, understand, apply, analyze, evaluate, and create. These processes map to our learning stages is presented in Figure 1.

The *user* level in our learning stage model denotes readiness to begin the process of professional development within our program. Mapping only the highest three levels of development to Krathwohl's adaptation of Bloom's taxonomy reflects this positioning. Remembering and understanding are consistent with the operational definition of a Problem Identifier in Table 2. To complete this stage, we expect students to remember and understand basic business principles, so that the business implications will be recognized in the practical case problems they will encounter in lower level MIS courses.

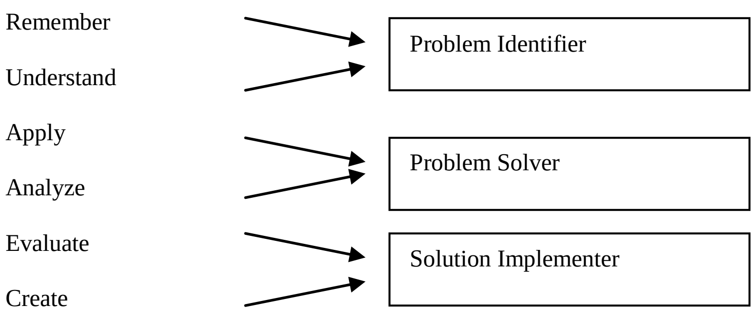

Figure 1: Cognitive Processes and Developmental Stages

Students that have attained the *problem solver* developmental stage have demonstrated the ability to 'form potential solutions' [apply] and 'select the most appropriate one based on organizational impact and feasibility [analyze]. Finally, students that have attained the *solution implementer* developmental stage can 'plan and execute solutions' [create] and 'cope with unexpected complications within a framework of priorities and constraints [evaluate]. Bloom's original taxonomy (1956) as revised by Krathwohl (2002) serves very well as a foundational construct for our hierarchy of developmental stages.

Putting Theory Into Practice:
Demonstrated Abilities And Key Learning Activities

Measurement of a student's development within each of the four competencies described above can be achieved by determination of what they can *do*. A widely accepted model of experience and learning is proposed by Kolb (1978). He posits that learning is most effectively facilitated and measured by iteratively offering learners new experiences, the opportunity to reflect, and a mandate to use their derived conceptions to interpret/solve new problems. To this end, we have identified *demonstrated abilities* (DAs) that are appropriate to each competency and developmental phase. Simply stated, demonstrated abilities are tangible, documented results of students' work in practical exercises or activities. These demonstrated abilities may or may not result from a classroom exercise; several result from co- or extra-curricular activities.

Demonstrated Abilities. The concept of how demonstrated abilities related to each competency and developmental phase is shown in Figure 2, the Student Outcomes Assessment Matrix. Demonstrated abilities are associated with the intersection of a developmental stage and a competency, rather like a field in a database table that represents the intersection of an attribute and a tuple.

DEVELOPMENTAL STAGES

COMPETENCY CLUSTERS

	Technical	Analytical	Communicative	Managerial
USER				
PROBLEM IDENTIFIER		**DEMONSTRATED ABILITIES**		
PROBLEM SOLVER				
SOLUTION IMPLEMENTER				

Figure 2: The Student Outcomes Assessment Matrix

Appendix A lists the DAs we have developed for every combination of developmental stage and competency cluster. In operationalizing our student outcomes assessment model, demonstrated abilities are assigned points that accumulate as more DAs are completed. The points are then used to determine whether a student has completed a developmental phase in a given core competency.

Key Learning Activities. Key learning activities (KLAs) are the actions that a student undertakes which, when successfully completed, result in a demonstrated ability. KLAs may be classroom based or they may be associated with organizations or events outside of the classroom. In our program curriculum, each class has a set of three to five KLAs that are appropriate to the topics within the course and lead to specific demonstrated abilities. For example, in the systems analysis class, a key learning activity might be a case study that requires the student to develop a set of data-flow diagrams. Successful completion of this assignment allows the student to demonstrate the ability to develop a data-flow diagram, given certain information – a demonstrated ability within the analytical competency cluster.

Successful completion of a key learning activity will allow a student to clearly document that he or she has demonstrated the skill to do one or more of the demonstrated abilities listed in Figure 3. Instructors have identified KLAs for each required MIS course in our curriculum.

This approach allows for assessment by observing process, outcomes, or both during the term (Michlitsch and Sidle, 2002). A standardized web form is used to define, justify, and establish metrics for KLAs for each course. Once identified, the KLAs are included in the Master Course Outline that is approved by the faculty and serves as a template for instructor syllabi. A minimum grade for each KLA is required in order to receive credit (points) for the demonstrated abilities associated with the KLA. The minimum grade varies with the KLA and is determined by the instructor.

Record Keeping. While it is each student's responsibility to manage his or her own portfolio, including outcomes assessment, the MIS program has developed a web-enabled database for data entry and tracking. At the end of each semester, each faculty member enters the grade of each student on each KLA. The database automatically calculates the points earned on each demonstrated ability and totals the points the student has earned within the appropriate competency/developmental phase cell.

Each student is able to print a report showing his or her demonstrated abilities and his or her status in each competency cluster. Once a student has earned a predetermined number of points associated with a particular developmental level in a particular competency, he or she is said to possess a particular level of development within the competency. For example, when a student has earned the predetermined number of points in the cell associated with the Problem Solver developmental level for the Analytical competency, the student is considered an Analytical Problem Solver. The goal of the program is to have each student obtain the points necessary to be a Solution Implementer in each of the four core competency areas. Students who obtain the points necessary to be a Solution Implementer in each of the four core competency areas graduate "with distinction" from the MIS program.

Curricular Development. Although this project was originally intended to provide a structured, formalized means for assessing student outcomes, a complimentary by-product was quickly identified. In addition to providing students a way to document their demonstrated abilities, this model allows for curricular review. Gap analysis can show deficiencies in the curriculum based upon the students' cumulative abilities to demonstrate competence. For example, if analysis indicates that most students are not demonstrating communicative skills at the Solution Implementer level, the curriculum can be adjusted to provide more emphasis on oral and written communication appropriate to that developmental level. Detecting "developmental gaps" during the university experience will help avoid "expectation gaps" (Trauth, Farwell and Lee, 1993) upon entry into the workforce.

Summary And Conclusions

A stage model for student outcomes assessment has been presented in this paper. The model is based upon student development along four competency clusters that MIS research has recognized as important to be a successful MIS practitioner. Progress in developing these competencies is measured by what students can *do* (demonstrated abilities) as they move to higher developmental phases. Key learning activities provide the opportunity for students to demonstrate and document these abilities.

The model is intended to be a practical means of determining students' preparation for entry into the workforce that is justified through what is formally known about industry needs in IS professionals and student learning. The model can measure progress of individual students and serve as a proxy for the effectiveness of the MIS program. Aggregate results can be used for ongoing program assessment and review. Additionally, data can be used by academic advisors in the guidance of their advisees into certain coursework or specialties. Documentation resulting from this approach can also be helpful in clearly presenting assessment efforts to external accrediting bodies.

Our work has been developmental in nature. As such, we expect that refinements and modifications will be necessary over time as more is learned about effective assessment and as our field continues to change. This is especially true for the demonstrated abilities presented in Appendix A. The model is not proposed as an "end-all" to student outcomes assessment and curricular review; instead, we envision this as an additional, formal and structured tool to assist in an important and meaningful process.

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APPENDIX A:
THE STUDENT OUTCOMES ASSESSMENT MATRIX

DEVELOPMENTAL STAGES

COMPETENCY CLUSTERS

	Technical	**Analytical**	**Communicative**	**Managerial**
User	TU1 - Possesses a basic understand-ing of the role and use of computer-based information systems in an organizational context TU2 – Demon-strates basic literacy of the functions of information technology devices and infrastructure TU3 - Uses personal productivity software effectively	AU1 - Separates cause and effect and understands relationships in a simple business scenario AU2 - Understands the logic and completeness of an analysis provided by another person	CU1 - Can understand a clearly written report CU2 - Is able to identify important components of an oral presentation CU3 - Participates in group discussion CU4 - Can identify important listening skills	MU1 - Able to understand stated project goals MU2- Understands project mgmt. concepts and purposes MU3 - Can understand an existing project plan
Problem Identifier	TPI1 - Understands programming structures and techniques TPI2 –Demon-strates familiarity with programming tools and their appropriate use TPI3 - Uses computer-based information tools in effective communication with others TPI4 - Uses computer-based information systems as an effective research tool	API1 - Evaluates an information-based problem in terms of technical, operational, and economic feasibility API2 - Determines the relevance of facts associated with an information-based problem API3- Understands and uses the analytical tools used in solving information-based problems	CPI1 - Submits short, effective reports on specific assigned topics CPI2 - Can give a short, effective original presentation on an assigned topic CPI3 - Asks relevant questions in group discussions CPI4 - Can perceive and restate what others have presented	MPI1 - Define boundaries of an information-based problem MPI2 - Works effectively in a team environment MPI3 - Defines an information-based problem using business terms and concepts
Problem Solver **Problem Solver**	TPS1 - Selects and applies appropriate programming structures and techniques based upon a specific problem context TPS2 - Designs a simple program from a basic specification TPS3 - Uses specialized software to represent business processes and information flows (logical models)	APS1 - Able to optimize key business variables in solution design while meeting stated constraints APS2 - Uses appropriate analytical tools to effectively evaluate solution alternatives to an information-based problem APS3 - Is able to develop a logical model based upon stated user requirements	CPS1 - Identifies and reports on appropriate topic within a project context CPS2 - Gives an oral presentation on a topic of choice CPS3 - Participates in discussions that resolve conflicts and result in achieving team goals CPS4 – Asks relevant questions to resolve uncertainties in a project context	MPS1-Develop project goals and objectives for an information-based problem MPS2-Able to take primary responsibility for accomplishment of a specific project task or component MPS3-Identifies the steps, sequencing, and resources needed to complete an information project

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		APS4 - Develops appropriate contingency plans based upon the potential interaction between the project solution and external systems		
Solution Implementer	TSI1 - Designs the specifications for a program which conforms to stated user requirements TSI2 - Can perceive the limitations of application development tools and select the most appropriate tool(s) in a given context TSI3 - Develops the program(s) for an information-based solution that satisfies user needs TSI4 – Demon-strates an understanding of the technical aspects of system administration TSI5 - Completes technical coursework or practical experience outside the MIS curriculum	ASI1 - Uses analytical tools appropriately in testing, monitoring, and maintaining an information-based solution ASI2 - Recognizes when to execute contingency plans ASI3 - Responds appropriately to unexpected changes in requirements during implementation or testing of a system with minimum impact on project goals ASI4 - Able to detect and evaluate levels of user satisfaction and other environmental cues associated with a delivered system ASI5 - Completes personal self-assessment preparatory to entering the employment market	CSI1 - Submits clearly written, logically organized, accurate reports that can be understood by a target audience CSI2 - Makes a poised and polished extemporaneous presentation that can be understood by the target audience CSI3 - Moderates discussions that resolve conflicts and result in achieving team goals CSI4 - Effectively presents project goals, progress, and results in the business context CSI5 - Delivers a presentation or significant report within a co-curricular organization or work environment	MSI1- Deliver a solution to an information-based problem that achieves stated goals MPSI2-Manage a team to successful project completion MSI3-Executes a plan that delivers an appropriate information-based solution MSI4-Demonstrates leadership qualities through a significant role (e.g. officer, chairperson or supervisor) in a co-curricular organization or work environment