Assessment of Student Learning Through Course Outcomes: Walking the Talk in a Computer Information Systems Class

Jay Hettiarachchy Ph.D.
Computer Information Systems Department
Ferris State University
hettiarj@ferris.edu

Abstract:

Learning outcomes specify the observable and /or measurable knowledge, skills and judgment, which a person is expected to have developed or acquired as the result of a course of study or a set of identifiable experiences. They are about what a person should know or be able to do or demonstrate at a given point in their development.

Writing learning outcomes is a challenge and requires detailed planning and identifying what we expect the student to achieve, and the level of that achievement than to describe what we intend to teach or cover in a syllabus. Writing course outcomes is also a continuous process of improvement of learning.

This paper discusses the importance of writing course outcomes as a method of continuous improvement of learning and assessment. Systems Analysis and Design, a required course in the computer information systems undergraduate curriculum is selected for this purpose.

An assessment method based on well-defined outcomes of learning is shown in this paper as a worthwhile and satisfying experience for both the learners and the facilitators of learning.

Introduction:

The concern for outcomes among educators reflects a significant shift of thinking from a syllabus-based educational inputs, content, and time allocation, towards one that emphasizes desired results. The shift is off teaching to learning; it gives more emphasis to outcomes of learning than the process of learning itself. Today, college educators are faced with the challenge of incorporating course outcomes within the curriculum framework of colleges and universities. This paper discusses not only the relevance of writing outcomes for college courses but also how such an approach is helpful to assess and validate the leaning experience and performance levels of the learners. The paper consists of three sections 1) a discussion of the mechanics of writing course outcomes for Systems Analysis and Design course in the CIS curriculum 2) a discussion of the benefits of linking course outcomes to assessment and 3) conclusions.

The Challenge:

Several factors drive the shift toward outcome-based education. Today, both students and employers demand specific technical skills to be provided by higher educational institutions to their consumers. Unlike few years ago, both the consumers and providers of higher education are living in an increasingly competitive environment in which the feasibility of technology-based delivery is making the higher education market attractive to new private-sector providers. In this competitive environment, the ability to offer quality programs that the consumers - both individuals and corporate clients- want, become increasingly critical. Consequently, learning outcomes, as measured by student competencies, has become a quality measure that makes the most sense to consumers as well as educators including program-accrediting agencies.

Today, educators try to validate the effectiveness of the learning experience of their students by asking such questions as “how do we know that the students comprehend the material delivered in the classroom?”, “what do we want students to be able to apply from their learning experience that they gain from the course after they graduate and join the workforce?” Technology-based disciplines that are constantly impacted by the rapid growth and changes in technology present greater challenges to educators when it comes to providing a quality education to learners. Benjamin Bloom’s Taxonomy provides valuable insights in this regard.

Benjamin Bloom identified six levels within the cognitive domain [of human learning experience], each becoming increasingly complex and abstract (see Appendix I). These are knowledge, comprehension, application, analysis, synthesis, and evaluation. Proper planning and determination of the expected outcomes that are closely associated with each of these levels would enable developing assessment rubrics that would help teachers to specifically and consistently assess and evaluate quality of learning and communicate expected levels of learning to their students. Could outcome-based teaching and learning methods that are closely linked with assessment techniques based on learning outcome levels provide us with better handle on students’ learning experience? The author

considers most technology-based disciplines that are impacted by the constant growth and development of technology and information are ideal grounds for outcome-based teaching and learning.

Determining Student Learning Outcomes: Writing Course Outcomes For ISYS 330 Systems Design and Analysis Course:

A logical starting point of writing outcomes for any course would be an examination of the program/department/college/university mission. Obviously, the beliefs of the writers of outcomes will have an impact on the course outcomes they write. Nevertheless, they need to ask questions like, "What do I want students to learn throughout this course?" and "What do I want students in my course to continue to know five or ten years after completing the course?" Such questions would enable them to determine what graduates of the program should know, what skills they should be able to demonstrate and what professional values they should hold. A general list of expected objectives for graduates could be generated from such an exercise. Converting this list into statements of specific learning outcomes and how these outcomes are achieved consist of the next step while the actual writing of the course outcomes is the very last step of this process.

A possible general list of the course objectives for a semester-based course curriculum for an undergraduate course in systems analysis and design course could be, but not limited to the following topics:

1) Describe the role of the systems analyst.
2) Demonstrate the skills used in structured design methodologies using CASE tools.
3) Use proper techniques in completing a feasibility study.
4) Describe the techniques used and conduct investigative systems interviews.
5) Define and use valid documentation techniques.
6) Design internal and external auditing controls.
7) Design system and information flows.
8) Design system inputs such as forms and CRT screens.
9) Design system outputs such as specialty forms, reports, CRT screens.
10) Design system data sets and define relationships among records and files.
11) Write appropriate narratives as required – management, system and user documents
12) Design and implement a prototype of the designed system using CASE or other prototyping tools.
13) Design several implementation plans for the system and select the most suitable one (with justification) for the environment in which the system would be implemented.

Once a list of objectives has been identified, the next step would be to convert them into statements of specific learning outcomes by describing how these outcomes are to be achieved. A few hints to writing course outcomes as given in the available literature are given below:

- Describe student performance, not teacher/professor performance
- Describe learning product, not process
- Be specific without simply stating the subject matter to be learned
- Stick to one type of result for each objective (e.g., do not say "knows the scientific method and applies it effectively")
- Each learning outcome should start with an action verb that indicates observable and measurable behavior
- Group similar outcomes into one [1]

A sample course outcome adopted by the author will be given in Appendix II.

Linking Course Outcomes to Assessment:

If student outcomes are about the actual learning students should exhibit as a result of planned learning experiences, the accountability mechanisms that directly reflect student performance are the validating tools of outcome-based education. Accordingly, educational structures and curriculum should be regarded as means and not ends of learning, and if they do not do the job they are intended for, they need to be rethought and re-worked.

One of the key features of assessment of student learning through outcomes method is that the students are made clear about the expectations for learning outcomes, and the expectations of them to work outside of the classroom in order to meet the outcomes. The acceptable level of achievement of learning outcomes forms an integral part of this method. For example, a low-level target achievement might be the ability of the student to accurately repeat what has been given, while a high-level target might be the ability of the student to go beyond the knowledge of the information given. However, it is vital that the students are well aware of the expectations for achievement in order to obtain the best results by demonstrating their ability to perform the tasks/functions at the level/standard determined and outlined at the very beginning of the learning experience.

Outcome-based education lends itself to continuous process improvement. Therefore, determining course objectives and writing specific course outcomes by themselves would not provide a complete picture of outcome-based education. The ability of the learners to perform the specific tasks identified as specific course outcomes should be an integral part of it. "[Outcome-based education] gives less emphasis to 'what' and 'how' and more to 'why' and 'who for' ". [2]

But, how do we go about evaluating learners' performance ability? Do quantitative tools of assessment suffice? What about incorporating qualitative methods of assessment into the assessment rubrics?

Quantitative and Qualitative Assessments:

While quantitative assessment enables educators to gather numerical data relating to student learning, qualitative assessments provide other observable, indirect and descriptive evidence of student learning. Selecting an appropriate assessment method depends on the learning outcomes identified in the program. The author uses multiple assessment methods listed below to validate students' ability to perform the learning outcomes identified in the selected course as given below.

Quantitative	**Qualitative**
Pre-test/Post-test evaluation	Teamwork evaluations
Un-announced quizzes	Timely submission of projects
Submission of homework using Web-CT on due dates	Presentations (both individual and in groups).
Mid-term exams	Presentations on topics assigned by the Instructor
Comprehensive exams	Field experiences
	Weekly journals
	Project planning and management
	Leadership and participation
	Outside reading and research on the Web
	Student surveys and interviews
	Exit interviews
	Unobtrusive observations done by the Instructor
	Peer evaluations

Unlike quantitative methods of assessment, qualitative assessment methods are time consuming and require consistent efforts on the part of both teachers and learners. Performance outcomes can be assessed across various attributes of performance using a rubric for each attribute at various levels. These performance tasks can be students' ability to understand a complex problem by analysis, find solution/s to a given problem, giving an effective oral presentation, practice performance in a professional role such as a systems analyst, ability to produce results on time under stressful circumstances etc. The specific attributes applied to a set of rubrics can be scored individually and summed together or an overall performance score may be generated.

Qualitative assessment measures are not limited to a few exams; active participation of the learners in the learning process and their ability to exhibit competence in more than one way tends to constantly validate not only the learning experience but the ability to apply the knowledge gained as a result of the learning experience. A list of selected activities done by students in ISYS 330 course under controlled environment is shown in appendix III. Students that actively participate in these activities go through the following steps systematically: 1) understand the requirement 2) gather data 3) analyze the data 4) evaluate the data 5) formulate the solution and 6) communicate the solution to others in

an efficient and effective manner. The author uses these activities for not only to assess but also to validate students' ability to produce learning outcomes at higher levels of Blooms Taxonomy referred to earlier.

Conclusions:

Course outcomes enable us to expand in specific detail a general list of course objectives. They also enable us to identify the ways in which such outcomes are achieved. The resulting list of outcomes that are closely associated with each course objective serves as a common "roadmap" for facilitators of learning as well as those who are engaged in the learning process. Linked with the quantitative and qualitative assessment criteria, these detailed outcomes provide a measuring mechanism that not only lends itself for validation but also for continuous improvement of learning. When learning outcomes are clearly defined to learners at the very beginning of a course, learners not only have a clear target to reach, they derive greater satisfaction as they reach those targets. In effect clearly specified outcomes of learning give greater control to learners over the learning process they go through.

References:

1. Grolund, N.E. (2000). How to write and Use Instructional Objectives (6th ed.). Upper Saddle River, NJ: Prentice-Hall Inc.

2. (Issues of Teaching and Learning, http://www.catl.uwa.edu.au?NEWSLETTER/issue0599/obl.html)

Appendix I

Bloom's Taxonomy of Cognitive Objects

Bloom's taxonomy of cognitive objectives, originated by Benjamin Bloom and collaborators in the 1950's, describes several categories of cognitive learning.

Category	Description
Knowledge	Ability to recall previously learned material.
Comprehension	Ability to grasp meaning, explain, restate ideas.
Application	Ability to use learned material in new situations.
Analysis	Ability to separate material into component

	parts and show relationships between parts.
Synthesis	Ability to put together the separate ideas to form new whole, establish new relationships.
Evaluation	Ability to judge the worth of material against stated criteria.

Many people also call the analysis, synthesis, and evaluations categories "problem solving."

Bloom's Taxonomy

Benjamin Bloom created this taxonomy for categorizing level of abstraction of questions that commonly occur in educational settings. The taxonomy provides a useful structure in which to categorize test questions, since professors will characteristically ask questions within particular levels, and if you can determine the levels of questions that will appear on your exams, you will be able to study appropriate strategies.

Competence	**Skills Demonstrated**
Knowledge	• Observation and recall of information • Knowledge of dates, event, places • Mastery of subject matter • *Question Cues:* List, define, tell, describe, identify, show label, collect, examine, tabulate, quote, name, who, when, where, etc.
Comprehension	• Understanding information • Grasp meaning • Translate knowledge into new context • Interpret facts, compare, contrast • Order, group, infer causes • *Question Cues:* Summarize, describe, interpret, contrast, predict, associate, distinguish, estimate, differentiate, discuss, extend.
Application	• Use information • Use methods, concepts, theories in new situations • Solve problems using required skills or knowledge

	• *Question Cues:* Apply, demonstrate, calculate, complete, illustrate, show, solve, examine, modify, relate, change, classify, experiment, discover
Analysis	• Seeing patterns • Organization of parts • Recognition of hidden meanings • Identification of components • *Question Cues:* Analyze, separate, order, explain, connect, classify, arrange, divide, compare, select, explain, infer
Synthesis	• Use old ideas to create new ones • Generalize from given facts • Relate knowledge from several areas • Predict, draw conclusions • *Question Cues:* Combine, integrate, modify, rearrange, substitute, plan, create, design, invent, what if?, compose, formulate, prepare, generalize, rewrite
Evaluation	• Compare and discriminate between ideas • Assess value of theories, presentations • Make choices based on reasoned argument • Verify value of evidence • Recognize subjectivity • *Question Cues:* Assess, decide, rank, grade, test, measure, recommend, convince, select, judge, explain, discriminate, support, conclude, compare, summarize

Appendix II

CIS 330 Web Page: **scsite.com**

Course Prerequisites:

ISYS 200 Database Analysis and Design plus proficiency in at least one high-level programming language (ISYS 316, ISYS 220, or ISYS 265).

Text and Materials:

Gary B. Shelly, Thomas J. Cashman & Harry J. Rosenblatt *Systems Analysis and Design* 4th edition; Course Technology, Boston, Massachusetts.
ISBN:0-7895-6828-4

Description:

The first course in structured methods of identifying the requirements for a system. This includes the analysis of current business operations and definitions of specific problems or opportunities. Goals, objectives, data, process design, and performance criteria are developed for the new systems. Fulfils General Education "writing intensive course" requirements.

Course outcomes:

Upon successful completion of this course, the student will:

14) Describe the role of the systems analyst.
15) Demonstrate the skills used in structured design methodologies using CASE.
16) Define and use valid documentation techniques.
17) Use proper techniques in completing a feasibility study.
18) Describe the techniques used and conduct investigative systems interviews.
19) Design system and information flows.
20) Design internal and external auditing controls.
21) Design system inputs such as forms and CRT screens.
22) Design system outputs such as specialty forms, reports, CRT screens.
23) Design system data sets and define relationships among records and files.
24) Write appropriate narratives as required.
25) Design and implement a prototype of the designed system using CASE or another prototyping tool.

Course Objectives	How Addressed	Outcomes	How Measured
1. Describe the role of the systems analyst	Lectures, based on Introduction to Systems Analysis and Design" chapter 1 in textbook, examples and discussion, Web search for information on systems analysts tasks and roles in various companies.	a)Student's ability to describe the job description, functions, and the role played by Systems Analysts in different business environments b)Student's ability to write a job description for a specific company c) student's ability to play the role (role play) of a systems analyst as required by the instructor	Questions that measure a) knowledge b) understanding c) application d) analytical cognition levels
2. Demonstrate the skills used in structured design methodologies using CASE tools	Lectures, examples and demonstrations of CASE tools like MS VISIO, and discussion of the relevance of using such tools for communicating complex concepts, based on "systems analyst's Toolkit' in textbook	Students ability to: a) describe the importance of CASE tools in systems design b) learn and use a selected CASE tool c) analyze a given system design d)draw a simple design for a verbal description of a system provided by the instructor	Ability to: a) represent complex systems using standard diagramming symbols b) correctness of diagrams produced by the student c) provide a verbal description (walkthrough) of a system diagram randomly selected by the instructor
3. Define and use valid documentation techniques	Lectures, examples class discussion, and case study assignment, based on "Systems analyst's Toolkit" in textbook	Students ability to: a) define different types of documentation used and generated by systems analysts, programmers and managers b) critique documentation c) write a document for an assigned case	a) Assessment of homework assignments on different types of documentations used and generated by systems analysts b) assessment of the correctness of answers on questions relating to

		study.	documentation
4.Use proper techniques in completing a feasibility study	Lectures, examples and class discussion. Case study on feasibility – based on Chapter 2 and "Systems Analyst's Toolkit" in textbook	Students ability to: a) comprehend the necessity and what is involved in completing a feasibility study b) analyze a given feasibility study c) do a feasibility study and produce the results within a specified period of time.	Evaluation of the feasibility group project for a) data gathering b) depth of requirements analysis c) technical writing capability and following given guidelines d) timeliness of delivery of the feasibility report
5. Understand Systems requirements	Lectures based on chapter 3 "Requirements Modeling"	Student's ability use fact finding techniques such as interviews, questionnaires, surveys, observations etc.	Student's ability to do perform the tasks of fact finding in real-life situations
6. Model system and information flows using traditional methods	Lectures, examples class discussion, and case study on DFDs and E-R diagrams, based on chapter 4 "Data and Process Modeling"	Student's ability to: a) draw data flow diagrams and Entity Relationship diagrams for a given system b) narrate the data and process flows of a DFD or E-R diagram randomly selected by the instructor	Assessment of: a) homework assignments, b) answers to exam questions c) accuracy of DFD's and E-R diagrams produced by students as answer to given assignments
7. Model system and information flows using object oriented methods	Lectures, example, and class discussion based on Chapter 5 "Object Modeling"	Student's ability to: a) represent systems using object oriented techniques	Assessment of homework, case study, and ability to accurately represent a given system using object oriented modeling techniques
8. Design system inputs such as forms and CRT screens and output reports	Lectures, examples, and class discussion based on Chapter 7 "User Interface, Input, and Output Design"	Students' ability to: a) shift from analysis to design phase b) design input screens and output formats	Students' ability to apply best practices of input and output design by actually engaging in producing input and

			output screens. Assessment of such student work for correctness and user friendliness
9. Plan application architecture	Lectures, examples, class discussion based on chapter 9 "Application architecture"	Students' ability to: a)do the case studies at the end of the chapter b) plan application architecture for any given business environment	Assessment of student case studies for correctness. Assessment of students' knowledge by quizzes and exams

Detailed Schedule:

Week	**Reading Assignment**	***Homework/Laboratory Assignment***	**Test Points**	**HW/Lab Points**
2 Jan 20th	Chapter 1	1. Page 1.32, Chapter Assignment # 3 2. Page 1.36, SCR Associates. Do assignments 1,2, 4		20
3 Jan 27th	Chapter 2	Page 2.28, Chapter Assignments 1-4		20
4 Feb 3rd	Chapter 2	Page 2.34, SCR Associates. Do assignments 1-4		20
5 Feb 10th	Chapter 3	Page 3.43, Chapter Assignments, 1-4		20
6 Feb 17th	Chapter 3	2. Page 3.48, SCR Associates, Assignments 3, 4.		20
7 Feb 24th **Exam 1 (Ch. 1-4) March 2nd**	Chapter 4	1. Page 4.47, Chapter Assignments, 1, 3, 4. 2. Page 4.49, SCR Associates, Assignments, 1, 2.	150	20

8 March 2nd **SPRING**	Chapter 5 **BREAK**	Page 5.37, Chapter Assignments, 1, 3, 4.		20
10 March 19th	Chapter 6	1. Page 6.38, Chapter Assignments, 1, 3, 4. 2. Page 6.42, SCR Associates, Assignments, 1		20
11 March 23rd **EASTER BREAK April 8-12**	Chapter 7	1. Page 7.50, Chapter Assignments, 1, 4 (you need to document your findings instead of discussing with the class as given in the textbook). 2. Page 7.52, SCR Associates, Assignments, 1, 4.		20
12 March 30th **Exam 2 (Ch. 5-8) April 6th**	Chapter 8	1. Page 8.45, Chapter Assignments, 1 2. Page 8.48, SCR Associates, Assignments, 1, 2.	150	15
14 April 16th	Chapter 9	1. Page 9.43, Chapter Assignments, 1, 2. 2. Page 9.45, SCR Associates, assignments, 1, 3.		20
15 April 22nd	Chapter 10	1. Page 10.32, Chapter Assignments, 3, 4. 2. Page 10.34, SCR Associates, assignments, 3, 4.		20
14 **Final Exam (Ch. 1-10)**			200	

Course Grading:

Course Grade	*Points*	*Approximate % of Grade*
Announced examinations	500	

(3)		
Unannounced quizzes (5)	50	
Homework and Laboratory exercises	235	
Participation in Group activities (at least 5 activities will be done) Perfect attendance (attending to class at least 25 days out of the possible 29 days)	50 15	
	850	

Point System: 850 total assigned points

A = ^ 765
B = ^ 680
C = ^ 595

The in between grades will be calculated accordingly.

Appendix III

A selected list of activities used by the author to validate the understanding and ability to apply knowledge by the learners

Given below is a selected list of activities done in teams within a specified amount of time. After completing each activity, teams present their ideas to the class.

Activity 1
Apply your knowledge

Systems Analysts Salaries
Situation:

As part of your job search, you decide to find out more about salaries and qualifications of systems analysts in the area where you would like to work. To increase your knowledge, search the Internet to perform the following research:

1. Find information about a career as a systems analyst.

2. Determine whether the Federal Bureau of Labor Statistics lists salary information for systems analysts. If so, summarize the information you find.
3. Find at least two online ads for systems analysts and list the employers, the qualifications, and the salaries, if mentioned.
4. Find at least one ad for an IT position that specially mentions e-commerce.

Rainbow's End Interview
Situation:

Your MultiTech interview seemed to go well, but you did not get the job. During the meeting, the interviewer mentioned that MultiTech uses structured analysis and relies heavily on modeling, prototyping, and CASE tools. Thinking back, you realize that you did not fully understand those terms. As you prepare for an interview with Rainbow's End, a large retail chain, you decide to review some IT terms and concepts. It is the day before the interview, and you are going through your notes about the following topics:

1. What is the main difference between structured analysis and O-O analysis?
2. What is a CASE tool and what does it do?
3. What is modeling and how is it done?
4. What is prototyping and why is it important?

Activity 2

JAD Session 2
Situation:

The JAD team wants you to draw up a check list of requirements for the new system.

1. List the five main categories of system requirements.
2. Use your imagination and provide a least one example per category of a system requirement that might be appropriate for an inventory system.
3. The project leader wants you to explain scalability to the team. How will you do that?
4. Several managers on the team have heard of TCO but are not quite sure what it is. How will you explain it to them?

Better Hardware Marketing System
Situation:
Your boss, the IT director, wants you to explain UML to a group of company managers and users who will serve on a systems development team for the new marketing system.

1. Describe UML and how it can be used during systems development.
2. Explain the case diagrams to the group, and provide a simple example.
3. Explain sequence diagrams to the group, and provide a simple example.

4. During the meeting, a manager asks you to explain why it is desirable to describe the system through the eyes of a user. How would you answer?

Activity 3

Background:
You have been asked to conduct user training sessions during the implementation phase for a new information system. Your first step was to prepare and overall plan. Now you must develop a specific schedule for form the tasks listed below. The following steps must be followed (the estimated time is shown in parenthesis).

Tasks:
First, you will send an e-mail message to all department managers announcing the training sessions (1 day). After the e-mail message goes out, two tasks can begin at the same time: you can develop the training material (5 days) and confirm arrangement for the training facility you plan to use (3 days). As soon as the training material is complete, you can work on two tasks at once; arrange to have copies of handout material printed (3 days) and develop a set of Power Point slides (4 days). As soon as the power Point Slides are ready, you conduct a practice training session with the instructor who will assist you (1 day). Finally, when the practice session is over, the hand out material is ready, and the training facility is confirmed, you conduct the session (3 days).

Assignments:
Using the PERT/CPM techniques, develop a chart that shows ECT's LCT's, project duration, and critical path for this project.

Activity 4

Use the Internet to gather material and then make presentation to the class on the following themes:

1. Main features of RAD methodology
2. Compare RAD to the traditional SDLC strategy.
3. Compare MSF strategy for application development with traditional SDLF strategy.
4. Describe the main features of Microsoft Enterprise Architecture Model