This guide is provided to assist faculty members in Illinois Institute of Technology's Department of Information Technology and Management in the drafting of course learning objectives. Courses presented by the Department of Information Technology and Management must have clearly defined learning objectives, based on Bloom's Taxonomy and other commonly accepted standards for the construction of these objectives; these guidelines outline commonly accepted practices expected in both the higher education and continuing education communities.

Background and Use

There are three types of commonly accepted learning objectives: Cognitive (knowledge), Affective (attitude, interests, feelings), and Psychomotor (motor skills). In the university learning environment, learning objectives are nearly always drawn from the Cognitive domains although on rare occasions there will be some Psychomotor-based objectives. We have included definitions of the six Cognitive domains accompanied by a table of verbs used in the construction of learning objectives that match these levels. These domains are expressed as levels that are hierarchical or cumulative in nature, i.e. students must have mastered one level before they are adequately equipped to proceed to the next higher, although this does not preclude teaching from several levels simul-taneously. Please use this table and the examples provided as a guide to assist you in the drafting of learning objectives for your course. For further information, please refer to works cited at the end of the document.

Learning Objective Levels

You should always match learning objectives to the cognitive domain in which you expect your students to learn the course content. A course taught at the Knowledge cognitive level should have learning objectives drawn from that cognitive level, and you should not expect a student in this course to perform at the Comprehension level or higher. Generally training, short courses and undergraduate courses will draw from the Knowledge through Application levels while graduate courses will focus more on the Analysis, Synthesis and Evaluation levels. When courses are dual-numbered (i.e. 400/500 level), the higher-level emphasis for graduate students will be attained through differentiation of assignments, research papers, or group projects as well as different Course Student Outcomes that reflect the expectation that graduate students will attain outcomes at higher cognitive levels. As an example, a Course Student Outcome for undergraduates may state "Describe the X process" while the graduate student Course Student Outcome would say "Analyze and explain the X process."

Learning Objective Requirements

Each course offered by the Department of Information Technology and Management will have three levels of learning objectives. Specific requirements for each level and examples of objectives are included below. These levels are:

1) Course Outcomes – at a course level, this equates to the ABET Criteria term "program objectives"
2) Course Student Outcomes – this equates to the ABET Criteria term "student outcomes," these are learning objectives at the course level. These used to be referred to as Course Objectives in ITM syllabi.
3) Specific objectives (objectives/outcomes specific to each lesson, lecture, lab, practical exercise, or assignment)

- Learning objectives for every course must be defined at these levels and must be sufficiently complete as to allow students to clearly understand expectations and outcomes of the course. You should use them as the primary basis for the drafting of requirements for projects, research papers and practical assignments and in the writing of course examinations.
- In many instance textbooks or other curricular materials will already have defined objectives that meet our requirements; if this is the case, you may certainly use these objectives as the basis for your course objectives, particularly for specific objectives.
- In some instances learning objectives may be included as a component of a course outline provided for your course by the department; if this is the case, all of these learning objectives must be addressed in your course but this does restrict you from defining additional objectives.
  - Specific objective requirements for a course may be defined by ABET student outcomes; course textbook objectives; ACM/IEEE model curriculum Domain or Subdomain Competencies or Learning Outcomes; U.S. Department of Labor *2012 Information Technology Competency Model*; *Guide to the Enterprise Information Technology Body of Knowledge* (EITBOK); NSA Center of Academic Excellence *Knowledge Unit* Outcomes; *NICE Cybersecurity Workforce Framework* NIST SP 800-181 tasks, knowledge, skills, or abilities; or external professional certification examination criteria. All of these sources may also be consulted when creating or designing learning objectives for your course. All except certification examination criteria are available for reference at http://www.itm.iit.edu/faculty/#external.
  - In addition, while many textbooks include a well-designed set of objectives using correct terms, many will still have objectives that start with "understand" or "be familiar with." Ensure they are properly worded before using them.
- Course objectives and objectives specific to each lesson, lecture, lab, practical exercise, or assignment must be worded in terms that ensure that the achievement of the objective can be measured for purposes of assessment. This is why verb selection is critical. "Understand" should never be used because it is not really possible to measure understanding. Instead the objective should be phrased in terms that allow measurement: explain, describe, outline, recall, name, construct, use, create.
- Every syllabus *must* contain Course Outcomes and Course Student Oucomes (formerly referred to Course Objectives.) Courses lacking definition of these elements in the syllabus are invalid as they cannot be assessed.
  - Each objective should be in a list and start with one of the verbs from the table found below.

Definitions of the Cognitive Levels

- ***Knowledge:*** Recall of data. Remember and recall information or specific facts.
- ***Comprehension:*** Understand the intent and meaning of the information delivered. Understand the meaning, translation, interpolation, and interpretation of instructions and problems. State a problem in your own words. Explain ideas or concepts. *Assumption:* student has knowledge of the information.
- ***Application:*** Remember the information, and apply the information correctly. Use a concept in a new situation or unprompted use of an abstraction. Apply what was learned in the classroom into novel situations in the workplace. Use information in new situations. *Assumption:* student has knowledge and comprehension of the information
- ***Analysis:*** Breakdown the information into its constituent parts and determine the organization, logic, relationship, and meaning of each part to the whole. Separate material or concepts into component parts so that its organizational structure may be understood. Distinguish between facts and inferences. Draw connections among ideas *Assumption:* student has knowledge and comprehension of the information and can apply it.
- ***Synthesis:*** Build a structure or pattern from diverse elements. Put parts together to form a whole, with emphasis on creating a new meaning or structure. Create an entirely new product or performance using a variety of resources available to the student. Justify a stand or decision. *Assumption:* student has knowledge and comprehension of the information, and can apply and analyze it.
- ***Evaluation:*** Make judgments about the value of ideas or materials. Make qualitative or quantitative judgment on the value of the information delivered, using distinct criteria/standards. Produce new or original work. *Assumption:* student has knowledge and comprehension of the information, and can apply, analyze, and synthesize it.

Verbs for Use in Cognitive Level Learning Objectives

Knowledge / Remember	Comprehension / Understand	Application / Apply	Analysis / Analyze	Synthesis / Evaluate	Evaluation / Create
Arrange	Convert	Apply	Analyze	Arrange	Appraise
Calculate	Describe	Categorize	Appraise	Assemble	Assess
Define	Discuss	Change	Calculate	Categorize	Choose
Identify	Distinguish	Classify	Compare	Combine	Compare
Label	Estimate	Compute	Contrast	Compile	Compute
List	Explain	Construct	Criticize	Compose	Conclude
Match	Express	Demonstrate	Debate	Construct	Contrast
Measure	Extend	Dramatize	Deconstruct	Create	Criticize
Name	Generalize	Employ	Diagnose	Design	Critique
Outline	Give an example	Illustrate	Diagram	Devise	Defend
Quote	Identify	Interpret	Differentiate	Deploy	Describe
Recall	Interpret	Manipulate	Discriminate	Formulate	Discriminate
Recognize	Locate	Modify	Distinguish	Generate	Estimate
Recite	Paraphrase	Organize	Examine	Manage	Evaluate
Record	Predicts	Operate	Experiment	Modify	Explain
Repeat	Recognize	Practice	Identify	Organize	Interpret
Reproduce	Report	Predict	Illustrate	Plan	Judge
Select	Restate	Prepare	Improve	Prepare	Justify
State	Review	Produce	Infer	Propose	Measure
	Summarize	Relate	Inspect	Rearrange	Rate
		Schedule	Interpret	Reconstruct	Relate
		Sketch	Inventory	Reorganize	Revise
		Solve	Question	Revise	Score
		Show	Relate	Rewrite	Select
		Summarize	Select	Set-up	Summarize
		Translate	Separate	Summarize	Support
		Use	Test	Write	Value

Verbs to Never Use When Writing Learning Objectives

Some verbs are vague and are not really observable or measurable. For example, how would you measure whether someone has "become familiar with" a particular tool? Use a more specific verb. If you want students to "understand" something, think more closely about what you want them to be able to do or produce as a result of their "understanding." You may see that many textbook authors use these, but we will not.

These **verbs to never use** are:

- Understand
- Appreciate
- Know about
- Be familiar with
- Learn about
- Become aware of

Educational Strategies for Use with each Cognitive Level

Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation
Analogies	Assessment	Demonstration	Case Studies	Case Studies	Appraisals
Audio	Discussion	Exercises	Critical Incidents	Construct	Case Studies
Examples	Presentation	Projects	Discussion	Creative Exercises	Critiques
Illustrations	Questions	Practice	Exercises	Develop Plans	Exercises
Lecture	Reports	Role playing	Problems	Problems	Projects
Video	Review	Simulations	Questions	Projects	Simulations
Visuals	Tests	Sketches	Test	Simulations	
	Writing				

Construction of Course Outcomes

Course outcomes must encompass all items and material specified in the course description. They will amplify and expand the course description and may discuss specific technologies used in the course. In order to accommodate this requirement, these outcomes will necessarily be quite broad in scope, and may not be measurable. It is acceptable if they employ words or phrases that cannot by assessed such as *understand* or be *familiar with*—but it is better if they do not. They may be expressed *either* as a paragraph or as bullet points.

- *Example*:

  Each successful student in this course will be able to:
  1) demonstrate knowledge of significant information modeling techniques appropriate to the information requirements at the professional, managerial and executive levels.
  2) apply these techniques in the development of information designs appropriate to each of these levels.
  3) describe and discuss quality control concepts and their application to design.
  4) describe several architectural strategies used to define information systems.

Construction of Course Student Outcomes

Course Student Outcomes (formerly referred to as Course Objectives) should clearly reflect the student's ability to make actual application of skills and knowledge resulting from participation in the course. They must be assessible, which means the attainment of the outcome can be *measured* at a single point in time. The should denote a skill, knowledge, or level of mastery unlikely to have been acquired before completing the course. As far as possible, they should be drawn from the application, synthesis, analysis and evaluation domains. They may be general (these are harder to assess) or they may be very specific (ideal).

- *Example* (general course objectives):

  At the completion of the course, each student will have:
  1) produced several information system designs demonstrating a knowledge of the major design techniques and architectural strategies presented in the course.
  2) demonstrated knowledge of various quality control measures, data mining techniques and knowledge models.

- *Example* (specific, detailed course objectives):

  Students completing this course should be able to:
  - Demonstrate basic tasks required to use a UNIX/Linux shell account including:
    - Telnet
    - Secure Shell (ssh)
    - File transfer protocol (FTP)
    - Change the login password
    - Navigate though directories
    - List the contents of a directory using appropriate parameters
    - Create a directory
    - Copy a directory
    - Move a directory
    - Delete a directory
    - Copy a file
    - Move a file
    - Delete a file
    - Change the protection of a file using `chmod`
    - View the contents of a file using `cat` & `less`
  - Describe the origin and basic structure of the Internet
  - Explain the function and operation of file transfer protocol (FTP)
  - Explain the use and operation of Internet electronic mail
  - Use leading Web search tools and indices
  - Describe basic functionality of the TCP/IP protocols and their relationship to the OSI network model
  - Discuss Internet Protocol packet routing
  - Explain the function and operation of Domain Name Service (DNS)

Construction of Specific Learning Objectives

Each lesson, lecture, lab, practical exercise or assignment should have specific learning objectives. Specific learning objectives should always follow the following format:

At the completion of this (lesson/lecture/module/lab/assignment) students should be able to:

1. (verb) (specific action)

- *Example:* Here is an example of specific learning objectives for a single lesson:

  At the completion of this lesson students should be able to:

  1. *Discuss uses of telnet/secure shell (ssh)*
     i. Explain the concept of terminal emulation
     ii. Describe ssh and what it does
     ii. Demonstrate how to remotely access a system using command line telnet/ssh (both Linux and Windows)
     iii. Discuss the ports associated with Internet host computers
        a. Identify ports associated with the principal Internet applications
  2. *Explain what "ping" does*
  3. *Explain what "finger" does*
     i. Describe the purpose of a .plan file

Sources

Material used in the preparation of this guide was drawn from the following sources:

1. Joint Commission on Allied Health Personnel in Ophthalmology. (2002). *INSTRUCTIONS FOR WRITING LEARNING OBJECTIVES*. Retrieved October 12, 2002 from http://www.jcahpo.org/objectives.pdf

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   (2) Bloom, B.S. and Krathwohl, D.R. (1956). *Taxonomy of educational objectives: The classification of educational goals, by a committee of college and university examiners. Handbook 1: Cognitive domain.* New York , Longmans. http://www.nova.edu/hpdtesting/ctl/forms/bloomstaxonomy.pdf

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