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. This September 2022 revision applies *Bloom's Revised Taxonomy* (Anderson & Krathwohl, 2001) and "Bloom's for Computing" (Geissler et.al., 2022).

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 descriptions of the six Cognitive domains accompanied by a table of verbs used in the construction of learning objectives that match these categories. 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 simultaneously. 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 Remember cognitive category should have learning objectives drawn from that cognitive category, and you should not expect a student in this course to perform at the Understand level or higher. Generally training, short courses and undergraduate courses will draw from the Remember through Apply categories while graduate courses will focus more on the Analyze, Evaluate and Create categories. 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 refecting higher order thinking skills. 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.
- A statement of a learning objective contains a verb (an action) and an object (usually a noun or phrase).
  - The verb generally refers to [actions associated with] the intended cognitive process.
  - The object generally describes the knowledge students are expected to acquire or construct. (Anderson & Krathwohl, 2001, pp. 4–5)
- 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, or skills; 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 many instances 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.
    - 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—or reword them—before using them.
  - 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.
- 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 Outcomes (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.

The Cognitive Process Dimension – categories, cognitive processes (and alternative names)

- *Remember:* Retrieve relevant knowledge from long-term memory. recognizing (identifying); recalling (retrieving)
- *Understand:* Construct meaning from instructional messages, including oral, written and graphic communication. interpreting (clarifying, paraphrasing, representing, translating); exemplifying (illustrating, instantiating); classifying (categorizing, subsuming); summarizing (abstracting, generalizing); inferring (concluding, extrapolating, interpolating, predicting); comparing (contrasting, mapping, matching); explaining (constructing models)
- *Apply:* Carry out or use a procedure in a given situation. executing (carrying out); implementing (using)
- *Analyze:* Carry out or use a procedure in a given situation. differentiating (discriminating, distinguishing, focusing, selecting); organizing (finding, coherence, integrating, outlining, parsing, structuring); attributing (deconstructing)
- *Evaluate:* Make judgments based on criteria and standards. checking (coordinating, detecting, monitoring, testing); critiquing (judging)
- *Create:* Put elements together to form a coherent whole; reorganize into a new pattern or structure. generating (hypothesizing); planning (designing); producing (construct)

(Iowa State University Center for Excellence in Learning and Teaching, n.d.)

Verbs for Use in Cognitive Level Learning Objectives (In multi-column entries, read across →)

Remember	Understand	Apply		Analyze		Evaluate		Create
Arrange	Annotate	Apply	Appraise	Analyze	Appraise	Appraise	Adapt	Arrange
Calculate	Categorize	Backup	Build	Articulate	Automate	Administer	Argue	Assemble
Define	Classify	Calculate	Categorize	Calculate	Combine	Assemble	Assess	Choose
Enumerate	Comment	Change	Classify	Compare	Contextualize	Categorize	Combine	Collaborate
Identify	Convert	Code	Compile	Contrast	Correlate	Compute	Coordinate	Compare
Label	Demonstrate	Compute	Configure	Criticize	Debate	Create	Critique	Compile
List	Describe	Connect	Construct	Deconstruct	Detect	Debug	Decide	Compose
Locate	Discuss	Decrypt	Deploy	Diagnose	Diagram	Defend	Design	Conclude
Match	Distinguish	Diagnose	Document	Differentiate	Discriminate	Devise	Deploy	Construct
Measure	Estimate	Dramatize	Encrypt	Distinguish	Examine	Estimate	Evaluate	Contrast
Name	Explain	Employ	Estimate	Experiment	Figure	Generate	Judge	Create
Outline	Express	Execute	Graph	Find	Generalize	Modify	Optimize	Devise
Quote	Extend	Illustrate	Implement	Identify	Illustrate	Organize	Predict	Develop
Recall	Generalize	Interpret	Install	Improve	Infer	Prioritize	Propose	Discriminate
Recognize	Give an example	Iterate	Manipulate	Inspect	Integrate	Prove	Rate	Evaluate
Recite	Identify	Map	Measure	Interpret	Inventory	Rearrange	Reconstruct	Explain
Record	Illustrate	Modify	Organize	Model	Monitor	Recommend	Relate	Formulate
Reference	Indicate	Operate	Practice	Organize	Predict	Revise	Support	Generate
Repeat	Interpret	Predict	Prepare	Question	Relate	Summarize	Test	Invent
Reproduce	Locate	Produce	Provision	Select	Separate	Validate	Write	Justify
Retrieve	Organize	Randomize	Recover	Simulate	Trace			Manage
Select	Paraphrase	Relate	Restore	Translate	Update			Modify
State	Predicts	Restrict	Schedule					Organize
	Recognize	Sketch	Solve					Plan
	Reorganize	Show	Store					Prepare
	Report	Summarize	Train					Produce
	Represent	Use	Virtualize					Program
	Restate							Revise
	Review							Score
	Rewrite							Select
	Summarize							Set-up
	Translate							Script
								Secure
								Verify
								Visualize

Items in red are from "Bloom's for Computing" (Geissler et.al., 2022) while additional items not normally included in Bloom's Revised Taxonomy are drawn from a variety of less well-documented sources

See Andrew Churches' *Bloom's Digital Taxonomy* for additional digital/online verbs.

Educational Strategies for Use with each Cognitive Category

Remember	Understand	Apply	Analyze	Evaluate	Create
Analogies	Assessment	Demonstration	Case Studies	Appraisals	Construct
Audio	Discussion	Exercises	Critical Incidents	Case Studies	Case Studies
Examples	Presentation	Projects	Discussion	Creative Exercises	Develop Plans
Illustrations	Questions	Practice	Exercises	Critiques	Exercises
Lecture	Reports	Role playing	Problems	Problems	Projects
Video	Review	Simulations	Questions	Projects	Simulations
Visuals	Tests	Sketches	Test	Simulations	
	Writing				

Verbs to Never Use When Writing Learning Objectives

Some verbs and verb phrases 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 and phrases to never use** are:

- Understand
- Appreciate
- Demonstrate understanding of

- Know about
- Be familiar with

- Learn about
- Become aware of
  (and there are others as well...)

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 and implement 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) (learning outcome statement that specifies what learning will take place)

- *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

        iv.   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

Checklist to Evaluate Outcomes

If your Learning Outcome or Student Learning Outcome is properly constructed, the answer to all of these questions should be *yes*.

1. Does the outcome support the program goals?

2. Does the outcome describe what the program intends for students to know (cognitive), think (affective, attitudinal), or do (behavioral, performance)?

3. Is the outcome:

   a) Detailed and specific?

   b) Measurable/identifiable?

   c) A result of learning?

4. Do you have or can you create an activity to enable students to learn and demonstrate the desired outcome?

5. Can the results from assessing this outcome be used to make decisions on how to improve the program?

   (Georgia Institute of Technology Office of Academic Effectiveness, n.d.)

Tools: Learning Outcomes Generator

These are free outcomes generators intended to assist you in the process of developing measurable outcome statements:

1. Learning outcomes generator from Easygenerator.com: https://learning-objectives.easygenerator.com/

2. Outcome Generator from Indiana University, Reno: https://elearn.sitehost.iu.edu/courses/tos/gen2/
   (Indiana University eLearning Design & Services, UITS, n.d.)

3. Learning Outcome Generator from Northwest Missouri State University:
   https://cite.nwmissouri.edu/CanvasEnhancements/LearningOutcomeGenerator/
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