

A GUIDE FOR CREATING COURSE LEVEL OBJECTIVES AND STUDENT LEARNING OUTCOMES

From the Center for Teaching and Learning Enhancement (CTLE)

at Lamar University

TABLE OF CONTENTS

<i>WHAT ARE COURSE LEVEL OBJECTIVES AND STUDENT LEARNING OUTCOMES.....</i>	<i>2</i>
<i>EXAMPLE OF COURSE LEVEL OBJECTIVES AND STUDENT LEARNING OUTCOMES BASED ON AN APPROVED COURSE DESCRIPTION.....</i>	<i>3</i>
<i>CREATING COURSE LEVEL OBJECTIVES BASED ON YOUR COURSE DESCRIPTION.....</i>	<i>4</i>
<i>CREATING STUDENT LEARNING OUTCOMES (SLOs) BASED ON YOUR COURSE DESCRIPTION AND OBJECTIVES</i>	<i>5</i>
<i>A NOTE ABOUT STUDENT LEARNING OUTCOMES, LEVELS, AND FORMATIVE AND SUMMATIVE ASSESSMENT.....</i>	<i>6</i>
<i>IMPORTANCE OF MEASURABILITY AND BENCHMARKING</i>	<i>8</i>
<i>EXAMPLES OF BENCHMARKING.....</i>	<i>9</i>

WHAT ARE COURSE LEVEL OBJECTIVES AND STUDENT LEARNING OUTCOMES

Course Level Objectives (CLOs) and student learning outcomes (SLOs) are related concepts in education. While both are included in syllabi, they serve different purposes and are used at different levels of instructional planning and assessment. **Objectives are intended results or consequences of instruction, curricula, programs, or activities. Outcomes are achieved results or consequences of what was learned**, i.e., evidence that learning took place. Here is a breakdown of the key differences between the two:

Course Level Objectives (CLOs):

1. **Instructor-centric:** CLOs are typically developed by instructors or curriculum designers to guide the teaching and learning process within a specific course.
2. **May not be measurable:** While CLOs should always be measurable and written from a learner perspective, if they are institutional or from an accrediting body, they may not always be.
3. **Focus on instruction:** They describe what the instructor intends to cover, teach, or emphasize during the course. They are often related to the content, topics, and activities within the course.
4. **May vary by instructor:** In some cases, different instructors teaching the same course may have slightly different CLOs based on their teaching style, expertise, and preferences.

Student Learning Outcomes (SLOs):

1. **Student-centric:** SLOs are focused on what students are expected to learn, understand, or demonstrate as evidence of completing the course. They are centered around student achievement.
2. **Measurable and specific:** SLOs are framed in a way that makes them measurable and specific, often using action verbs tied to Bloom's Taxonomy (see <https://www.niallmcnulty.com/2017/11/blooms-digital-taxonomy/> for an overview of Bloom's) that describe observable behaviors or skills.
3. **Assessment and accountability:** SLOs are used for assessment and accountability purposes. They guide the evaluation of whether students have achieved the intended learning outcomes.
4. **Consistency across sections:** SLOs are recommended to be consistent across different sections of the same course, ensuring that all students who take that course have the same learning expectations.

In a nutshell, CLOs are primarily designed to guide instructors in planning and delivering a course, while SLOs are designed to measure and assess what students have learned or achieved as a result of taking that course. Both are important components of effective course design and assessment, but they serve different roles and perspectives within the educational context.

HOWEVER, it is important to note that BOTH CLOs and SLOs must match the approved course description for the given course. Course descriptions must not be altered without proper review and approval by curriculum councils. If your course description is poor or inadequate, speak with your department leadership about submitting a revision for review.

EXAMPLE OF COURSE LEVEL OBJECTIVES AND STUDENT LEARNING OUTCOMES BASED ON AN APPROVED COURSE DESCRIPTION

Course Title: AINT 4567 Advanced Artificial Intelligence

Course Description: This senior-level course in Advanced Artificial Intelligence explores advanced topics and techniques in the field of AI. Building on foundational AI concepts, students will delve into cutting-edge research and practical applications. Topics include machine learning, natural language processing, computer vision, and reinforcement learning. Through hands-on projects and discussions, students will develop a deep understanding of AI algorithms, applications, and ethical considerations.

Course Level Objectives:

1. **To deepen understanding:**
 - To provide students with an in-depth understanding of advanced AI concepts and techniques beyond the introductory level.
2. **To explore cutting-edge research:**
 - To expose students to current research in AI, including recent developments in machine learning, deep learning, and neural networks.
3. **To apply AI algorithms:**
 - To enable students to apply algorithms to real-world problems and challenges, emphasizing practical applications.
4. **To enhance problem-solving skills:**
 - To enhance students' ability to analyze complex problems and develop AI-driven solutions.
5. **To foster critical thinking:**
 - To encourage critical thinking and discussions about the ethical and societal implications of AI technologies.

Student Learning Outcomes:

By the end of this course, students should be able to:

1. **Apply advanced machine learning techniques.**
 - Develop, implement, and evaluate advanced machine learning models for various AI applications.
2. **Analyze and process natural language.**
 - Apply natural language processing techniques to analyze and process text data, including sentiment analysis and language generation.
3. **Develop computer vision systems.**
 - Create computer vision systems to recognize and interpret visual data, including image classification and object detection.
4. **Implement reinforcement learning algorithms.**
 - Design and implement reinforcement learning algorithms for decision-making tasks in dynamic environments.
5. **Critically assess AI ethics.**
 - Evaluate ethical considerations related to AI, including bias, fairness, transparency, and accountability, and propose strategies for responsible AI development.

6. Present and communicate AI solutions.

- Effectively communicate AI findings and solutions through presentations, reports, and technical documentation.

This course aims to equip senior-level students with the knowledge, skills, and ethical awareness required to engage in advanced AI research and applications, contributing to their academic and professional growth in the field.

CREATING COURSE LEVEL OBJECTIVES BASED ON YOUR COURSE DESCRIPTION

Creating CLOs in higher education is a fundamental step in designing an effective and meaningful course that aligns with the program's curriculum and overall educational goals. Here is an overview of the process:

- 1. Understand the course and program context:** Begin by thoroughly understanding the context of the course. This includes reviewing the program's curriculum, prerequisites, and any relevant institutional or accreditation requirements. Familiarize yourself with the course description, which typically provides a brief overview of the course's content, goals, and intended audience.
- 2. Identify the course's purpose:** Clearly define the purpose of the course. Ask yourself, "What do I want students to achieve and learn by the end of this course?" Consider how the course fits into the broader program's curriculum and its role in helping students progress toward program-level learning outcomes.
- 3. Align objectives with the course description:** Ensure that the CLOs directly align with the course description. The objectives should elaborate on the goals outlined in the description. If the course description mentions specific topics or content areas, make sure your objectives reflect those areas and clarify what students will achieve within them.
- 4. Prioritize key learning objectives:** Limit the number of CLOs to a manageable and realistic quantity. Focusing on a few key objectives allows for more effective teaching, assessment, and student learning. Prioritize objectives based on their importance in achieving the course's overall goals.
- 5. Seek feedback and review:** Share your proposed CLOs with colleagues, mentors, or curriculum committees for feedback and validation. Revise and refine the objectives based on feedback to ensure they are clear, achievable, and aligned with the course description and program curriculum.
- 6. Communicate objectives to students:** Your CLOs will be listed in your syllabi. Clearly communicate the CLOs to your students at the beginning of the course. This helps students understand what is expected of them and provides a roadmap for their learning journey.
- 7. Continuous assessment and improvement:** Continuously assess and reflect on whether the objectives are being met throughout the course. Use student feedback and assessment results to make necessary adjustments and improvements to enhance student learning.

Creating CLOs involves a systematic approach that considers the course's context, alignment with the course description and program curriculum, and the use of clear language. Well-crafted objectives contribute to effective teaching and learning experiences that prepare students to meet the program's learning outcomes and achieve their educational goals.

CREATING STUDENT LEARNING OUTCOMES BASED ON YOUR COURSE DESCRIPTION AND OBJECTIVES

Creating measurable student outcomes in higher education is essential for assessing the effectiveness of a course and ensuring that students achieve the intended learning goals. Here's an overview of how to create measurable student outcomes, including the application of Bloom's Taxonomy, and ensuring alignment with the course description, objectives, and program curriculum:

Creating measurable student learning outcomes:

Master Bloom's Taxonomy: Use Bloom's Taxonomy as a guide to ensure that outcomes reflect the depth and complexity of learning expected from students. Bloom's Taxonomy is a framework that categorizes learning into six levels of cognitive complexity, ranging from lower-order to higher-order thinking skills:

- Remembering
- Understanding
- Applying
- Analyzing
- Evaluating
- Creating

NOTE: The higher level your course, the higher the level of learning complexity (higher level of Bloom's) you should be incorporating. For example, freshman level courses might focus on memorization and understanding, while senior level courses should have a higher order of thinking at levels of evaluation and creation. This level of increased expectation in higher level courses is often reviewed by accrediting bodies.

2. **Align with course level objectives:** Review the CLOs, which should already be aligned with the course description, and use them as a foundation for crafting your outcomes. Ensure that outcomes expand on the objectives, specifying the knowledge, skills, or abilities that students should gain.
3. **Use action verbs:** Select action verbs that are specific, measurable, and aligned with Bloom's Taxonomy to describe the expected student behaviors or achievements. For example, use verbs like "analyze," "evaluate," "synthesize," or "apply" to indicate the level of cognitive rigor.
4. **Specify conditions and criteria:** For each outcome, specify the conditions under which students will demonstrate the outcome and the criteria that define successful achievement. Clearly articulate what students should do and how well they should do it.

5. **Quantify when possible:** Whenever feasible, include quantitative measures in your outcomes. This makes assessment more objective and enables straightforward evaluation. For instance, "Students will achieve an 80% accuracy rate in solving complex mathematical problems."
6. **Align with assessment methods:** Ensure that the assessment methods used in the course, such as exams, projects, or assignments, align with the stated outcomes. Each assessment should directly measure one or more of the specified outcomes.
7. **Link to program-level learning outcomes:** Consider how the course outcomes contribute to the overall program's curriculum and align with program-level learning outcomes. This ensures that individual courses support the broader educational goals of the program.
8. **Review and revise:** Regularly review and revise student outcomes based on assessment results, student feedback, and changes in the field or curriculum requirements. Outcomes should remain relevant and reflective of the course's goals.
9. **Communicate outcomes to students:** Your SLOs will be included in your syllabi. Share the student outcomes with your students at the beginning of the course. This helps them understand what is expected and provides a framework for their learning.

Creating measurable SLOs in higher education involves specifying what students should learn or achieve in a clear, measurable, and aligned manner. These outcomes should build upon CLOs, reflect the depth of learning, and contribute to the overall program's curriculum while being student-centered in focus. They serve as a foundation for assessment, ensuring that students are meeting the intended learning goals of the course.

A NOTE ABOUT STUDENT LEARNING OUTCOMES, LEVELS, AND FORMATIVE AND SUMMATIVE ASSESSMENT

Student Learning Outcomes (SLOs) should match the level of thinking expected of your course level. They should act as guides for development of formative and summative assessment during the course. To be completely transparent, you might consider adding the level of thinking and assignments associated with achieving each outcome. Each outcome, ideally, will be tied to a formative (developing) assessment and summative (achieved) assessment.

Using our previous example of a senior level course in Artificial Intelligence, below is an example of the SLOs for the course, along with the Bloom's Taxonomy levels and assignments (formative and summative) to address each SLO.

Example of SLOs that include level of thinking required and formative and summative assignments for assessment of achievement of each outcome (Note: this section could replace the original SLO section in the original example for AINT 4567 Advanced Artificial Intelligence):

1. Apply advanced machine learning techniques: Develop, implement, and evaluate advanced machine learning models for various AI applications.

- **Bloom's Taxonomy level:** Application (3 - application)
 - **Formative assignment:** Weekly coding exercises where students implement and fine-tune advanced machine learning models, such as deep neural networks, recurrent neural networks, or convolutional neural networks.
 - **Summative assignment:** A final project where students select an AI application (e.g., image recognition, speech recognition) and develop a machine learning model from scratch. They must present their model's performance and evaluation results.
2. Analyze and process natural language: Apply natural language processing techniques to analyze and process text data, including sentiment analysis and language generation.
 - **Bloom's Taxonomy Level:** Analysis (4 - analysis)
 - **Formative assignment:** In-class discussions and analysis of research papers on natural language processing. Students must critically review and summarize the key findings of these papers.
 - **Summative assignment:** A midterm exam that includes questions on the theory and practical implementation of natural language processing techniques. Additionally, a final project where students develop a sentiment analysis system using a real dataset.
 3. Develop computer vision systems: Create computer vision systems to recognize and interpret visual data, including image classification and object detection.
 - **Bloom's Taxonomy level:** Application (3 - application)
 - **Formative assignment:** Hands-on labs where students work with image datasets and learn to implement image classification algorithms step by step.
 - **Summative assignment:** A final project where students design a computer vision system capable of both image classification and object detection. They present their system's performance and results.
 4. Implement reinforcement learning algorithms: Design and implement reinforcement learning algorithms for decision-making tasks in dynamic environments.
 - **Bloom's Taxonomy level:** Application (3 - application)
 - **Formative assignment:** Weekly reinforcement learning programming assignments that build upon previous concepts, gradually increasing in complexity.
 - **Summative assignment:** A reinforcement learning project where students choose a dynamic environment (e.g., game, robot control) and develop and evaluate a reinforcement learning agent to make optimal decisions.
 5. Critically assess AI ethics: Evaluate ethical considerations related to AI, including bias, fairness, transparency, and accountability, and propose strategies for responsible AI development.
 - **Bloom's Taxonomy level:** Evaluation (6 - evaluation)
 - **Formative assignment:** Class debates on AI ethics topics, where students argue for or against specific ethical stances.
 - **Summative assignment:** A research paper or presentation where students select an AI ethics topic, conduct a thorough evaluation of the ethical issues involved, and propose concrete strategies for addressing them.
 6. Present and communicate AI solutions: Effectively communicate AI findings and solutions through presentations, reports, and technical documentation.

- **Bloom's Taxonomy level:** Synthesis (5 - synthesis)
- **Formative assignment:** Practice presentations throughout the course where students receive feedback on their communication skills.
- **Summative assignment:** A final presentation where students showcase their AI projects, including their methods, results, and implications. They must also submit a comprehensive technical report summarizing their work.

IMPORTANCE OF MEASURABILITY AND BENCHMARKING

It is important for SLOs to be measurable and have benchmarks for several reasons:

1. **Assessment of learning:** Measurable SLOs provide a clear framework for assessing whether students have achieved the intended learning outcomes. Without measurable outcomes, it becomes difficult to gauge the effectiveness of teaching and learning processes.
2. **Accountability:** Measurable SLOs help educational institutions and instructors be accountable for the quality of education they provide. Benchmarks provide a standard against which performance can be compared, allowing for accountability at various levels, from individual instructors to entire institutions.
3. **Continuous improvement:** Measurable outcomes and benchmarks enable a feedback loop for continuous improvement. When specific targets are set, instructors and institutions can identify areas where students are struggling and make necessary adjustments to instructional methods, curriculum, or resources to better meet those targets.
4. **Resource allocation:** Measurable SLOs assist in allocating resources effectively. By assessing student performance against benchmarks, institutions can make informed decisions about where to allocate resources such as faculty training, technology, or support services to help improve learning outcomes.
5. **Program evaluation:** Measurable SLOs are essential for evaluating the effectiveness of academic programs. If a program consistently falls short of its benchmarks, it may prompt a review of the program's curriculum, objectives, or instructional strategies to ensure it aligns with the desired outcomes.
6. **Student engagement and motivation:** Clear, measurable SLOs can motivate students by providing them with a sense of purpose and direction in their studies. When students know what is expected of them and can see their progress toward achieving specific learning outcomes, they are more likely to stay engaged and committed to their education.
7. **Data-driven decision-making:** Measurable outcomes and benchmarks provide data that can inform decision-making at both the classroom and institutional levels. This data-driven approach allows for evidence-based adjustments to improve educational practices.
8. **Accreditation and quality assurance:** Many accrediting bodies and quality assurance agencies require educational institutions to define measurable outcomes and demonstrate that they are meeting established benchmarks as part of the accreditation or review process. Having these in place is essential for maintaining accreditation and ensuring the quality of education.

Measurable SLOs with benchmarks are fundamental for assessing student learning, promoting accountability and continuous improvement, allocating resources effectively, and ensuring the overall quality of education in an institution. They provide a structured framework for educational planning, delivery, and evaluation. NOTE: Benchmarks are not often shared with students but rather serve as an indicator of when a course and instructor are successful in helping students achieve expected outcomes. While these are often not included in syllabi, it is important for faculty to have these benchmarks available for review of their course and use in continuous improvement plans.

EXAMPLES OF BENCHMARKING

Using our same example senior level course in Artificial Intelligence, here are potential benchmarks for measured success for each of the SLOs.

1. **Apply advanced machine learning techniques: Develop, implement, and evaluate advanced machine learning models for various AI applications.**
 - **Benchmark:** At least 80% of students should complete the final project successfully, demonstrating the ability to develop, implement, and evaluate advanced machine learning models. The average performance on the final project should exceed 85%.
2. **Analyze and process natural language: Apply natural language processing techniques to analyze and process text data, including sentiment analysis and language generation.**
 - **Benchmark:** In the midterm exam, the average score for questions related to natural language processing techniques should be above 80%. For the final project, at least 70% of students should achieve satisfactory results in sentiment analysis using real-world data.
3. **Develop computer vision systems: Create computer vision systems to recognize and interpret visual data, including image classification and object detection.**
 - **Benchmark:** In the final project, at least 85% of students should design and implement a computer vision system that achieves an accuracy rate of 90% or higher in image classification and demonstrates successful object detection.
4. **Implement reinforcement learning algorithms: Design and implement reinforcement learning algorithms for decision-making tasks in dynamic environments.**
 - **Benchmark:** For the reinforcement learning project, at least 75% of students should develop agents that outperform baseline algorithms in their chosen dynamic environments, achieving a success rate of 80% or higher.
5. **Critically assess AI ethics: Evaluate ethical considerations related to AI, including bias, fairness, transparency, and accountability, and propose strategies for responsible AI development.**
 - **Benchmark:** In the research paper or presentation, at least 70% of students should provide a comprehensive evaluation of ethical issues related to their chosen AI ethics topic and propose actionable strategies for responsible AI development.

6. **Present and communicate AI solutions: Effectively communicate AI findings and solutions through presentations, reports, and technical documentation.**
 - **Benchmark:** For the final presentation and technical report, the average evaluation score from peers and instructors should be above 90%, indicating effective communication of AI findings and solutions.