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Increasing Student Interactions With Learning Objectives

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By Emily Kaye Faulconer

As educators, we recognize the importance of strong student learning objectives. We also know that students benefit by being well informed of expectations. Existing literature offers little guidance in methods and teaching strategies to apply in exposing students to their learning objectives. In this article, we discuss the use of specific teaching strategies to increase student interactions with the learning objectives. Student opinions regarding learning objectives were measured using an end-of-course Likert survey. Although no statistically significant changes in student opinions were detected in this study, a future study will investigate the influence of these targeted strategies on content mastery. The discussion of teaching strategies used for the explicit purpose of increasing meaningful student interaction with the learning objectives fills an important gap in the literature.

In pedagogy literature, there is ample support for the importance of well-designed student learning objectives (SLOs; Eberly Center for Teaching Excellence, n.d., 2015; Mager, 1997; Marzano, 2009; Office of the State Superintendent of Education, 2013). There is thorough guidance on designing objectives and measuring student attainment (Bloom, 1956; Bresciani, Zelna, & Anderson, 2004; Diamond, 1998; Gronlund, 1998; Mager, 1997; Marzano, 2009). There is also evidence for the benefit of articulating the learning objectives prior to a lesson (Stiggins, 2002). Many faculty educational resources emphasize the importance of connecting SLOs with assessments and teaching (Bannister, 2016; Eberly Center for Teaching Excellence, n.d., 2015; O'Reilly, 2007). The role of learning objectives in course design is clear. Another purpose of learning objectives is to clearly communicate with students the course expectations of content and performance. Despite this important role, there is very limited discussion of strategies to encourage direct student interaction with the objectives. Although many resources identify the importance of aligning learning objectives with assessments and instructional strategies, there is a gap in the conversation that omits methods and teaching strategies to apply in exposing students to their learning objectives. This is a critical gap to fill; low achievement has been linked to the failure of students to understand what teachers are requiring of them, whereas the best-performing institutions make it clear to students what is expected of them to succeed (Kuh, Kinzie, Schuh, & White, 2005; Leahy, Lyon, Thompson, & Dylan, 2005).

The approach taken at Mira Costa College to increase the transparency of SLOs was to provide an orientation at the beginning of a laboratory course (Haugsness-White, 2011). This orientation explained where students would encounter SLOs, what they look like in the lab activity, and how the students' achievement of the SLOs would be assessed. The SLOs are directly referenced in homework activities, and students are reminded that they will be assessed on their achievement of this SLO. At the end of the course, students were again exposed to the SLOs in the framework of summarizing what the students should now feel confident doing.

Another approach to increasing student awareness of SLOs was presented as a seven-step method (Arenivar, 2012). First, the SLOs were agreed on by faculty members and placed in the syllabus. Next, the instructor reconsidered the course assignments in light of these SLOs and forged the connection between the two. The relevant SLOs were placed on each assignment sheet. The final step was to connect the SLOs to assignments throughout the semester. The only example of this provided was an example assignment for a self-evaluation essay that specifically provided the SLOs for the students to reflect on (Althoff, Linde, Mason, Nagel, & O'Reilly, 2007).

The body of suggested teaching strategies for explicitly engaging student interaction with the SLOs centers on these reflective self-assessments (Althoff et al., 2007; Bowman & Stephan, 2011; Wiese, Niosi, & Mitchell, 2013). At Clemson University, the GEARSET (General Engineering Assessment Record Self-Evaluation Tool) module was developed for the university's web-based class management tool to connect the learning activities to the course learning objectives (Bowman & Stephan, 2011). The module allowed students to track their progress in the course, including a display of daily, unit, and overall course learning objectives with an interface that allows students to check off objectives they mastered.

The purpose of this work was to develop additional teaching strategies to increase student interaction with and awareness of the student learning objectives. The influence of these targeted strategies on student perception of both the clarity of learning objectives and their overall connection to the course activities and deliverables was measured using an end-of-course evaluation (EOCE) with Likert-scale responses.

Methods

Teaching strategies implemented

This study was conducted at a large private university, in Introduction to Environmental Science in fall 2013, fall 2014, spring 2015, fall 2015, and spring 2016 terms. The course has a small lecture size and serves as a three-credit science elective. In the control group ($n = 114$), learning objectives were posted on the online course portal as well as embedded in the lecture slides, but SLOs were rarely directly addressed through in-class activities. In the test group ($n = 34$), specific active and collaborative learning strategies were selected and applied to increase student interaction with the SLOs.

Many of the teaching strategies identified in Table 1 were implemented without modification. The 3-2-1 teaching strategy is commonly used to structure student review and has several variations. One common variation asks students to record three key ideas, two vocabulary words, and one question that remains unanswered. This strategy was not modified for this project but was connected to SLOs by prompting students to apply the exercise specifically to one of the learning objectives. Concept sort is also a reading and vocabulary strategy where learners sort key words or phrases into categories. The list of words and category labels can be generated by either the teacher or student. For this project, the categories were the learning objectives. Consensogram is a self-assessment strategy where students apply a percentage to represent how much they think they know about the subject, which was the learning objective for this project. The Concept Map strategy takes this one step further by organizing and visualizing connections between concepts in a category. The Jigsaw strategy positions students in small groups where they work together to formulate a minilecture on a topic, after which one person from each team rotates to other teams to teach their topic. In this project, the assigned topics were the learning objectives. For the One-Minute Paper, students openly write about a prompt (e.g., a learning objective) for 60 seconds. The strategy can be extended to have students work together to fill in missing elements in their responses. Writing course questions encourages students to critically review the learning objectives to determine

FIGURE 1

Example Tic-Tac-Toe diagram for food webs topic.

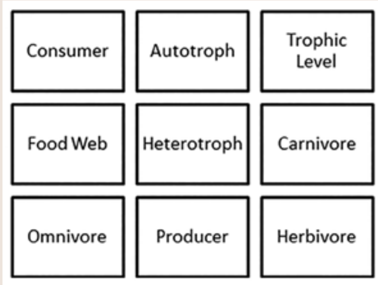


TABLE 1

Strategies implemented in Introduction to Environmental Science.

Strategy	No. of lectures implemented
3-2-1 (Rutherford, 2002)	2
Concept Sort (Rutherford, 2002)	1
Consensogram (Rutherford, 2002)	1
Flow Chart or Concept Map (Macpherson, 2009; Rutherford, 2002)	1
Jigsaw (Barkley, Cross, & Major, 2005)	2
One-Minute Paper (Macpherson, 2009; Nilson, 2003)	1
Submitting Questions (Macpherson, 2009)	1
Think-Pair-Share (Barkley et al., 2005; Gunter, Estes, & Schwab, 1999; Rutherford, 2002)	2
Graph a Change (Macpherson, 2009)	3
Tic-Tac-Toe (Rutherford, 2002)	3
Matching Objective to Activity	3
Quotefalls	2

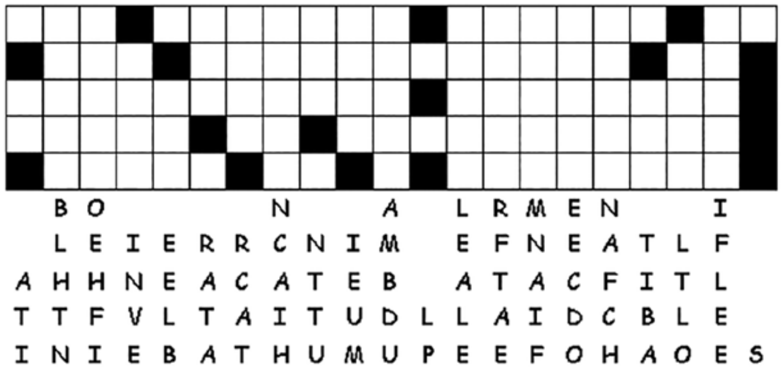
what level of mastery will be expected. In Think-Pair-Share, learners take a few moments to formulate a response, then discuss responses with a partner before sharing with the class. Graph-a-Change is a reflective exercise that asks students to rate the change in their mastery or confidence level before and after an activity.

Several of the teaching strategies in Table 1 were modified prior to implementation. Rutherford presents the Tic-Tac-Toe active learning strategy (Rutherford, 2002) as a vocabulary review. For this study, the strategy was modified to connect to the SLOs. Nine key vocabulary terms relevant to the SLOs were placed in a box diagram (Figure 1), and students were asked to use the words to build a sentence (tic-tac-toe style) that demonstrates their knowledge related to one or more of the learning objectives.

Matching is a common active learning strategy that is easily modified to provide an opportunity for students to more deeply interact with the SLOs. Rather than match terms to definitions or concepts to categories, the students were asked to match the SLOs to the course activities that best helped them master the SLOs (Table 2).

FIGURE 2

Example Quotefall for the solid wastes topic.



This modification not only encourages student interaction with the SLOs, but it also makes clear the connections between the content, course activities and assessments, and expectations. This particular strategy is metacognitive, asking students to consider how they best learned a concept. The students were also instructed that not making a match was acceptable if they felt like they did not master the concept.

Quotefalls are not a teaching strategy discussed in literature but rather a puzzle game. Instructions for solving this type of puzzle are readily available online (Puzzle Baron's drop quotes; http://www.dropquotes.com/). Discovery Education offers a free puzzle generator (http://puzzlemaker.discoveryeducation.com/FallenPhraseSetupForm.asp). As with other games such as crosswords and word search, they can be used to review concepts and vocabulary. In this project, the phrases used in the Quotefall were directly related to the SLOs (similar to the phrases expected to result from the Tic-Tac-Toe strategy mentioned previously), and students were asked to match the phrase to the appropriate SLO after solving (Figures 2).

When solved, the Quotefall states:

TABLE 2

List of student learning objectives and course activities for biogeochemical cycles topic.

Learning objective	**Activity**
Diagram the carbon, nitrogen, and water cycles including storages and fluxes	Quiz
Identify the form of nitrogen, carbon, and water found in different stages of their respective cycles	Instructor-led discussion
Predict the outcome of altering inputs to various stages of the carbon, nitrogen, and water cycles	Peer-led discussion
Explain how humans have influenced biogeochemical cycles	In-class activity
Describe the role of microbial communities in the nitrogen cycle	Your own research (i.e., Google)
	Lecture slides
	Textbook

TABLE 3

Student responses from Tic-Tac-Toe prompt in Figure 1.

Learning objective	Student response
Categorize organisms based on how they obtain energy for life	**Omnivores** and **herbivores** are not considered **producers** because they must consume other organisms to obtain energy for life. In an ocean **food web**, a shark is a **carnivore,** a type of **heterotroph** that eats meat.
Construct a food web for an ecosystem with trophic levels labeled	**Autotrophs** make their own food from inorganic sources so they are found in the first **trophic level** of a food web and are eaten by **consumers** on the second or higher trophic level. Because **omnivores** (a type of **heterotroph)** do not make their own food, they are not found on the first **trophic level.**

Note: Bold added for emphasis on words from the Tic-Tac-Toe diagram.

"The bathtub effect is the accumulation of infiltrated leachate above an impermeable liner in a landfill." This statement connects to the SLO "Describe the bathtub effect."

Survey procedures

The influence of these SLO-targeted teaching strategies was measured using an EOCE standard for all courses at the university. The EOCE was voluntary at the university, and the survey was used without modification for this project. Surveys were completed through Evaluation Toolkit, where faculty can only view overall responses, not personal identifying information or demographic data. The survey and research process were approved by the institutional review board at the university.

The EOCE prompts were measured using a 4-point Likert scale ranging from *strongly disagree* to *strongly agree*. The survey included multiple questions associated with student experiences in a course, but for this study the prompts in the evaluation relevant to this project were:

- The learning outcomes were clearly stated.
- The learning outcomes were addressed via the learning activities in the course.
- I achieved the learning outcomes for this course.

Results

Teaching strategies

Throughout the course, the teaching strategies identified in Table 1 were implemented in course meetings. Each strategy required a different amount of time both prior to class and during the class meetings. For example, even though the Tic-Tac-Toe strategy was modified from its

FIGURE 3

Student responses to matching activity for biogeochemical cycles topic.

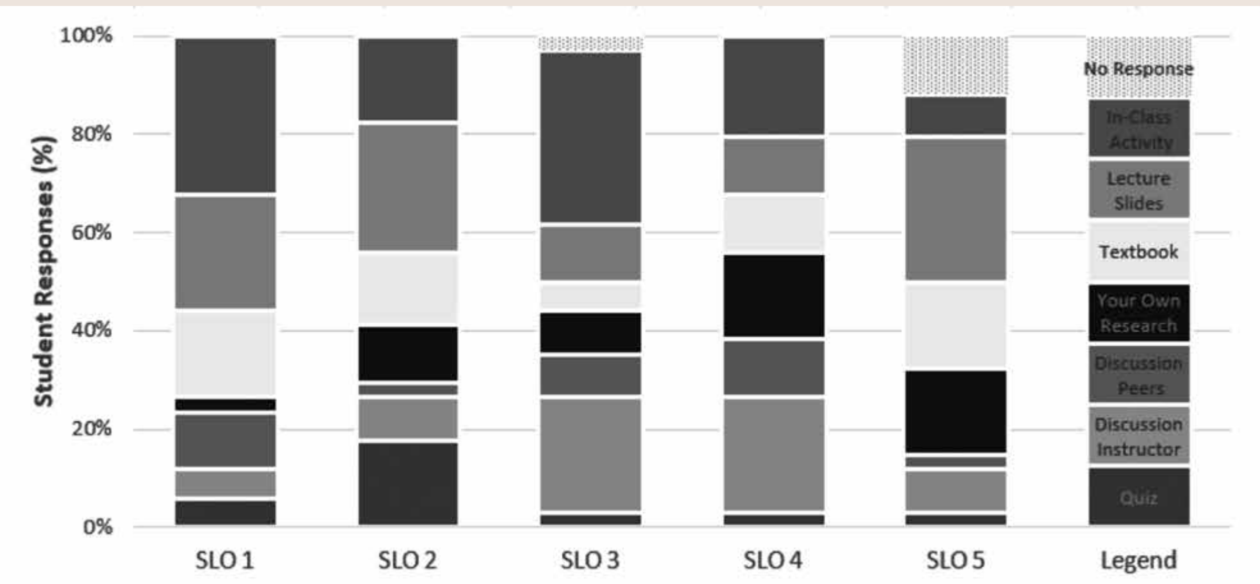


TABLE 4

Student learning objectives (SLOs) for biogeochemical cycles.

Learning objective	
SLO 1	Diagram the carbon, nitrogen, and water cycles including storages and fluxes.
SLO 2	Identify the form of nitrogen, carbon, and water found in different stages of their respective cycles.
SLO 3	Predict the outcome of altering inputs to various stages of the carbon, nitrogen, and water cycles.
SLO 4	Explain how humans have influenced biogeochemical cycles.
SLO 5	Describe the role of microbial communities in the nitrogen cycle.

original form, it was simple to prepare and took only a small portion of class time to execute. Students typically provided strong responses, some of which are listed in Table 3 (bold text added for emphasis on words from the Tic-Tac-Toe diagram). Although only a few select student responses are shown here, most student responses demonstrated a clear mastery of the content related to the learning objectives.

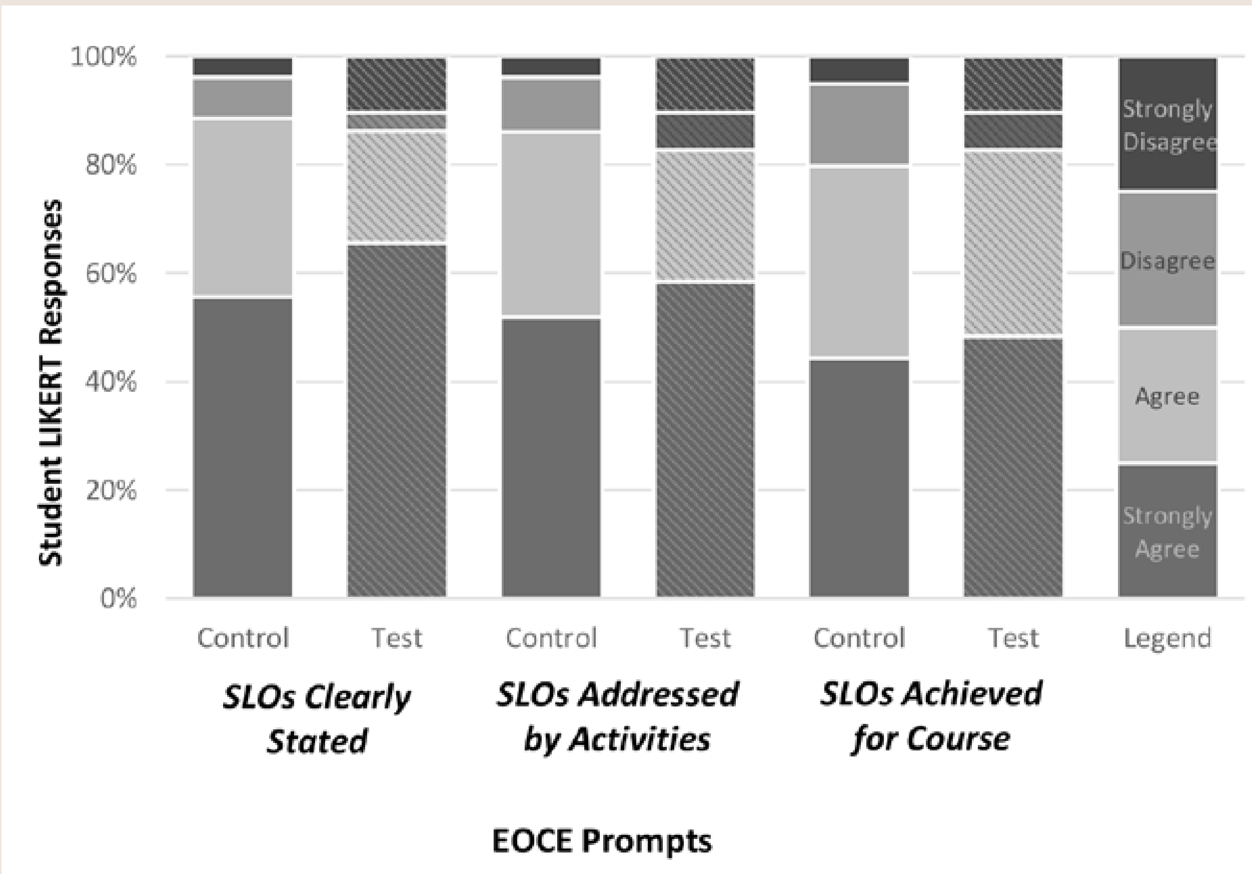
The matching activity was also modified from the original teaching strategy available in literature. To demonstrate its course implementation, student responses from one of the matching exercises were compiled into Figure 3. It is important to note that for SLO 3 and SLO 5 (Table 4), not all students provided a response. Students were instructed to not make a match if they did not feel that they had mastered the learning objective.

End-of-course evaluation

The effectiveness of these teaching strategies on increasing student interaction with the learning objectives was measured using the institution's voluntary EOCEs.

FIGURE 4

Student opinions regarding SLOs before and after implementation of SLO-targeted teaching strategies.



At the end of the term, students were presented with the 12-question, EOCE survey; a total of 108 students completed the survey out of 148 enrolled. The Likert response for each of the three EOCE questions of interest for this work are presented in Figure 4. The remaining nine questions in the institution-standardized EOCE were not related to learning objectives, but instead addressed topics such as the instructor's subject matter expertise, clarity of instructions for course assignments, and usefulness of instructor's feedback on assignments. As such, these questions were not considered for this study.

Likert item data have discrete, rather than continuous values. Researchers have used parametric and nonparametric procedures to analyze the item data. Although this study used four-point Likert items, the literature indicates that the *t*-test (to assess differences in means) and the Mann-Whitney-Wilcoxon (to assess differences in mean ranks) show similar power for five-point Likert items (de Winter & Dodou, 2010; Norman, 2010). Analysis of variance and significance using the control group versus the test group is presented in Table 5.

TABLE 5

Statistical analysis of Likert item data.

EOCE prompt	*F*	*F* critical one-tail	*t* stat	*t* critical two-tail
SLOs clearly stated	1.54	1.62	−0.05	1.98
SLOs addressed by activities	1.52	1.62	−0.17	1.98
SLOs achieved for course	1.24	1.62	0.09	1.98

Note: EOCE = end-of-course evaluation; SLOs = student learning objectives.

Discussion

Before we analyze the potential influence these teaching strategies had on student interactions with the learning objectives, it is important to note that the control group of students (prior to implementation of these targeted strategies) generally had a positive opinion about the SLOs, with a median and mode of 4 (*strongly agree*) for all three EOCE prompts regarding SLOs. Within the control group, each Likert item had a positive response rate of 88.7%, 86.1%, and 79.8% (3 and 4 for *agree* and *strongly agree*). This high starting point left little room for a statistically significant improvement because of the SLO-targeted teaching strategies.

This study was not able to show that the SLO-targeted teaching strategies had a statistically significant influence on student opinions. The *t*-tests assuming equal variances confirmed that the observed difference in averages was not convincing to say that the averages differed significantly (Table 2).

The average response rate for all the EOCEs analyzed in this study was 73.0%, with a response rate of 69.3% in the control group and 85.3% in the test group. Although it is unlikely that a 100% response rate would have significantly altered the results, the less-than-ideal rate could have affected the results. It is important to note that the literature indicates that students with a higher cumulative GPA are more likely to complete online course evaluations (Hativa, Many, & Dayagi, 2010).

These teaching strategies have benefits beyond simply connecting to the SLOs. They can be used as formative assessment. For example, the matching activity clearly identified SLO 5 as the least mastered, with 11.8% of the students not making a selection, indicating that they did not feel they had mastered the SLO (Figure 3, Table 4). These strategies can even be helpful in evaluating course components. The matching exercise revealed the importance of the lecture slides and in-class activity in achieving the learning objectives for the biogeochemical cycles topic. It also revealed that a noticeable number of students sought out additional resources for two of the five learning objectives. If the intent was not to encourage online research, then the course materials could be modified to better address that learning objective.

Conclusion

The primary objective of this project was to develop teaching materials that increased meaningful student interaction with content learning objectives. Even though an influence on student perceptions of SLOs was not demonstrated, this study fills a gap in the available literature by presenting modified strategies for incorporating learning objectives more meaningfully into the classroom environment. Because the teaching strategies were either unmodified or minimally modified, application would not be time consuming. Although not investigated in this study, it is possible that increased awareness of the SLOs increased student learning. Future research should investigate the impact of consistent exposure to SLOs through targeted teaching strategies on content mastery. ■

References

Althoff, S., Linde, K., Mason, J., Nagel, N., & O'Reilly, K. (2007). *Learning objectives: Posting &*

communicating daily learning objectives to increase student achievement and motivation (Master of Arts Action Research Project). Chicago, IL: Saint Xavier University & Pearson Achievement Solutions.

Arenivar, S. (2012). *7 steps to increasing student awareness of SLOs*. Oceanside, CA: MiraCosta College.

Bannister, S. (2016). *Developing objectives and relating them to assessment*. Retrieved from http://teaching.uncc.edu/learning-resources/articles-books/best-practice/goals-objectives/developing-objectives

Barkley, E., Cross, K., & Major, C. (2005). *Collaborative learning techniques*. San Francisco, CA: Jossey-Bass.

Bloom, B. S. (1956). *Taxonomy of educational objectives, handbook 1: The cognitive domain*. New York, NY: David McKay.

Bowman, R., & Stephan, E. (2011). Using GEARSET to promote student awareness of learning objectives. *Proceedings of the American Society for Engineering Education Annual Conference and Exposition 2011*.

Bresciani, M. J., Zelna, C. L., & Anderson, J. A. (2004). *Assessing student learning and development: A handbook for practitioners*. Washington, DC: National Association of Student Personnel Administrators.

de Winter, J., & Dodou, D. (2010). Five-point Likert items: T test versus Mann-Whitney-Wilcoxon. *Practical Assessment, Research & Evaluation, 15*(11).

Diamond, R. (1998). Clarifying instructional goals and objectives. *Designing and assessing courses and curricula: A practical guide*. San Francisco, CA: Jossey-Bass.

Eberly Center for Teaching Excellence. (n.d.). *The educational value of course-level learning objectives/outcomes.* Pittsburgh, PA: Carnegie Mellon. Available at https://www.cmu.edu/teaching/resources/Teaching/CourseDesign/Objectives/CourseLearningObjectivesValue.pdf

Eberly Center for Teaching Excellence. (2015). *The why's and how's of assessment.* Pittsburgh, PA: Carnegie Mellon. Retrieved from https://www.cmu.edu/teaching/assessment/basics/alignment.html

Gronlund, N. (1998). *Assessment of student achievement* (6th ed.). Needham Heights, MA: Allyn & Bacon.

Gunter, M., Estes, T., & Schwab, J. (1999). *Instruction: A models approach* (3rd ed.). Boston, MA: Allyn & Bacon.

Hativa, N., Many, A., & Dayagi, R. (2010). The whys and wherefores of teacher evaluation by their students. *Al Hagova, 9,* 30–37.

Haugsness-White, J. (2011). *Increasing the transparency of SLOs in your course*. Retrieved from hub.miracosta.edu/biomfg/jhwhite_SLO_2012.pptx

Kuh, G., Kinzie, J., Schuh, J., & White, E. (2005). *Student success in college: Creating conditions that matter*. San Francisco, CA: Jossey-Bass.

Leahy, S., Lyon, C., Thompson, M., & Dylan, W. (2005). Classroom assessment minute by minute, day by day. *Educational Leadership, 63*, 18–24.

Macpherson, A. (2009). *Cooperative learning group activities for college courses: A guide for instructors.* Surrey, BC, Canada: Kwantlen Polytechnic University. Retrieved from http://kora.kpu.ca/islandora/object/kora%3A43/datastream/PDF/view

Mager, R. (1997). *Preparing instructional objectives: A critical tool in the development of effective instruction* (3rd ed.). Atlanta, GA: Center for Effective Performance.

Marzano, R. (2009). *Designing and teaching learning goals and objectives: Classroom strategies that work*. Bloomington, IN: Marzano Resesarch Laboratory.

Nilson, L. (2003). *Teaching at its best: A research-based resource for college instructors* (2nd ed.). Boston, MA: Anchor.

Norman, G. (2010). Likert scales, levels of measurement and the "laws" of statistics. *Advances in Health Sciences Education: Theory and Practice, 15*, 625–632.

Office of the State Superintendent of Education. (2013). *Student learning objectives guidebook and technical assistance.* Washington, DC: Author. Available at http://osse.dc.gov/publication/student-learning-objectives-slos-guidebook-and-technical-assistance

O'Reilly, L. (2007). *Assessment & instructional alignment: An online tutorial for faculty*. Denver, CO: University of Colorado Denver. Retrieved from http://www.ucdenver.edu/faculty_staff/faculty/center-for-faculty-development/Documents/Tutorials/Assessment/index.htm

Rutherford, P. (2002). *Why didn't I learn this in college? Teaching and learning in the 21st century*. Alexandria, VA: Just ASK Publications.

Stiggins, R. (2002). Assessment crisis: The absence of assessment for learning. *Phi Delta Kappan, 83*, 758–765.

Wiese, K., Niosi, A., & Mitchell, K. (2013). *Increasing student awareness of SLOs* [Workshop]. Retrieved from https://www.ccsf.edu/en/about-city-college/slo/professional_development/student_awareness.html

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