

Multiple Learning Strategies and Assessments used in an Online Technology, Society & Ethics Course

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Introduction

The author of this article has taught Electronics Engineering Technology courses for 20+ years, mostly in a classroom face-to-face setting. The usual assessment of student learning depends mostly on the evaluation of how well the students have learned the theory-based, numerically-involved, and hands-on applications of each course's content. For the past three summers, the author has also taught an on-line course entitled Technology, Society & Ethics. This kind of course calls for an emphasis on discussion and student writing, which requires a very different style of teaching and assessment than the instructor had used in the past.

The Department of Construction & Operations Management (COM) programs at South Dakota State University are preparing for accreditation by ABET-Applied Science Accreditation Commission (ASAC), for Operations Management and ABET-Engineering Technology Accreditation Commission (ETAC) for Electronics Technology and are already accredited by the American Council for Construction Education (ACCE) for Construction Management. It is mainly the students in these programs that take this course, but is available as one of many General Education courses that any SDSU student can take. In the summer, most of the students in our programs are working in industry-related jobs, or doing an Internship, and this ten-week course is designed so students can complete the class requirements while holding down a job.

For the course, there must be defined Student Learning Outcome statements that meet the requirements of four different entities: Accreditation bodies ABET and ACCE, the university's General Education requirements for two different categories - Globalization and Cultural Awareness/Social and Environmental Responsibility, and the student evaluation of teaching process the university uses, which comes from the Individual Development and Educational Assessment (IDEA) Center¹.

Student Learning Outcomes

As a preparation for teaching the course for the first time, the goals of the course were developed before the specific teaching style and assessment process were chosen. Suskie² says that for good assessment to happen, the instructor at the start needs to "develop clearly articulated written statements of expected learning outcomes", that is, what the students know and will be able to do by the end of the course.

An overall course goal statement was developed for this course, and provided in the syllabus: "... the goal of education is better conceived as helping students develop the intellectual tools and learning strategies needed to acquire the knowledge that allows people to think productively about history, science and technology, social phenomena, mathematics and the arts³." While this is a lofty educational statement, it does not provide any measureable goal, so valid

assessment cannot be done. Instead, smaller sub-topics, student learning outcomes, are developed that can be assessed.

Since 2000, under ABET criteria, institutions must demonstrate through assessment and evaluation that students are reaching the desired outcomes of the program. A meaningful assessment program would use both direct and indirect assessments from a variety of sources. Direct assessment can be instruments such as tests, papers, homework, and lab exercises that measure the student's learning or achievement of ABET Criterion 3 a–k student outcomes⁴. Indirect methods, such as surveys student opinions, or of alumni and employers, provide a valuable supplement to direct methods and are generally a part of a robust assessment program⁵.

Gloria Rogers, formerly ABET's Managing Director of Professional Services, writes extensively on the topic of assessment. In an article entitled “When is Enough Enough?”⁵, she says that data collection activities must be examined in light of good program assessment practice, efficiency, and reasonableness. She says several questions need to be asked, such as, “Is there a clear vision of why specific data are being collected?” She answers, “Without clearly defined outcomes, there can never be enough data because there is no focus.” The National Academy of Engineering⁶ in 2009 issued a report called “Developing Metrics for Assessing Engineering Instruction: What Gets Measured is What Gets Improved”. In that report they reinforced the idea that a sustainable evaluation system must not require implementation that is burdensome to faculty or administrators. While the assessment instruments and rubrics presented in this paper took much time and effort to develop, once that is done, the assessment process does become more straight-forward and relatively easy to implement.

Online Teaching Strategies

Once the learning outcomes for the course were established, then the question is how to best engage the students so these learning outcomes can be achieved. In 2012, Magna Publications posted a document entitled “Online Student Engagement Tools and Strategies.” In that document, there were many suggestions from a wide variety of experienced online course providers, for ways to engage students in an online course. Zappala⁷ says to make sure to establish a calendar of course assignment milestones. Dail⁸ says “A simple, but often-overlooked solution is to require students to submit work on a daily/weekly basis ... but far too often we presume that this connection will be made without providing a structure.” Baker and Taylor⁹ say “An instructor is perceived as ‘present’ in the online classroom when ‘visible’ to the student. In other words, the student knows the instructor is attending to and participating in the class.” Some ways of doing this include using pictures, developing a ‘welcome’ video, designing content with personalized anecdotes, recording your screen navigating the course or going through PowerPoint slides and capturing audio to go along with the video, and video options where students actually get to see and hear you speaking.

Sull¹⁰ suggests these considerations:

- Post a “Welcome to the Course!” announcement that is enthusiastic and motivating.
- Be first (to post in a discussion) whenever possible
- Respond to all student queries, etc., within 24 hours
- Be certain all assignment feedback is detailed and positive in tone

- Respond to all—or nearly all—student discussion postings
- Have ready a frequently asked questions link at the beginning of your course
- Establish and populate an “extra resources” section in your course
- Control knee-jerk reactions
- Use your interest in the subject to help build your online teaching personality.
- Read and reread each post, assignment comment, webmail, and email before sending.

This paper’s author used these and a few other suggestions, and created the course activities. All of the activities listed below are different ways of doing active learning, which is generally defined as any instructional method that engages students in the learning process.¹¹ Active learning requires students to do meaningful learning activities and think about what they are doing, particularly in the classroom¹². In an online course, anytime the student is logged onto the course management system, in our case Desire2Learn (D2L), should be considered as ‘class time’.

For the course, the active learning strategies adopted were:

1. Text Readings. The text by Easton¹³, *Taking Sides: Clashing Views in Science, Technology, and Society*, worked well for discussion, with a Yes and No side presented to each question with technological and societal implications. For the ten weeks of this course, there were ten of the text’s topics chosen and scheduled on a weekly basis.
2. Introduction video on how to navigate D2L to find the course material and assignments.
3. Instructor Presentations, which are produced using Camtasia (voice added) PowerPoints (10 minutes maximum) and posted in D2L.
4. Student-student D2L Discussion. For eight of the ten weeks, the students are directed to go online a minimum of 3 times during the week. They are to post by Wednesday an original reflection of the readings, and then again at least twice later in the week to post replies to other students’ comments.
5. Quizzes. For two of the ten weeks, a short answer and multiple choice quiz is required. These were used to provide variety to the course, rather than discussions each week. They were especially useful for those weeks where the course instructor was traveling, such as to the ASEE Annual Conference.
6. Alternative Learning Strategies. As a replacement for up to four weekly D2L Discussions, for use when students may have heavier summer job obligations, and cannot keep up with the class discussion requirements.
 - Textbook Test Your Knowledge. Students fill out a form including a specific set of questions to guide them to summarize and assess the text reading.
 - TED Talks. Students fill out a form including a specific set of questions to guide them to summarize and assess the presentation.
7. Reaction Papers & Final Paper.
 - By week 3 - Reaction Paper 1, describing the background of the topic you wish to investigate further. Text as the only source.
 - By week 6 - Reaction Paper 2, include the instructor’s feedback from Paper 1 and at least 3 other sources of information.
 - End of course - Final Paper, include the instructor feedback from Reaction Papers 1 & 2 and a total of 5 other APA properly cited sources of information

Assessment

The COM Department Assessment program defines for each course 2 to 5 student learning outcomes to be measured in that course. These measures are direct assessment of student work. The department's continuous improvement process reviews this assessment data every semester. Each program has a faculty meeting at the beginning of each semester to review the results of the outcomes assessments for each course, to refine the assessment instruments if necessary, and to decide on the action that will be taken as a result of not meeting the assessment goal.

The assessment instruments are generally the homework, quizzes, tests, labs, papers, reports, projects, etc., that are a part of the standard course offering. Rubrics are developed for each assessment instrument, and are used to measure if the students are meeting the goal set. The use of a rubric is more likely to provide meaningful and stable appraisals than are traditional scoring methods. Assessing student's knowledge and skills on the basis of a scale offers several advantages. First, it presents a continuum of performance levels, defined in terms of selected criteria, towards full attainment or development of the targeted skills. Second, it provides qualitative information regarding the observed performance in relation to a desired one. Third, its application, at regular intervals, tracks the student's progress of his or her skill mastery¹⁴. In our department in the past, we have found using rubrics is very useful in a capstone course¹⁵.

What follows is for each of the four entities or categories of learning outcomes that are assessed. For each is listed the category, specific learning outcome to be met, assessment instrument, rubric, and, when possible, collected evaluation numbers for three years that the class has been taught under these guidelines.

Student Learning Outcomes & Assessment – ABET/ACCE

The COM Department are preparing for Accreditation by ABET-ASAC, ABET-ETAC, and ACCE. Each accreditation body defines its required student learning outcomes slightly differently, but they can be grouped together. There are two student learning outcomes that are assessed and evaluated for use in the program's continuous improvement process.

As a result of taking the course, students will possess:

1. ABET-ASAC Criterion 3 f) an understanding of professional and ethical responsibility
ABET-ETAC Criterion 3 i) an understanding of and a commitment to address professional and ethical responsibilities, including a respect for diversity,
ACCE 6. Analyze professional decisions based on ethical principles

This student learning outcome will be assessed through the two Reaction Papers and Final Paper Assessment Instrument: The final paper rubric is shown in Table 1

Final Paper-100 pts (for Reaction Papers 1 & 2, each category is 5 pts/25 pts total)					
Criteria	Excellent	Good	Fair	Below Avg	Un-acceptable
Analysis - Supporting Evidence	30 points Evidence clearly supported the assertion/thesis. Evidence and quotes were sufficient, and personal experience is used expertly as support for the impact of technology on everyday life	25 points Evidence and quotes clearly supported the assertion/thesis, but there were not enough. Personal experience is used for support but not entirely reflective of the impact of technology on everyday life.	20 points Assertion/thesis was supported by limited evidence/quotes. Some are improperly cited. Personal experience is mentioned but does not support the impact of technology on everyday life	15 points One or two improperly cited quotes that support assertion/thesis statement. Personal experience is barely mentioned.	0 points No properly cited quotes that support assertion/thesis statement. Personal experience is not mentioned.
Organization	30 points Had an introduction that hooked the reader into the paper. Also had a clear beginning, middle, and end. Paragraphs had at least 5-7 sentences and were well developed. Effective transitions were used.	25 points Introduction was interesting. Had a beginning, middle and end. Most paragraphs had 5-7 sentences, were developed and transitions were used.	20 points The writer tried to create an introduction to grab the reader's attention. Some paragraphs had between 5-7 sentences and are only somewhat developed. Some transitions were used. The argument has been made, but the structure is poorly developed.	15 points Introduction was trite, showing little originality. Paper jumped from topic to topic with little or no apparent organization.	0 points Unacceptable. There was a total lack of structure.
Facts – website sources are found and believable	20 points All websites cited can be found, and are from "reputable" websites	16 points All websites cited can be found, and most are from "reputable" websites	12 points All websites cited can be found. Only some are from "reputable" websites	6 points One website cited cannot be found. Only some are from "reputable" websites	0 points More than 1 website referenced cannot be found
APA standard citations	10 points All in-paper citations are written correctly and all References are written correctly	8 points Most in-paper citations are written correctly and all References are written correctly	6 points Some in-paper citations are written correctly and most References are written correctly	4 points Few in-paper citations are written correctly and few References are written correctly	0 points Unacceptable - no citations are written correctly and no References are written correctly
Style and Conventions	10 points Paper was a full 1000 words long. No mistakes in spelling, punctuation or grammar.	8 points Paper was a full 1000 words long. Some mistakes in spelling, punctuation or grammar.	6 points Paper was a full 1000 words long. Many mistakes in spelling, punctuation or grammar.	4 points Paper was a less than 1000 words long. Some mistakes in spelling, punctuation or grammar.	2 points Paper was a less than 1000 words long. Many mistakes in spelling, punctuation or grammar.

Table 1. Reaction Paper & Final Rubric

The second student learning outcome - As a result of taking the course, students will possess:

2. ABET-ASAC Criterion 3 h) the broad education necessary to understand the impact of solutions in a global and societal context
- ABET-ETAC Criterion 3 j) a knowledge of the impact of engineering technology solutions in a societal and global context

This student learning outcome will be assessed through the D2L Discussions.

Assessment Instrument: The discussion rubric is shown in Table 2.

D2L Discussions: Original post – 15 pts				
Criteria	10 points	7 points	4 points	1 point
Original Post - Understanding of Topic	Post shows insight, depth and understanding. Entry is relevant with reference to supporting material. Personal opinion is expressed in an appropriate style and is clearly related to the discussion topic.	Post shows insight and understanding. Entry may contain some irrelevant material. Personal opinion is expressed in an appropriate style and is related to the discussion topic.	Post shows some insight and understanding. Entry may contain some irrelevant material. Personal opinion may not be on task and is mostly related to the discussion topic.	Post shows little insight or understanding. Entry is short and contains mostly irrelevant material. Personal opinion is not on task and is little related to the discussion topic.
Construction	5 points	4 points	2 points	1 point
Construction	Spelling and grammatical errors are rare. Good structure and reasoning is easy to follow.	Few spelling and grammatical errors. Has structure and the entry flows.	Some poor spelling and grammatical errors. Has some structure, but the entry does not flow.	Some poor spelling and grammatical errors. Has some structure, but the entry does not flow.
Replies – 10 pts				
Criteria	5 points	4 points	3 points	1 point
Referencing	Student refers to other posts. The reply post is related to the thread.	Student refers to other posts. The reply post is mostly related to the thread.	Student does refer to other posts. The reply post is little related to the thread.	Student does not refer to other posts or the referred posts are irrelevant, inappropriate or unrelated to the thread. The post may be a repeat of prior posts.
Critique	The student is judging other posts on their merits. The student provides a detailed critique of posts in an appropriate manner.	The student is somewhat judging other posts on their merits. The student provides a critique of posts in an appropriate manner.	The student provides a simple critique of posts in an appropriate manner.	Student does not provide any critique of other posts or comments.

Table 2. Discussion Rubric

When the rubrics are used to evaluate student work, data is generated that can be used in the department’s continuous improvement process. Table 3 shows three years of results of these assessments (in terms of meeting ABET-ASAC Student Outcomes), that will be reported.

As can be seen in the table, for Outcome ASAC h), the students met the goal each time, and no changes or improvements to the course were suggested. For the Outcome ASAC f), in the summer of 2014, the students did not meet the goal. Those goals are set by agreement of all faculty in the department, and are, in general, that 80% of the students will score 70% or better, based on a rubric. For 2014, only 78% of the students met the goal, which is just under the goal.

The department’s continuous improvement process and procedures allows faculty to make the recommendation that was made: “Did not meet goal, but just under. No changes made now, but will monitor in the future.” This is in keeping with general good quality control practice, that is, not to overreact to small changes in a part of a process that does not substantially affect overall quality.

GE 231	ABET SO	Specific Course Outcome & Criteria	When	Tool
	ASAC f) an understanding of professional and ethical responsibility	Demonstrate ability to summarize the history of a technological & ethical problem and construct their own opinion on possible solutions to the problem - 80% of the students will score 70% or better, based on a rubric	end of course	Final Paper, after two rounds, Reaction Paper 1 & 2, of submission and feedback
Year		Assessment Results		Use of Results to Improve Program
Su12		18/20	90%	met goal, no changes needed
Su13		14/16	87%	met goal
Su14		11/14	78%	Did not meet goal, but just under. No changes made now, but will monitor in the future.

GE 231	ABET SO	Specific Course Outcome & Criteria	When	Tool
	ASAC h) the broad education necessary to understand the impact of solutions in a global and societal context	Demonstrate ability to describe contemporary technological problems and appraise different viewpoints on solutions to the problems - 80% of the students will score 70% or better, based on a rubric	middle of course - weeks 4, 5, and 7	Total score, measured against a rubric, on three group discussion postings
Year		Assessment Results		Use of Results to Improve Program
Su12		17/20	85%	met goal
Su13		16/16	100%	met goal
Su14		13/14	93%	met goal

Table 3. ABET Assessment Data for the Continuous Improvement process

Student Learning Outcomes – Globalization

The course fulfills the requirements for Globalization in the 2014-15 and later SDSU catalogs. Globalization is defined as a process of interaction and integration among different people, organizations and governments that takes place outside of and above the level of national boundaries.

As a result of taking the course, students will:

1. Demonstrate a basic understanding of modern-day globalization, including outlining the benefits and cost implications of globalization, and interpret consequences of global issues through various forms of analysis¹⁶.

Assessment Instrument: Figure 4 shows a portion of the rubric for the weekly discussion topics, from Easton's¹³ text, such as Should DDT Be Banned Worldwide?, and Are Genetically Modified Foods Safe to Eat?, where students gain a deeper understanding of their own choices' impacts on global issues. The line of the rubric that assesses the specific learning outcome being assessed would be used, as well as the Construction, and Reply-Referencing and Critique lines that Table 2 details.

Criteria	Level 4 10 points	Level 3 7 points	Level 2 4 points	Level 1 1 point
Original Post - Understanding of Facts of Globalization	Post shows thorough knowledge of facts. Entry is relevant with reference to supporting material.	Post shows good knowledge of facts. Entry is relevant with reference to supporting material.	Post shows some knowledge of facts. Entry is relevant with reference to supporting material.	Post shows little knowledge of facts. Entry is relevant with reference to supporting material.
Original Post - Understanding of Costs of Globalization	Post shows thorough understanding of the costs of change. Entry is relevant with reference to supporting material.	Post shows good understanding of the costs of change. Entry is relevant with reference to supporting material.	Post shows some understanding of the costs of change. Entry is relevant with reference to supporting material.	Post shows little understanding of the costs of change. Entry is relevant with reference to supporting material.
Original Post - Understanding of Implications & Consequences of Globalization	Post shows insight, depth and understanding. Entry is relevant with reference to supporting material. Personal opinion is expressed in an appropriate style and is clearly related to the discussion topic	Post shows insight and understanding. Entry may contain some irrelevant material. Personal opinion is expressed in an appropriate style and is related to the discussion topic.	Post shows some insight and understanding. Entry may contain some irrelevant material. Personal opinion may not be on task and is mostly related to the discussion topic.	Post shows little insight or understanding. Entry is short and contains mostly irrelevant material. Personal opinion is not on task and is little related to the discussion topic.

Table 4. Portion of Globalization Rubric

Assessment data is not required each semester to see how the students meet the Globalization (or the Cultural Awareness/Social and Environmental Responsibility, below) General Education requirements. Instead, a university committee, on a three- or four-year rotating basis, reviews each course that is on the General Education course list. The course instructor submits information about the course, including samples of student work that have been evaluated using the rubric. This paper does not include that information.

Student Learning Outcomes – Institutional General Requirement (IGR) #2 Cultural Awareness and Social and Environmental Responsibility

Goal: Students will acquire knowledge about the world’s peoples – their cultures, arts, and environments – that prepares them for further study, deepens their understanding of the human condition, and strengthens their commitment to social and environmental responsibility¹⁶.

As a result of taking the course, students will:

1. Articulate the ways in which different peoples express an understanding of the human condition and respond to environmental opportunities and constraints.
2. Describe how personal choices derive from and affect social, cultural, and environmental contexts.
3. Explain the ethical consequences of decisions and actions concerning the environment to strengthen commitment to local, national, and global citizenship.

Assessment Instrument: Table 5 shows the portion of the paper rubric used to assess the student learning outcomes for globalization. The complete rubric includes the Organization, Facts, APA and Style lines that Table 1 details.

Criteria	Excellent	Good	Fair	Below Average	Unacceptable
Express an understanding of the human condition	30 pts Shows insight, depth and understanding of the human condition. Personal opinion is expressed in an appropriate style and is clearly related to the discussion topic	25 pts Shows insight and understanding of the human condition. Personal opinion is expressed in an appropriate style and is related to the discussion topic	20 pts Shows some insight and understanding of the human condition. Personal opinion may not be on task and is mostly related to the discussion topic	15 pts Shows little insight or understanding of the human condition. Personal opinion is somewhat on task and is little related to the discussion topic	0 pts Shows no insight or understanding of the human condition.. Personal opinion is not on task nor related to the discussion topic
Personal choices affect social, cultural, and environmental contexts	30 pts Shows insight, depth and understanding of personal choices. Personal opinion is expressed in an appropriate style and is clearly related to the discussion topic	25 pts Shows insight and understanding of personal choices. Personal opinion is expressed in an appropriate style and is related to the discussion topic	20 pts Shows some insight and understanding of personal choices. Personal opinion may not be on task and is mostly related to the discussion topic	15 pts Shows little insight or understanding of personal choices. Personal opinion is somewhat on task and is little related to the discussion topic	0 pts Shows no insight or understanding of personal choices. . Personal opinion is not on task nor related to the discussion topic

Table 5. Portion of Cultural Awareness/Social and Environmental Responsibility Rubric

IDEA Learning Objectives

At the end of each SDSU course, students get a chance to evaluate the course and instructor with a survey from IDEA¹ called the Student Ratings of Instruction System. The survey asks the students to “describe the amount of progress you made on each [course] learning objective”, which is an indirect measure of student achievement.⁵

This survey is required by the South Dakota Board of Regents for all courses. The information gathered is used as a part of an ongoing process to improve and enhance instructor’s teaching technique and style. For this course, there are four learning objectives that we concentrate on. The students fill out the survey online, using a link provided in D2L, during the last two weeks of the course. Table 6 shows the results of the IDEA Survey for the last three years.

The students see this instruction:

Describe the amount of progress you made on each of these learning objectives: For this course, there are four [of the twelve total] learning objectives that are assessed.

1. Learning how to find and use resources for answering questions or solving problems.
2. Developing a clearer understanding of, and a commitment to, personal values
3. Learning to analyze and critically evaluate ideas, arguments, and points of view.
4. Acquiring an interest in learning more by asking my own questions and seeking answers

The scale the students use to answer the questions is:

- (1) No apparent progress
- (2) Slight progress, I made small gains
- (3) Moderate progress, I made some gains
- (4) Substantial progress, I made large gains
- (5) Exceptional progress, I made outstanding gains

IDEA Learning Objective	Su12	Su13	Su14
1. Learning how to find and use resources for answering questions or solving problems	4.4	3.3	*
2. Developing a clearer understanding of, and a commitment to, personal values	3.8	3.8	*
3. Learning to analyze and critically evaluate ideas, arguments, and points of view.	4.6	4.3	*
4. Acquiring an interest in learning more by asking my own questions and seeking answers	4.4	3.8	*

Table 6. IDEA Results

* IDEA survey results for Summer 2014 were not available at the time this paper was submitted

These assessment results are not used as a part of the department's continuous improvement process, because they are a personnel issue. The department head reviews the results for all courses that a faculty member teaches over the course of a year, and make recommendations to the faculty member about improvements that can be made, individually.

As a faculty member, this author keeps track of the IDEA results, and uses them on a personal basis to make decisions about teaching overall, not necessarily for that learning objective for that course. For example, there was a substantial drop in the results for Objective 1: Learning how to find and use resources, from 2012 to 2013. So for 2014, more emphasis on searching for appropriate sources while writing the Reaction Papers/Final Papers was added, and the students received more specific feedback on the quality of the sources they chose for Reaction Paper 2. As IDEA scores for Summer 2014 have not been returned at this time, it remains to be seen if that change of teaching style will result in improved scores.

Summary

This paper details the multiple learning strategies and assessment instruments used and data gathered in an online course offered through our Department of Construction & Operations Management. Much work was needed to develop the course assignments, matching assessments, and rubrics to satisfy the requirements of diverse interested parties: ABET and ACCE Accreditation, the university's General Education requirements, and the IDEA student assessment of learning survey. Once the instruments were developed and put into place, care must be taken each time the course is offered that the approved rubrics are used to evaluate student work, and data is gathered that can be reported. The overall goal of all this assessment is so students have a good learning experience, but it requires vigilance and a balancing act by the course instructor.

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