ASEE AMERICAN SOCIETY FOR ENGINEERING EDUCATION

Paper ID #35751

Civil Engineering Accreditation Assessment in a Forced Online Learning Environment

Dr. Indumathi Jeyachandran, San Jose State University

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Civil Engineering Accreditation Assessment in a Forced Online Learning Environment

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Abstract

In this paper we describe the challenges faced in a forced online learning environment in the aspects of course delivery and assessment for ABET accreditation. The ABET assessment development and mapping process in the Civil and Environmental Engineering Department at San Jose State university, and the assessment organization is described. Further, a handbook developed to assist faculty in curricular redesign and rethinking assessment strategies for use in an online learning environment is described. This paper emphasizes the need for redesign of assessment methods for ABET accreditation in an online learning environment.

Introduction

With the sudden shift in the mode of instruction for face-to-face classroom setting to an online setting in Spring 2020, there were challenges which arose in Spring 2020. Instructors had to suddenly transition to deliver course material and conduct assessments through online tools and platforms, ensuring academic integrity and preventing academic cheating while doing so. It is virtually impossible to use the course delivery and assessment methods previously used in face-to-face classroom setting without modifications for use in an online setting. The activities previously used in a face-to-face classroom setting have to be replaced with similar activities which are conducive to be used in an online setting.

The course delivery methods and instructional activities part aside, assessments methods must be modified as well for use in an online setting. While one of the reasons being that some of the assessment methods cannot be effectively used in an online setting, the other pressing reason is the cheating which occurs in exams in an online setting. Notable cases of academic cheating with the transition to an online mode of learning include Boston University cheating in Spring 2020 [1], Boston University cheating in Fall 2020 [5], Texas A & M University cheating in Fall 2020 [2].

It is inevitable to acknowledge the need for rethinking curricular development and assessment strategies for effective use in an online mode of learning. This paper talks about effective curricular development and assessment strategies for use in engineering courses used for ABET Assessment taught in an online setting.

ABET Accreditation

This section describes the ABET assessment development and mapping process, and the organization of the assessment folders.

Assessment Development and Mapping Process

Until the end of 2017, ABET outcomes A through L were used for assessment. In September 2017, an ABET evaluator visit was completed and the B.S Civil Engineering Program was declared to be void of any deficiencies. With the introduction of new ABET outcomes in 2018, all ABET accredited programs were expected to use the new ABET outcomes (1 through 7) for future ABET assessment cycle. The department chair and ABET coordinator worked on mapping new ABET outcomes to old ABET outcomes. Further new PCs were drafted, and the PCs were mapped to the new ABET outcomes. This was a significant change in the ABET outcome mapping process. In the past, each outcome had one or more corresponding PC. In the new process, each draft PC was mapped to one or more ABET outcomes.

The draft PCs development and mapping of PCs to ABET outcomes and courses was done in Spring 2018. During this process, the course coordinators were shared a spreadsheet with the draft PCs, ABET outcome mapping, and the course Student Learning Outcomes (SLOs)for each of their courses to be used for assessment. The course coordinators were requested to respond if their current course SLOs mapped to the new draft PCs, and if the SLOs didn't map could the SLOs be modified?

In Fall 2018, the draft PCs and mapping of the draft PCs to new ABET outcomes and courses were presented to the department faculty. The draft PCs and outcomes and course mapping were approved with some modifications. Subsequently, course coordinators were sent an email requesting they modify the course SLOs based on the new PCs if needed.

The new PCs and the mapping of PCs to old and new ABET outcomes, courses and the course coverage guidelines are shown in Figure 1, and Table 1. The courses are color-coded to indicate the corresponding coverage in the PCs in Table 1.

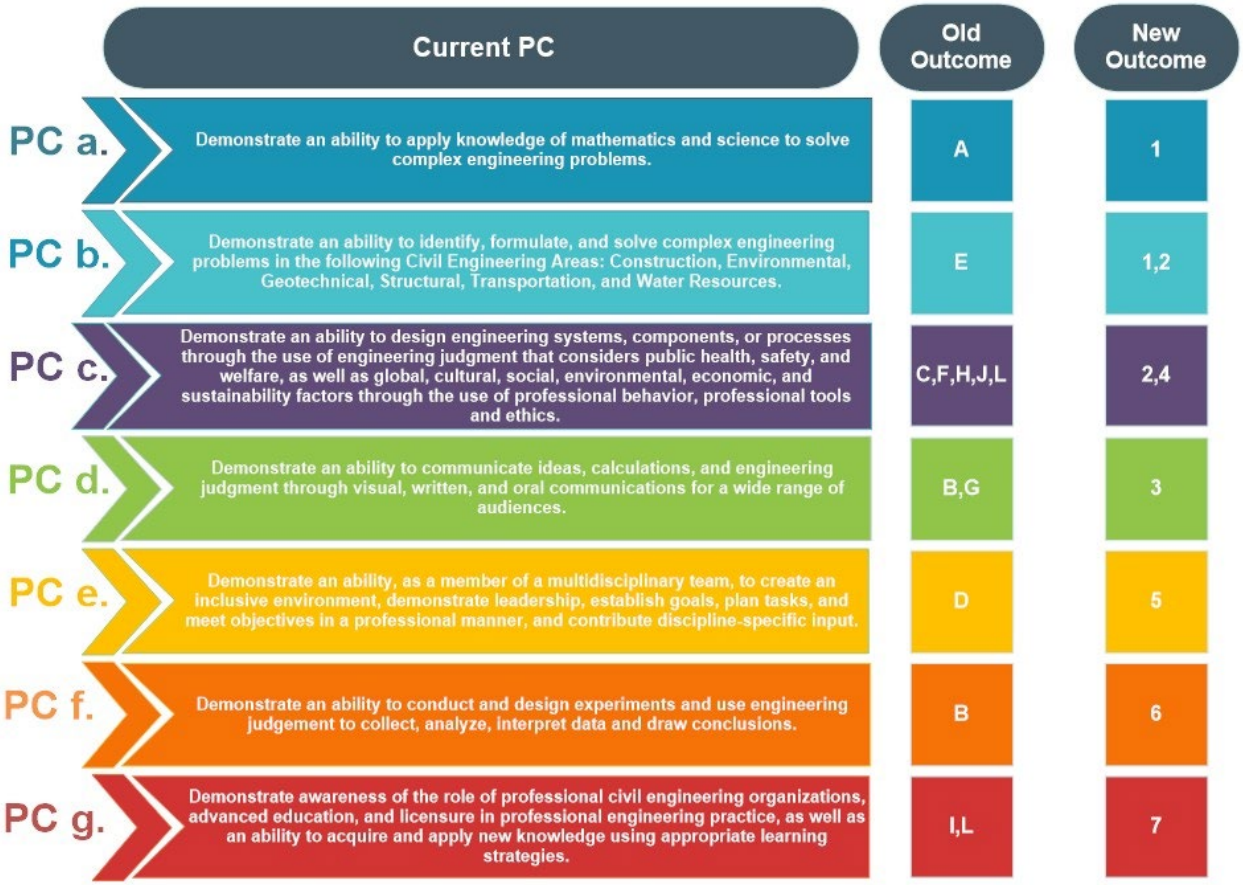

Figure 1: Mapping of Revised New PCs to old and New ABET Outcomes.

Table 1: Mapping of New PCs to Courses

New Performance Criteria	Courses
a. Demonstrate an ability to apply knowledge of mathematics and science to solve complex engineering problems.	CE 112, CE 190
b. Demonstrate an ability to identify, formulate, and solve complex engineering problems in the following Civil Engineering Areas: Construction, Environmental, Geotechnical, Structural, Transportation, and Water Resources.	CE 131, CE 170, CE 140, CE 160, CE 121, CE 150
c. Demonstrate an ability to design engineering systems, components, or processes through the use of engineering judgment that consider public health, safety, and welfare, as well as global, cultural, social, environmental, economic, and sustainability factors through the use of professional behavior, professional tools and ethics.	CE 181, CE 162, CE 170, CE 150
d. Demonstrate an ability to communicate ideas, calculations, and engineering judgment through visual, written, and oral communications for a wide range of audiences.	CE 140, CE 162
e. Demonstrate an ability, as a member of a multidisciplinary team, to create an inclusive environment, demonstrate leadership, establish goals, plan tasks, and meet objectives in a professional manner, and contribute discipline-specific input.	CE 162
f. Demonstrate an ability to conduct and design experiments and use engineering judgement to collect, analyze, and interpret data and draw conclusions.	CE 120, CE 140, CE 192
g. Demonstrate awareness of the role of professional civil engineering organizations, advanced education, and licensure in professional engineering practice, as well as an ability to acquire and apply new knowledge using appropriate learning strategies.	CE 131

In Spring 2019, instructors were informed in the beginning of the semester to revise their syllabus with new PCs, and new ABET outcomes. Instructors were also informed to consult with their course coordinator to check if the SLOs were modified for the courses based on the new PCs if they need to be modified. If the SLOs were modified the instructors were required to revise the syllabus to include the new SLOs. In Fall 2019, data collection based on new PCs and new ABET outcomes was done for the very first time.

In Spring 2020, Assessment data from Fall 2019 was compiled into a master assessment spreadsheet which was made available for viewing by all faculty in the department. The data collection in Spring 2020 halted due to sudden shift in the mode of instruction to online from face-to-face classroom teaching. However, employer survey and alumni survey were sent out in May 2020. Employer survey and alumni survey are used as indirect tools for assessment. In Fall 2020, data collection was resumed.

Assessment Organization

This section describes the change in the assessment process, and the organization of the assessment folder.

Change in the Assessment Process

Until the end of 2017, instructors were required to prepare and submit a Course Report, and Course Coordinators were required to prepare an Outcome Champion Report for each outcome. The Outcome Champion Report for a specific outcome summarized results for all the courses used for assessment of that outcome. This process consumed a lot of time and effort and resulted in huge stacks of documentation which wasn't being used effectively. Instructors weren't always informed about how the assessment results from the Course Reports were used, or how the assessment data was being used.

In late 2017, the Department Chair and the Assessment Coordinator discussed about simplifying the assessment data collection and results compilation process. It was decided to follow another department's data collection process of using google spreadsheets for assessment data collection. However, the spreadsheets were customized to the Department's needs.

As the first step in the assessment organization process, an ABET folder was created in Google Drive. Under the ABET master folder, are the Master and Course sub-folders. The organization of the ABET folder is shown in Figure 2.

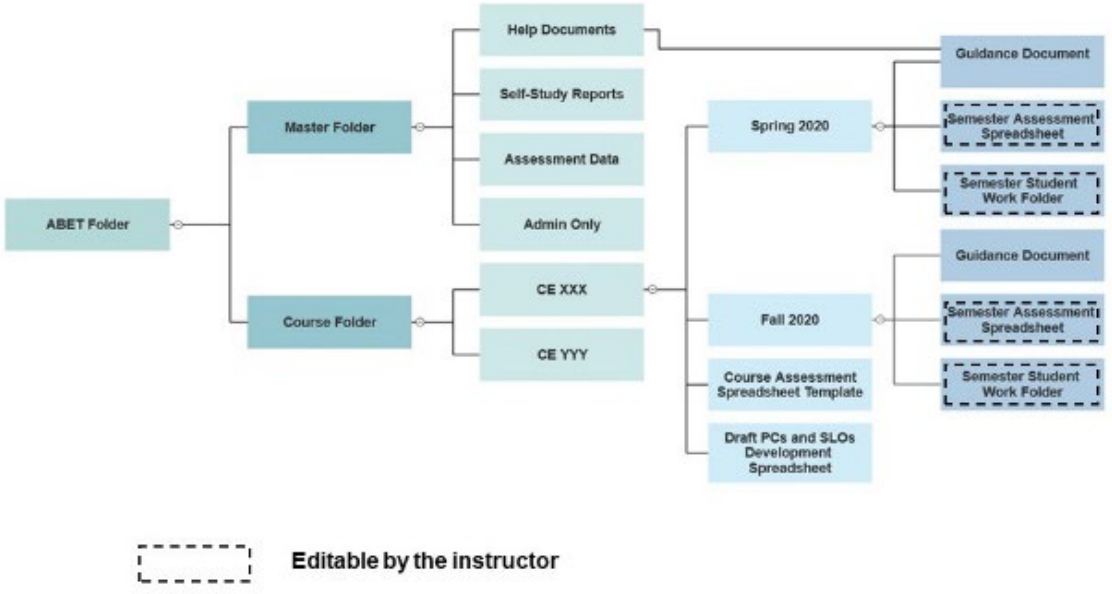

Figure 2: Assessment Folder Organization. Faculty have limited access to folders and documents that are relevant to their course.

The Master folder has the previous self-study reports, annual assessment reports, courses and instructors list for each semester, and also an Admin sub-folder. The admin sub-folder has documents which can be accessed only by the Department Chair and Assessment Coordinator.

The Course folder has 12 sub-folders; one for each course used for assessment. 12 courses are used for the assessment of ABET outcomes and PCs. Each course folder has a sub-folder for each semester (Fall 2019, Spring 2020, Fall 2020), and a master spreadsheet for the course, the spreadsheets used in the development of draft PCs as mentioned in the assessment development process section.

Each semester sub-folder for each course consists of sub-folders for each section of the course. There are courses which have multiple sections. The instructor for each section has access to their specific section folder. Each section sub-folder consists of student work folder where instructors are asked to upload their student work, and a spreadsheet where instructors are asked to report the assessment results. At the beginning of each semesters, instructors are sent an email with links to the spreadsheet and the student work folder with instructions for reporting assessment results in the spreadsheet. Instructors are expected to report the assessment results in the spreadsheet by a certain date in the beginning of the following semester. For instance, assessment results for Fall 2020, are expected to be reported by January 29, 2021. The deadline is set in a way to provide instructors with time to complete grading of the final exams and compile the results. The Assessment folder organization is shown in Figure 2.

Assessment Loop

The data collected for all the courses and PCs are compiled into a master spreadsheet and the results are presented to the department's curriculum committee annually by the Assessment Coordinator. There the faculty are able to discuss what is going on and determine if a change needs to be made on a program level. If there is an issue in an upper division course that is tied to a lower division course, the assessment coordinator has the instructors and course coordinators meet to discuss curriculum changes in response to the issue. If the discussions are contentious, then the full curriculum committee will be called to discuss the issue and make a final decision. These decisions are reported back to the instructors and course coordinators for incorporation into their course. This is the full loop of assessment followed in the Department. With this new assessment organization method, all instructors have access to the previous assessment spreadsheets for their courses and can refer to what changes were made to the course curriculum, and why these changes were made. The new method is more transparent and provides an insight of the complete assessment process to the instructors, whereas in the past instructors weren't always aware of how their course reports were used and the importance of collecting assessment data.

COVID Disruption in Spring 2020

San Jose State University, in downtown San Jose and the heart of Silicon Valley, was considered the hotspot of COVID-19 in the state of CC in March 2020. The area had many of the earliest cases of COVID-19 and first death reported in California. Those facts led to San Jose State University's call for distance learning on Monday, March 9, 2020, very early in the crisis. The university called for a suspension of courses for the remainder of that week to allow for faculty to transition to online learning and allow students to make decision regarding their location for the remainder of the semester. Campus was essentially closed for commuter students on March 9, though it remained open for faculty and staff.

Resident students were encouraged to return home, though the residence halls and dining facilities remained open for their use. Campus was effectively closed for all non-essential activities on March 16, 2020 when Santa Clara County announced their shelter-in-place order. At that time, campus was closed except for essential personnel and student housing for those who remained.

As soon as the call for remote instruction was made, several campus offices responded with immediate training opportunities for faculty. The Center for Faculty Development (CFD), eCampus, and college instructional designers began offering a variety of training sessions and open work sessions to assist faculty in using resources like Canvas, the campus learning management system and Zoom. They were also offering sessions on creating lecture videos, identifying quality online resources, and using proctoring software for assessments. These offerings continued throughout the spring semester.

Soon after this emergency response was put into place, the campus administration recognized that these offerings were meant as a short-term solution to the sudden transition to online learning and not a means of training faculty for effectiveness in an online environment to promote student success. The administration chose to use a portion of their Federal CARES funds to support faculty training to improve their effectiveness in online instruction for upcoming semesters. While this funding provided resources for a portion of the curricular development activities faculty needed to conduct, it did not address any of the stress faculty were feeling during this time.

A research team in the College of Engineering conducted an online survey with follow up interviews for both students and faculty. The research project's goals were to identify the stressors students and faculty were experiencing in Spring 2020 after the shift to online learning, as well as their perspectives on the effectiveness of the online instruction that occurred after March 16. The survey was sent to 287 faculty who taught in the college in Spring 2020, and104 faculty responded. The Civil and Environmental Engineering Department had 14 responses out of a possible 30. Faculty demographics are summarized in Figure 3.

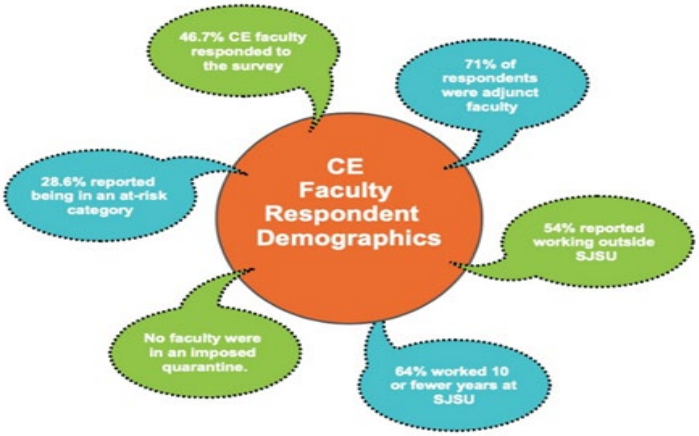

Figure 3: Demographics of CE faculty respondents to the COVID-19 survey

A similar survey was sent to all engineering students. Of all 496 civil engineering students, 86 provided responses to the survey. In the survey, faculty and students were asked about their experiences since the Shelter-in-place order. Results are compared in Figure 4. Faculty tended to report fewer negative experiences overall, while students reported greater issues with discrimination and their living situation. Both groups were also asked about stressors and whether they were better, the same, or worse prior to COVID-19. When asked about healthcare access, faculty reported feeling worse or much worse than prior to COVID-19 (33.3%), whereas 40% of students reported the same. Students tended to report greater concerns with time management (61% compared to 46.2%) and their overall wellbeing (66.2% compared to 50%). Both faculty and students reported that their ability to socialize with their peers and friends was worse or much worse than before. An equal percentage of faculty and students report an increase in expenses after the shelter-in-place (15.4% compared to 15.6% of faculty). Students were far more likely to report a decrease in their income (55.1% compared to 30.8% of faculty) and more likely to report an increase in debt (14.7% compared to 8.3% of faculty).

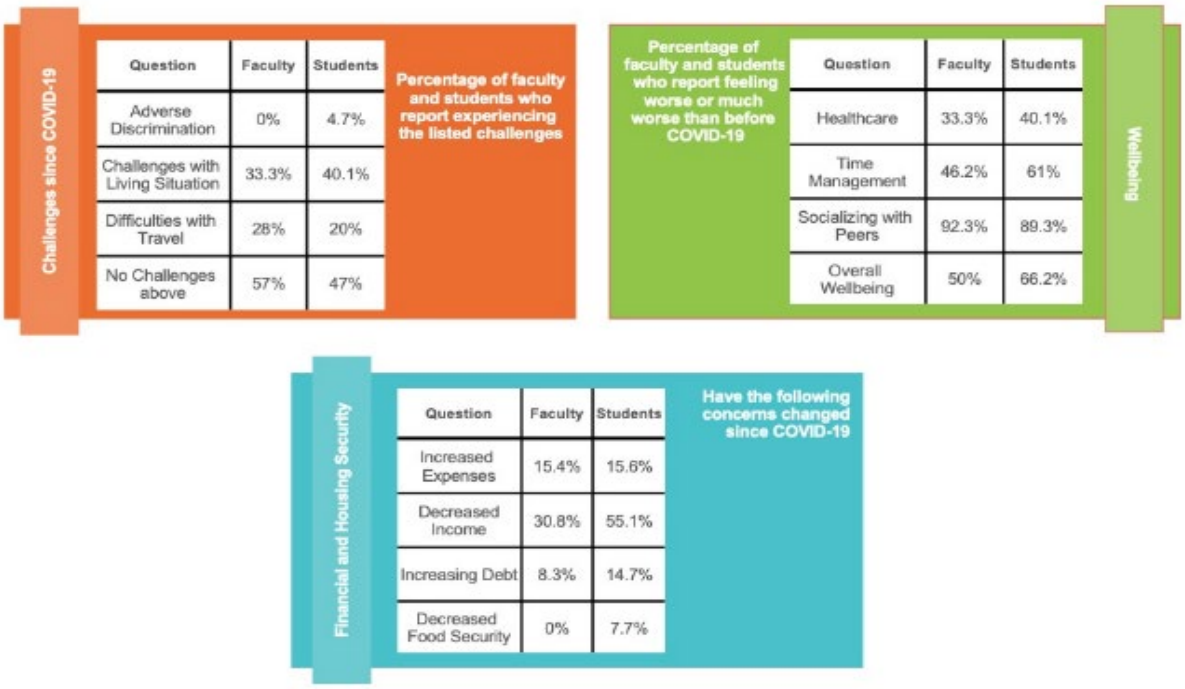

Figure 4. Faculty and students report different stressors as a result of COVID-19 and the shelter-in-place order.

Intense Curriculum and Faculty Development

The Chancellor's Office of the California State University System announced on May 12, 2020 that the Fall 2020 term would remain online for all campuses in the system, with limited exceptions for courses that would be inadequate in an online format. In anticipation of this decision, San Jose State University announced on May 4, 2020 that the Center for Faculty

Development would offer faculty development over the summer, called the SJSU Teach Online Summer Certificate Program. The program would be offered three times over the summer, to accommodate faculty schedules. Each cohort would have a 3-week long program that focused on training faculty for improved online course offerings. Faculty were compensated $1000 through SJSU's CARES funds if they completed the program.

The SJSU Teach Online program was offered in an asynchronous mode, with a few interactive sessions for faculty who wanted the support. Each participant was assigned a mentor, who was tasked with communicating with the participants, grading submitted assignments, and offering office hours that participants could attend. The program was offered through Canvas, the university's learning management system. The program content consisted of 13 modules, four of which were required for all participants. Participants had to choose three of the remaining modules to complete to satisfy the program requirements. The required modules focused on overall online education. The remaining modules covered a variety of topics that suited a wide range of courses. The SJSU Teach Online modules were:

- Module 1: Mastering Online Teaching Essentials (required)
- Module 2: Supporting Universal Design for Learning (required)
- Module 3: Analyzing Assessment Strategies, and Equity (required)
- Module 4: Inclusion Frameworks in Design in Online Settings (required)
- Module 5: Conducting Online Labs and Simulations
- Module 6: Getting Creative with Adobe
- Module 7: Developing Media and Recording Lectures
- Module 8: Providing Feedback and Adopting Timesaving Grading Strategies
- Module 9: Illustrating Canvas Best Practices
- Module 10: Examining Open Education Resources
- Module 11: Developing Online Mindset
- Module 12: Exploring Technologies
- Module 13: Integrating Support Services

Faculty could choose modules that suited their course topics and format. Each module had a similar format, with an overall page that summarized the module topic, had a video describing the module, the module learning objectives, module activities, readings for the module, module instructional videos, examples, and module assignments. Each module took an average of 2-3 hours to study the instructional materials and complete the associated assignments. Some modules took significantly more time, depending on the assignment. Faculty were encouraged to study more than the minimum seven modules for completion of the program.

In Civil Engineering, 75% of faculty respondents reported having participated in training for online learning in Spring 2020. They report having taken training in Canvas, Development of Online videos and tutorials, Collaboration Tools (Google Docs, Google Drive, etc.), Audio or video conferencing tools (Google Hangout, Zoom, Microsoft Teams, etc.), Controlled online testing environments (ProctorU, Proctorio, Lock Down Browsers, etc.). All respondents reported that they intended to continue to participate in training through the summer. When asked if they were satisfied with the support offered to transition to online learning, most reported satisfaction, with 75% reporting moderately or extremely satisfied and 16.7% reporting being slightly satisfied. The remaining (8.3%) reported being neither satisfied nor dissatisfied.

Strategies in the Assessment Handbook

With the change in the mode of instruction from in-person to online that would continue for at least a full academic year, it became a critical need to rethink course design and assessment strategies for ABET accreditation. The Assessment Coordinator and Department Chair decided to develop a handbook for faculty to assist with course design and assessments in an online learning environment. The handbook was partly based on the topics covered in the SJSU Teach Online Summer Certificate Program, and was customized to address strategies for ABET assessment. The topics in the handbook were chosen based on the relevance and importance of the topics for ABET assessment. The handbook was organized into four modules, each focusing on a key aspect of the instructional shift. The organization of the assessment handbook is shown in Figure 5.

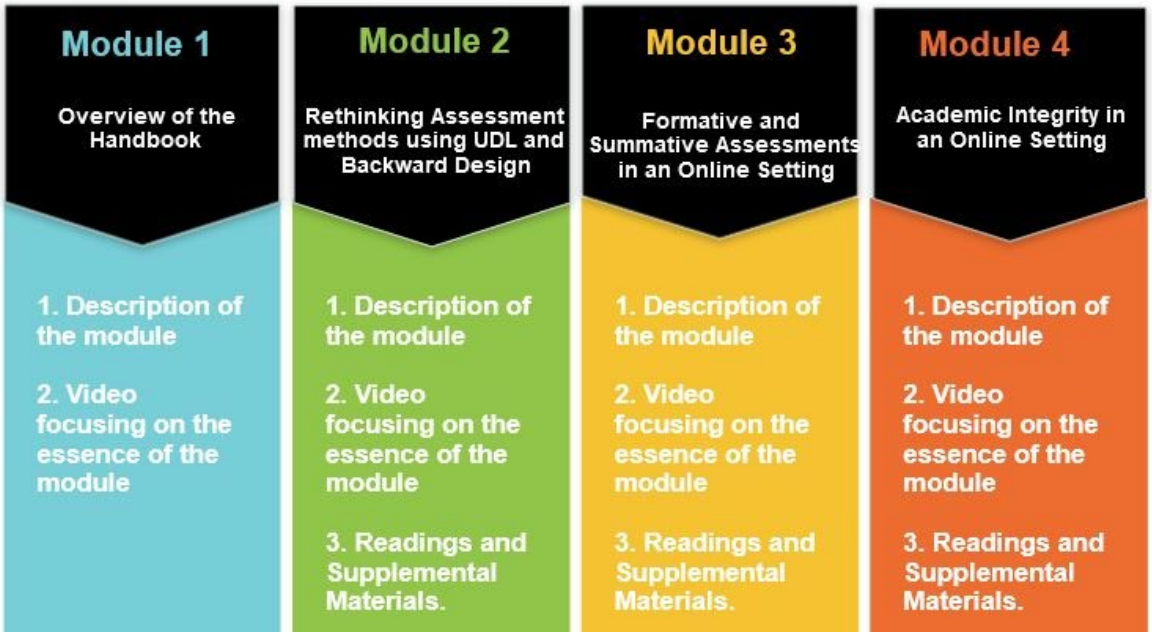

Figure 5: Assessment Handbook Organization.

The first module provides an overview of topics addressed in the handbook and provides context for the need to rethink assessment. The second module focuses on course design approaches: Backward Design and Universal Design for Learning (UDL). The second module is intended to help instructors with redesigning course content for more effective delivery in an online learning environment. The third module focuses on assessments for use in an online environment. The assessment methods addressed cover both formative and summative assessments and encourages faculty to move away from forcing in-person assessment methods, such as high stakes exams, into an online environment. Two courses with formative and summative assessments are included in the handbook as example. The fourth module focuses on preserving academic integrity in an online setting.

Each module offers a brief overview of the module, a short video addressing the concepts, topics in the module, and a table with readings and supplemental materials. A sample table of Module 2 is shown in Table 2. All materials are linked to stable websites or to PDF documents held in the master Assessment Handbook folder.

Table 2: Module 2 – Readings and Supplemental Materials

Topic	Content Link	Resource Type
Course Design	The Course Design Triangle	Online Article
	Course Mapping	Online Article
Backward Design	A Self-Directed Guide to Designing Courses for Significant Learning	Handbook
	Three key Questions on learning what matters	Journal article
	Introduction - The Logic of Backward Design	Textbook chapter
	Understanding by Design framework	White paper
	Assessment Planning Framework	PDF
	Understanding by Design Template	PDF
Universal Design for Learning (UDL)	UDL at a glance	YouTube Video
	CAST'S UDL Guidelines Graphic Organizer	PDF
	An Introduction to UDL and Assessment	YoutTube Video
	Top Ten UDL tips for Assessment	PDF

Course design approaches were chosen as topics for the handbook as learning objectives, lecture materials, and assessment methods are integral elements of course design, and all the three are inter-connected to each other as shown in Figure 6. The course design approaches focused in the handbook are Backward Design [4], and Universal Design for Learning also known as UDL [3]. Backward Design Approach is a three-step process which entails framing the Course Learning Objectives (CLOs), plan assessment activities and methods to assess if the CLOs are met, and planning learning experiences and instruction which includes lecture materials. With the change in the mode of instruction from in-person to online, assessment methods, and learning experiences need to be restructured while ensuring that the CLOs are met. The overall course design process is vital while trying to rethink the assessment strategies and course material delivery.

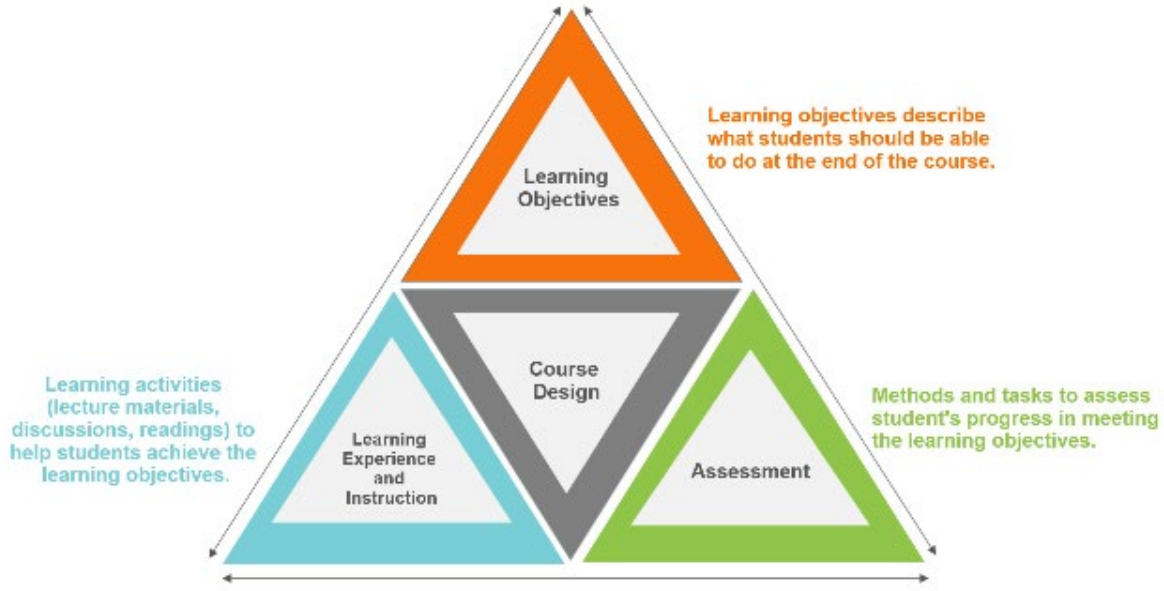

Figure 6: Elements of Course Design.

UDL approach (Rose et al. 2002) focuses on acknowledging the variability in learners and designing course materials, delivery, student engagement and assessments while providing equitable opportunities to all learners. The three UDL principles which were focused in the handbook are shown in Figure 7.

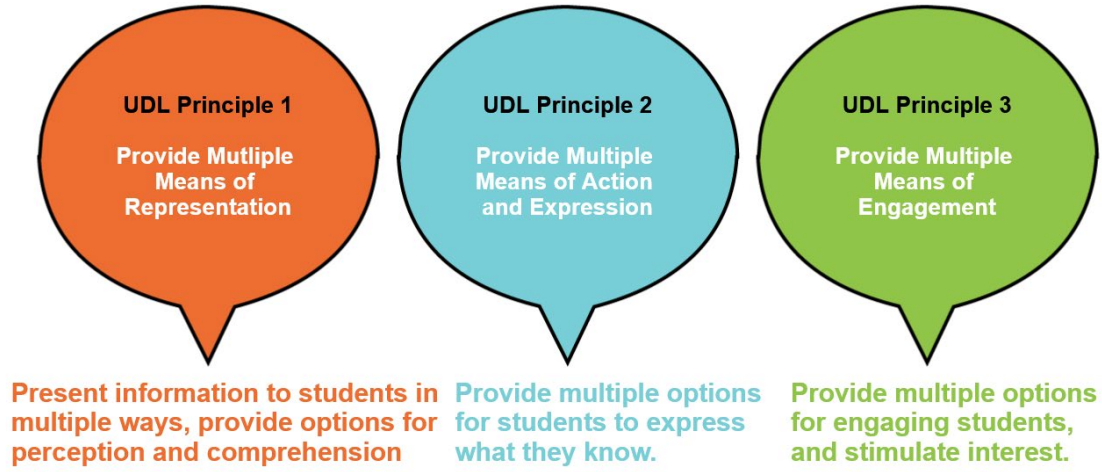

Figure 7. The elements of Universal Design for Learning (UDL).

The three UDL principles address course instruction and course materials delivery (UDL principle 1), assessments (UDL principle 2), and student engagement (UDL principle 3). While rethinking assessment methods, and planning learning experiences for an online learning environment, UDL is a vital approach to nurture inclusion and equitable learning opportunities for variable learners.

Another topic that was focused in greater detail in the handbook is the assessment methods. With the change in the mode of teaching from in-person to online, there is an urging need to rethink assessment strategies. Some of the key topics addressed in this context was the use of formative and summative assessment methods, instead of relying solely on high-stake midterm and final exams. Two specific courses which were redesigned using the formative and assessment methods were provided as examples in the handbook: a course that is a part of the undergraduate capstone experience, and a graduate level course.

While transitioning to the online mode of instruction and assessment methods, it is critical to preserve academic integrity in an online setting. This is one of the topics addressed in the handbook. Academic integrity in an online learning environment can be a challenge for both students and faculty. In the handbook resources for faculty on best practices, expectations and faculty responsibility when academic dishonesty occurs have been provided. Further, the difference between the Student Conduct Code, and the Academic Integrity Policy has been explained. Preserving academic integrity is critical while transitioning to the online mode of teaching and learning, and it is vital to make the assessments done in the online mode meaningful and valid.

The assessment handbook was shared with all the faculty in the Department. Further, all the faculty were informed about the option of setting up a meeting with the Assessment Coordinator and Department Chair to discuss course specific assessment strategies if needed.

Formative and Summative Assessments in Online Civil Engineering Courses

A few online Civil Engineering courses in the department have adapted the use of formative and summative assessments in Fall 2020. The courses and the assessments used in these courses are provided below.

The undergraduate course (part of the capstone experience) previously used a midterm exam, a course quiz, final exam and a student project for assessment. This course was offered in Fall 2020 in a combination of synchronous and asynchronous delivery methods. With the redesign to adapt to the online learning environment, weekly Canvas module quizzes were used as formative assessments. Although, the formative assessments were low-stake quizzes, the formative assessments enabled the instructor to assess student learning periodically, identify topics that students struggled with, and address these topics and issues in the subsequent lectures. The formative assessments simultaneously served as a tool to provide feedback to the students on what areas/topics they needed to improve and focus on, on a weekly basis. In addition to the formative assessment, summative assessments were used to assess mastery of learning material; midterm exams, final exam, course quiz, and student project, assignments were used as summative assessment methods.

The graduate level course used synchronous mode of instruction. This course used graded Canvas discussion forums as formative assessments. Project proposal, project report, and final exam were used as summative assessments in the graduate level course. The statics course used synchronous mode of instruction. This course used flip reading, auto-graded Canvas quizzes, auto-graded homework, auto-graded end-of-chapter tests, and graded Canvas discussion forums as formative assessments. Two midterm exams and final exam were used as summative assessments. The undergraduate hydrology course used synchronous mode of instruction, and used a combination of formative and summative assessments. Pre-lecture Canvas module quizzes were used as formative assessments.

Upon following up with the instructors after the implementation of the formative and summative assessments, instructors reported enhanced student engagement based on student participation and performance in the formative assessment activities. In the undergraduate course which is part of the capstone experience, percentage of students meeting the 70% benchmark for ABET assessment purposes increased from 76% to 100% following the implementation of the formative assessments.

Conclusions

Teaching in an online setting is vastly different from teaching in a face-to-face classroom setting. The challenges faced in instruction, assessments, and preserving academic integrity can be solved by effective curricular redesign and rethinking assessment strategies. The assessment process for ABET Accreditation has been described in the ABET Accreditation section of the paper. The challenges faced with the pandemic induced sudden transition in March 2020 both by the students and the instructors have been described in the COVID Disruption section of the paper. A handbook was developed to assist faculty in curricular redesign and rethinking assessment strategies for use in an online environment and has been described in the Strategies in the Assessment Handbook section of the paper. Examples of courses utilizing formative and summative assessments has been described in the Formative and Summative Assessments Section of the paper. This paper emphasizes the need for rethinking assessment strategies for use in an online learning environment. Future work would focus on student performance in courses utilizing formative and summative assessments.

Acknowledgements

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