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Quarter to Semester Transition: Lessons Learned from a Mechanical Engineering Case

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Overview

During the fall of 2021, our university was mandated to make the transition from our historical quarter-based system to a semester-based system, effective starting the school year of 2025-2026 [1]. A quarter system is based on three 10-week terms in the fall, winter, and spring, that gives enough time for a full 10-week summer term and, although less common than the semester system, is prevalent across the United States [2]. A semester system is based on two 15 or 16-week terms in the fall and spring. Our university was mandated to make this switch, with the primary reason given to make centralized operations of our university system easier; we are the last university campus (of 27) in our system on the quarter system [1]. This transition involves completely transitioning our entire curriculum in a university wide effort, requiring many different perspectives and opinions.

In approaching this process, we found several helpful resources. For example, there are resources available that describe suggested curriculum changes that focus on specific fields and majors (e.g. [3]) quarters vs semesters [4], [5]. However, the aim of this paper is to broadly focus on the process used and how that process can be best utilized to maintain a focus on student learning and maintain the strengths of a given program. We present our experience of making the transition from quarters to semesters in a mechanical engineering program. However, we hope to provide information that would be beneficial to not just mechanical engineering programs, but any discipline making major curriculum changes or creating a new curriculum.ing a new curriculum.

Our goals for the new curriculum, as both desired by our department and mandated by our university, include maintaining the strengths of our current program as well as offering flexibility in the curriculum for major/specific interest exploration that also supported increasing our 4-year graduation rates. Additionally, we aimed to ease the path for transfer students, especially transfer students from our state's community colleges. However, the research on the potential for improving graduation rates is mixed. For example, [4] in a study across 731 universities found that when a university switches from quarters to semesters, first year grades are lower, average time to graduation increases, and students are more likely to be enrolled in below a full course load. On the other hand, [5], in a study of 17 Ohio institutions that transitioned from quarters to semesters, found that although there was an increase in students becoming de-motivated, there was an increase in students' self-efficacy towards their coursework. This research informed choices we made in our curriculum design, such as having flexibility in the structure so that students could change majors in their first year and potentially second year without a delay in graduation.

Description of Case Study

This paper focuses on the quarter to semester transition for a single department (mechanical engineering) at a large, public, undergraduate teaching focused university in the western United States. The university is 48% women and 52% men, 15% of students are from out-of-state, 1% international students, and the remainder are in-state students. The College of

Engineering has the largest enrollment. The student body is 53 % white, 19 % Latino or Hispanic, 13 % Asian, 1% Black and 0.1% Native American. The university focuses on a hands-on, experience-based philosophy.

The initial announcement at our university was met with primarily negative emotions, centered around fears of increased workload for faculty and students, fear of losing unique aspects of our program that flourish in our current system, and concerns about whether semesters were actually going to be better for students learning. The fears are not unfounded; other universities have faced similar struggles in their transitions. For example, [6] found that during a transition from quarters to semesters, students faced increased anxiety levels about graduating on time, new degree requirements, and credit conversions. As another example, there is fear of additional faculty workload under the new system [7].

Initial curriculum development

We approached the curriculum design using a backward design approach [8], [9]. This approach has three stages: 1. Identify design results, 2. Determine acceptable evidence, and 3. Plan learning experiences and instruction. It includes establishing curricular priorities of knowledge and skills of enduring understanding, important to know and do, and worth being familiar with. The design results that we identified were the goals of the curriculum, which are explained later in this section. Our acceptable evidence was identifying which skills we would see in our students when they graduated. Since the goal for the first stage of the curriculum development--planning learning experiences--we focused on high level of topics and skills that should be covered and determining how to scaffold the skills. For example, to improve students' programming and computational skills, we identified courses to incorporate those skills from the freshman to senior year.

Our goal was to use the backward design approach to design a "good" curriculum, rather than focus on converting what we had. Although there were structural challenges, (which we will discuss later in the paper), we also had successes using this approach.

To implement our backwards design approach, our first step was to form what we called a Q2S (quarter to semester) task force. This group consisted of a subset of our department (all volunteers) who met together to propose a plan for the curriculum design. We started by setting aside time during a faculty meeting to meet in small groups to discuss what we hoped to see from the Q2S transition, without dictating specific objectives. We used a Jamboard (a free brainstorming tool available through Google) to give the small groups the opportunity to document their ideas. The Jamboard had four different pages with the following prompts:

1. ME Graduate of 2029 – Knowledge
2. ME Graduate of 2029 - Skills
3. ME Graduate of 2029 – Attitudes
4. 2025 ME Pedagogy

These boards were focused on the graduate of 2029 as this would be the first class that would be educated at our university completely in the semester system. Then, two of the working group members used a qualitative content approach to code these responses [10], [11]. Table 1 displays the categories that emerged.

Table 1. Results of initial Jamboard ideas about curriculum

Page	Category	Example comments
ME Graduate of 2029 – Knowledge	Ethics	Environmental ethics, legal system as related to engineering decisions, robotics ethics
	Overarching ways of thinking	Sustainable development, sociotechnical thinking, creative process, iteration in design, integration of energy and system usage
	Specific topics students should know	Statics, renewable energy, basic programming, fluid dynamics, technical writing
ME Graduate of 2029 - Skills	Defining problems	Design a design challenge, identify problems that need solutions
	Working in teams	Working in teams, work in interdisciplinary teams
	Understand connections between engineering and "real world"/community engagement	Transfer skills between class and the “real world”, stakeholder empathy, anticipating impacts of their design choices and technological developments
	Communication	Reading and writing, ability to sketch, active listening
	Manufacturing	Hands on manufacturing, design for manufacturability
	Computing skills	Beginning programming -> algorithms, general computing skills (file organization, etc.)
	Other	Ethical reasoning, think creatively, solve statically indeterminate problems
ME Graduate of 2029 – Attitudes	Mental health	Value mental health, work life balance
	Growth mindset	Embrace failure, resilience, growth mindset, crave lifelong learning, adaptable
	Ethical work	Pride in professionalism, value ethical behavior, keep safety paramount
	Diversity	Value neurodiversity, value diversity and inclusion
2025 ME Pedagogy	Connections across courses	More parallel course structure with support departments, Direct connection from one course to another. Between sequences (i.e., heat transfer to design), Team Teaching
	Experiences students should have	Do integrated projects, undergraduate research experiences, design-build-test every year, in class team activities, transition to workplace/career planning

	Assessments	Lower stakes assessments, equitable grading, emphasis on mastery not performance, motivational grading-motivate students to academic success, support growth mindset and give opportunities for redemption
	Course formats	Can we integrate shops into curriculum?, Instructors work with students in labs, partial semester courses allow more diversity of topics, "Clinics" - design things, experimental, basic skills
	Student ownership of learning	Instill Self Efficacy, Foster Intrinsic Motivation

The sorted responses were presented at the next faculty meeting and faculty were asked to discuss them again, this time we focused on what may be missing from these bins. These discussions provided further insight into the goals of the curriculum. Overall, this process gave us a good starting point for developing the goals of the curriculum. It allowed us to get a variety of perspectives from the department without burdening any one person with a lot of time input. However, the large number of inputs from many different people also made it hard to manage.

Iterative process to develop curriculum

Our next stage of the process involved an iterative process of surveying our department, developing drafts, and editing those drafts.

During the summer of 2022, two faculty members (the authors of this paper) volunteered to be the Q2S leads for the department. We set out with the goal of developing two initial drafts of the curriculum by the fall department retreat, one that was similar to our current curriculum, but converted to semesters and one that was “radically” different. Additionally, we did extensive research about other programs that are on semesters to look at their structures, courses, and curriculum to give us ideas about potential ideas for our curriculum. In addition to our work on the mechanical engineering curriculum, there were also two college wide committees meeting during the summer 2022, one focused on the first-year experience and the other focused on service courses, i.e. courses that students from multiple majors in the college take. The recommendations from the summer committees were incorporated into the draft curriculum.

A key to the student-centered process we took was to start from the perspective of how many student contact hours each of our current (quarter) courses have–broken down by lecture and laboratory. When putting together options for the courses, we calculated the new student contact hours and compared them to the quarter hours. The accounting of hours is a more accurate representation of the conversion from quarter to semester and took out some of the uncertainty of the conversion. For example, the direct conversion of a 3-unit lecture quarter course is a 2-unit lecture semester course (3 times 2/3). On the surface, a 2-unit course sounds like and can feel like a loss when in reality both have the same number of contact hours for a 15-week semester, i.e., 10 weeks times 3 hours/week equals 30 hours contact hours in quarters and 15 weeks times 2 hours per week also equals 30 hours of contact time in semesters. Using

student contact hours also helped us determine which courses might benefit from combining quarter courses/topics. Another benefit was that when faculty think they need that extra unit, such as wanting a 3-unit lecture course instead of 2-unit, then they need to justify the extra time with the students–informing us and the department what additional learning objectives will be covered in the course now. Keeping the process student-centered took the focus off individual courses and individual faculty wants and onto what would be best for the students and what is best overall for the curriculum.

Using our initial potential ideas, we developed a survey to gather feedback from the entire department. We worked to keep this survey focused on student learning, rather than the other constraints that are at play during the Q2S conversion. The survey included 9 sections:

1. An open place to share concerns and opportunities for the process

2. Overall program goals

3. Student Flow Chart

4-8. Options for specific groups of courses

9. Final thoughts

The first and last sections were important for faculty to be able to express thoughts, opinions and feelings. The whole process of changing the entire curriculum is not only a lot of work, but also is fraught with emotional responses at each stage. For example, the idea of combining classes and perhaps losing "your class" or feeling a loss when it looks like a course changes form. At every stage, we made sure to acknowledge these thoughts and feelings to make sure that everyone felt heard during the transition.

Section 2 included a list of items, e.g., manufacturing labs that include hands-on experience with welding, year-long senior design project, taking service courses (statics, dynamics, etc.) along with other majors, and asked for responses on a Likert type scale of importance for the curriculum. This list was based in part on the initial conversations with the department during the faculty meetings described in the previous section as well as informal conversations with members of the department. In addition to the list that we included in the survey, there was also a place to add things missing from the list as well as a place for comments/feedback. Section 3, Flowchart, asked general questions about the curriculum. These questions included topics on how many courses are reasonable for the students to take in a term, what, if any, major changes would you like to see in the curriculum, comments/feedback on the future flow chart.

The remaining sections were focused on options for different subject areas: Solid mechanics, Design, Thermo/Fluids, and Concentrations and Technical Electives. For each of these subject areas, we presented between 6 and 9 different options and asked for Likert type scale responses on the acceptability of these options. We worked to make these options diverse-some of them were direct conversions of our current time spent ranging to radically different that our current system. Figure 1 displays the options that were given for the solid mechanics subject

area and Figure 2 shows the responses to those options. Note that for each option, the number of student contact hours is explicitly stated and can be used to compare the options.

OPTION A	Semester Course	Semester Units	Lec/Lab	Lec Hours	Lab Hours
	Statics +	3	3/0'	45	
	Dynamics +	3	3/0'	45	
	Mech of Mate	2	2/0'	30	
	sys. Dyn +vib	4	3/1'	45	45
	Controls	4	3/1'	45	45
	Totals	16		210	90

OPTION E	Semester Course	Semester Units	Lec/Lab	Lec Hours	Lab Hours
	Statics	2	2/0'	30	
	Dynamics	2	2/0'	30	
	Mech of Mate	3	3/0'	45	
	sys. Dyn +vib	4	3/1'	45	45
	Controls	3	2/1'	30	45
	Totals	14		180	90

OPTION B	Semester Course	Semester Units	Lec/Lab	Lec Hours	Lab Hours
	Statics +	3	3/0'	45	
	Dynamics +	3	3/0'	45	
	Mech of Mate	3	3/0'	45	
	sys. Dyn +vib	3	2/1'	30	45
	Controls	3	2/1'	30	45
	Totals	15		195	90

OPTION F	Semester Course	Semester Units	Lec/Lab	Lec Hours	Lab Hours
	Statics +	3	3/0'	45	
	Dynamics +	3	3/0'	45	
	Mech of Mate	3	3/0'	45	
	sys. Dyn +vib	3	2/1'	30	45
	Controls	3	2/1'	30	45
	Totals	15		195	90

OPTION C	Semester Course	Semester Units	Lec/Lab	Lec Hours	Lab Hours
	Statics +	4	4/0'	60	
	Dynamics +	4	4/0'	60	
	Mech of Mate	2	2/0'	30	
	Controls	4	3/1'	45	45
	Totals	14		195	45

OPTION G	Semester Course	Semester Units	Lec/Lab	Lec Hours	Lab Hours
	Statics/Dynamics combo	4	4/0'	60	
	Mech of Mate	3	3/0'	45	
	sys. Dyn +vib	3	2/1'	30	45
	controls	3	2/1'	30	45
	Totals	13		165	90

OPTION D	Semester Course	Semester Units	Lec/Lab	Lec Hours	Lab Hours
	Statics +	4	4/0'	60	
	Dynamics +	4	4/0'	60	
	Mech of Mate	3	2/1'	30	45
	Vib+controls	4	3/1'	45	45
	Totals	15		195	90

OPTION H	Semester Course	Semester Units	Lec/Lab	Lec Hours	Lab Hours
	Statics/Dynamics combo	4	4/0'	60	
	Mech of Mate	3	3/0'	45	
	int dyn + sys dyn	4	3/1'	45	45
	Vibes + controls	4	3/1'	45	45
	Totals	15		195	90

Figure 1. Example of specific group of classes presented as options to the faculty in a Survey.

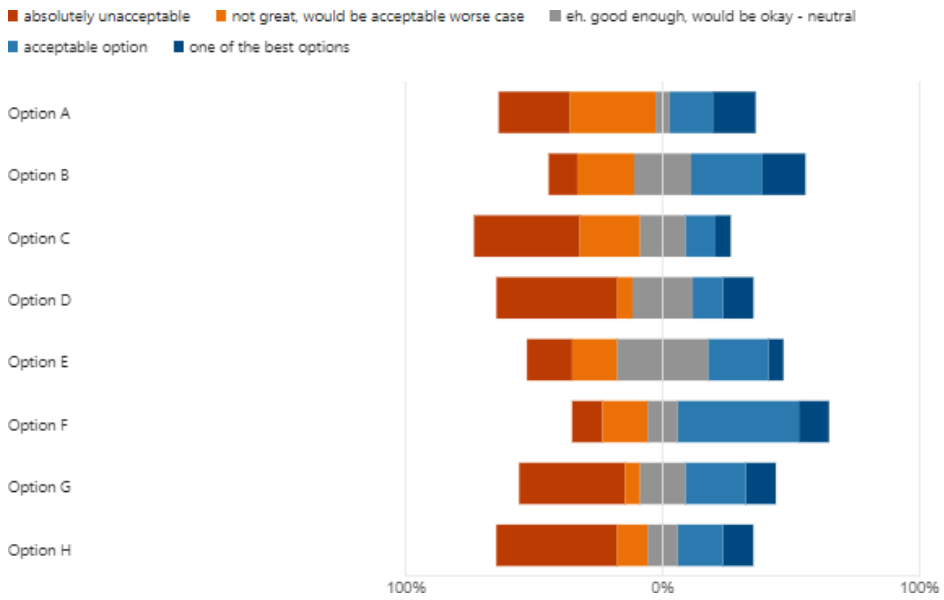

Figure 2. Example responses to the faculty survey about potential options for specific group of classes.

This initial survey gave us some good insights and a variety of perspectives. For example, we ruled out a few options presented based on the results. Additionally, many people mentioned to us that they appreciated having the survey to be able to spend time giving their input. However, there were also challenges. For example, several people commented that they were not prepared to respond, either because they did now know enough or because they did not understand enough about the repercussions of the options. Additionally, several respondents commented that there was too much information in the survey and it was hard for them to make sense of it.

We took the results of this survey and coalesced the options in two different potential options. The first option was very similar to our current curriculum with slight modifications based on survey results and the university requirements. For example, we slightly increased the number of units for technical electives because the survey results really pointed to the value of flexibility for students to explore different options. The second option included what we call "tracks" that gave options of groups of courses and gave more flexibility for students' choice. We presented both options, as well as the results from the survey for reference at our department retreat at the start of the Fall 2022 quarter. We also presented the timeline moving forward and the deadlines for deliverables set by the university. During the department retreat, we split into smaller groups, each focused on specific areas of the curriculum to discuss that area of the curriculum in more depth. These areas were: design/solid mechanics, dynamics/controls, thermo/fluids, manufacturing/design communication, support courses/non-ME service courses. We asked each of the small groups to discuss the following points and record their thoughts:

- List essential student outcomes expected from the thread.
- List essential topics/hands on experience for the thread.
- List Prerequisite knowledge needed from support courses.
- Determine minimal and desired units to accomplish outcomes.
- Discuss ideal elective courses related to the thread.
- Prepare to report to group and document.

Although these conversations were a good start, most of the groups also had to meet a few times during the upcoming months to finalize their ideas about their thread.

In addition to the individual groups meeting, the two Q2S leads met with several other groups during the fall term 2022. Every three weeks, we met with the college wide Q2S working group. This group was led by an associate dean and consisted of representatives from each of the departments. In these meetings, we received information about the process from the associate dean, compared curriculum plans, and helped each other through difficulties and questions. These meetings were valuable to get different perspectives, figure out the best ways to organize service courses (courses taken by students in multiple departments), and serve as resources for each other (e.g., when one department had a good idea or a success with a method, we could easily share those ideas). Additionally, meeting every three weeks did not overburden anyone

with the time commitment and having the associate dean lead the meetings kept them focused and on track.

We also met with our department frequently during the fall (every 2-3 weeks). During these meetings, we presented what we were currently working on or trying to figure out and asked for feedback. Our department has a large faculty and therefore there was not usually time for everyone to speak at these meetings to share their ideas. Therefore, we also sent out surveys before or after the meetings to solicit individual feedback. We also had frequent, informal conversations with faculty members to get their individual ideas.

We have followed the process outlined in this paper to develop an initial draft of the curriculum that will be used after the semester transition. This was submitted to our college curriculum committee, and we will be provided feedback that we will have the opportunity to address before the plans are sent to the provost's office.

Summary of lessons learned

- Keep the whole process student-centered. There were several other constraints that came up as concerns from a variety of people (e.g. faculty workload, lab space, ownership of certain courses). When these issues came up, they were often very concerning and stressful for those who were worried about them. However, when we were able to refocus on student learning and designing a curriculum that is best for the students, these issues became less stressful, and the work became more productive. These issues still need to be resolved and are a work in progress, but with the focus on the students we can get everyone on the same side (the benefits to the students) to work together toward a common goal.
- It worked well to have two "leads" with frequent communication with rest of the department. The two leads could also talk about ideas, work out early issues and come to the department as a team whose has the department and student's best interests in mind. It is also important to be as neutral as possible, and not seem to be favoring one part or another of the curriculum. For example, while each lead has their own area of expertise and courses, other faculty members were put as sub-leaders for those parts of the curriculum. It was critical to create sub-groups and delegate to each group tasks such as course divisions, and general topics. The sub-groups reported to and could ask questions of the leads, but they oversaw their own part of the curriculum. These delegations and sub-groups also gave individual faculty ownership of the curriculum and transition.
- Short surveys with short time deadlines had highest response rates
- Some faulty were most vocal during department meetings, some in surveys, some in one-on-one conversations. It is important to have a variety of opportunities for stakeholders to express their ideas. For example, providing a place for comments on each survey was good.
- Everyone liked to be included in the process and they then felt that had an influence on the process.
- Keep the big picture in mind – there are a lot of moving parts and things changing all the time, such as what courses math or physics are offering. It is easy to get lost in the

details, but reminding everyone of the status and big picture every meeting helps focus the meeting on the tasks that need to be discussed and keeps the curriculum development moving forward.

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