

Mini-mesters as a Process to Enhance Freshman Education

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Abstract – Mini-mesters are explored as an attempt to improve retention. Freshman engineering courses have been divided into 1-credit pieces. Each 1-credit course will meet three times per week for 5 weeks. Ultimately this will allow students to arrange their schedules in a variety of ways.

The pilot for mini-mesters is a new “Introduction to Mechanical Engineering” course. This delivery technique allows this lab course to be taught to over 100 students in a semester in smaller groups of less than 36.

Logistical issues of introducing a mini-mester course into a traditional semester environment are discussed along with the content and schedule of the pilot course.

Keywords: Retention, curriculum, mechanical engineering, assembly

INTRODUCTION

One of the ongoing primary concerns of engineering institutions is retention. It is not uncommon for some institutions, particularly large state universities, to graduate less than half of the freshmen who enter their engineering program. To that end, many hours of faculty and administrator time are spent discussing ways to improve student retention. In the past, introductory engineering courses have been added at various institutions, and there are many variations of freshman engineering programs around the country. Yet we continue talking about retention challenges. [1-4]

One creative solution to this problem is to divide the freshman engineering program into several 1-credit hour experiences. If these 1-credit experiences were taught in 5-week mini semesters or mini-mesters, freshmen would have the opportunity to drop and add courses at several key points in their first semester of college instead of feeling overwhelmed if they experience academic difficulties as they adjust to higher education.

SAMPLE FRESHMAN ENGINEERING CURRICULUM

A list of one-credit courses that a freshman engineering student in Calculus I could take at the University of Alabama are presented in Table 1. In addition to some selection of these courses, a student would also take General Chemistry 1 (CH 101, 4 cr), Calculus I (MATH 125, 4 cr), and English Composition I (EN 101, 3 cr), so a typical student may want to take three or four 1-credit courses, such as the following:

MATH 125	CH 101	EN 101	ENGR 111
ENGR 131	ENGR 151	ME 121	

After a few weeks into the semester, the student feels overwhelmed by calculus, and decides to withdraw. In this scenario, a student would fall below full time status which would affect a variety of financial issues such as financial aid. In addition the student is having doubts about majoring in mechanical engineering, but all of his/her friends

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appear to really enjoy ECE 121. With the five week mini-mesters, the student would have the option of dropping calculus and adding into ECE 121 to explore another career path without falling below full time status.

Table 1. One-credit Courses Available to Freshmen in Calculus I

Course Abbreviation/Number	Course Name
ENGR 111	Engineering the Future
ENGR 131	Engineering Concepts I
ENGR 151	Fundamental Graphics
AEM 121	Introduction to Aerospace Engineering
CHBE 121	Introduction to Chemical and Biological Engineering
CCEE 121	Introduction to Civil Construction and Environmental Engineering
CS 121	Introduction to Computer Science
ECE 121	Introduction to Electrical Engineering
ME 121	Introduction to Mechanical Engineering
MTE 121	Introduction to Materials Engineering

If a student entered the University completely unsure of an engineering major, he/she would have the option to take CCEE 121, MTE 121, and AEM 121 all in the same semester. Five-week mini-mesters provide students numerous options for career exploration.

PILOT COURSE: INTRODUCTION TO MECHANICAL ENGINEERING

As part of the transition to 1-credit hour courses in the freshman engineering program, ME 121, Introduction to Mechanical Engineering was created. The faculty committee charged with creating ME 121 wanted the course to be something that would interest freshmen without taking too much time away from their primary business of learning calculus and chemistry. As part of the discussion of the ASME Task Force – Vision 2030, industry surveys showed that graduates need some experience disassembling and assembling a system.[5] Faculty creating this course decided to build it around that type of activity.

ME 121 was to contain the following features:

- Introduce students to both the mechanical systems and thermal/fluids stems of mechanical engineering
- Introduce students to the department and the American Society of Mechanical Engineers, Society of Automotive Engineers, and Pi Tau Sigma (mechanical engineering honor society)
- Provide students with some hands-on opportunities, such as taking something apart and determining how it works

The committee spent time talking about potential benefits to ME freshmen and talked with current sophomores to learn more about their freshman experience. As a course began to take shape, the department faculty as a whole spent time debating appropriate hands-on activities for freshmen students. It was decided that taking apart an engine would provide students exposure to both stems of mechanical engineering if a device could be found that met the limits of the course budget.

As a new course, ME 121 was designed to work as a mini-mester course with students meeting 3 days per week for five weeks. As the course was developed, some logistical advantages to having a five-week course were apparent. In a five-week course, in theory three groups of students could take apart and re-assemble a device throughout the entire semester, so only one-third as many devices had to be bought. If a classroom was found that held about 35 students, over 100 students could be taught during the semester. [6] In addition, as a new course, ME 121 could be refined as it was taught the second and third time.

From the faculty teaching load perspective, a faculty member would meet with students three times per week for 15 weeks, just like any other 3-credit course. Minimal preparation for the course would be needed after week 5. Thus teaching mini-mesters would not necessarily increase faculty workload, and it might relieve time for other faculty activities.

Course Content

To create the class-to-class details of the course, a doctoral student familiar with engines was hired over the summer. He explored several devices for cost and ease of disassembly and re-assembly. Once a device was selected, he disassembled it and documented the process in a lab manual. It was determined that the least expensive power lawn mower that we could find would meet our instructional needs. A dozen additional lawnmowers were purchased so that a maximum of 12 teams of three could take the course in any particular mini-mester. Through review of the lab manual, the class schedule shown in Table 2 was created for the course.

Table 2. Class Schedule of Topics for ME 121

Class	Date	Topic
1	11/1/10	Course Introduction; Getting to Know You pt 1; Meet the Faculty
2	11/3/10	ASME; Getting to Know You pt 2; Machines and Mechanisms
3	11/5/10	Co-op
4	11/8/10	SAE; Machines and Mechanisms; Engineering Documentation; Safety and Personal Protective Equipment
5	11/10/10	Consumer Products – final assembly
6	11/12/10	Consumer Products – return to original state; Disassembly 1
7	11/15/10	Disassembly 2
8	11/17/10	Disassembly 3
9	11/19/10	Disassembly 4
10	11/22/10	Assembly 1
11	11/29/10	Assembly 2
12	12/1/10	Assembly 3
13	12/3/10	Pi Tau Sigma; Machine Shop/Lab Tour

In an attempt to make it clear that this was an engineering course and not a course for lawnmower mechanics, the following course objectives were published: At the conclusion of this course, students will be able to

- Relate real-world devices to different courses in the ME curriculum
- Sketch and properly label mechanical components
- Identify and use hand tools
- Describe the roles and differences of ASME and SAE
- Discuss differences between mechanical systems and thermal/fluid systems

As a "hands-on" class, attendance was mandatory, and the following grading scheme was created:

- Participation: 45%
- Daily Assignments: 45%
- Professional Society Attendance: 6%
- Final Exam: 5%

Students were required to attend two professional society meetings during the mini-mester (3% each with a built-in bonus point).

Personnel

The student who created the lab manual was not available as a Graduate Teaching Assistant for fall semester, but the goal was to find a student with good communication skills who would work well with freshmen and who was knowledgeable about engines. With concern that bright, theoretical, honors students might balk at a class where they got their hands dirty, a high-GPA Undergraduate Assistant was sought as well. Once the team was assembled, the final details of the class were created, and we practiced disassembling and re-assembling a lawnmower.

RESULTS

Mini-mesters

A number of challenges with implementing this course were due to the fact that it was the only mini-mester course offered that semester.

The way that this course was scheduled, Section 1 met from August 18 – September 22, Section 2 met from September 24-October 29, and Section 3 met from November 1-December 3. Although these dates were written on the students' schedules, it was expected that many of them would not realize that this was not a full semester course. Plans were made to have extra students attend the first class. The first item of business was a welcome by the Department Head followed by a reading of the class role so that students could be told when to return for the proper class. A few students contacted the instructor in a panic during the second week of class because they thought that they had been missing class although it turned out that they were in section 2 or 3.

The first section ran fairly smoothly. Grades for the first five weeks could not be submitted until the end of the semester, but grades were emailed to the students so that they didn't have to wait additional weeks to find out how they did in the course.

A major concern was that students in sections 2 and 3 would not remember to come to class. A week before section 2 began, all students in that section were contacted by email and asked to respond that they would be coming to class. Students who did not respond were contacted by phone. A few students had difficulty finding the classroom in section 2. A similar process was used to contact students before section 3 began. That appeared to work better. This logistical issue of students forgetting what day their course began would be alleviated by teaching other Intro to the major courses (AEM 121, CHBE 121, ECE 121, etc.) as mini-mester courses.

Before section 3 began, some students were withdrawing from other classes, and we were able to add a few students into section 3.

Professional Society Events. On our campus, the student professional societies are extremely active at the beginning

of the semester, when officers have time to plan things, with a number of events to welcome freshmen in particular. However, by the time that November arrives, things begin to wind down for the semester. It was challenging to find activities for students in section 3 to attend. This is an issue to be addressed in the future.

ME 121 – Introduction to Mechanical Engineering

The final course description for ME 121 is “An introduction to the discipline of mechanical engineering and the role of the mechanical engineer, including both mechanical and thermal/fluid stems. Focus is on learning about the discipline through a series of student hands-on activities.” While this is vague, it is an accurate description of how the course was taught and will be taught in the future. It also allows flexibility by future instructors. Course objectives were loosely met.

The schedule of topics shown in Table 2 is for section 3. Several additions were made to the schedule after the beginning of the semester.

First a day of presentation by the Cooperative Education staff was added. While cooperative education is not required for our students, the philosophy of the department is that co-op is a valuable experience. This appeared to be a valuable session for the students.

Second, during section 2, a student cut himself on the piston ring compressor and had to be taken to the emergency room for a couple of stitches. As a result of this accident as well as several incidental cuts on sharp edges, a small presentation on Personal Protective Equipment was added to the course. The current plan is to expand this lecture next semester, and add a safety quiz to the grading scheme. Also in section 3, the piston rings were removed from the pistons. This made the re-assembly process easier for the students, increased safety, and really did not take away from their fundamental knowledge of how an engine works.

Third, it did not take as long to disassemble and re-assemble the lawnmower as originally expected. An extra day of lab tours was included on the last day of classes. The students saw three uniquely distinct labs in the department: Engines Lab, Aeronautics Lab, and the BioDynamics Lab.

Fourth, after watching the first few dis-assembly classes, there was concern that this would simply become a class about removing bolts, so students were required to answer questions about the pieces they were dis-assembling each day. A sample sheet, with answers provided, is shown in Figure 1. The questions have turned this into a course of fundamental physical concepts where students see how abstract ideas of stress, combustion, spark, and others relate to a real device.

Fifth, the lab manual was given to the students as a single document when dis-assembly of the lawnmower began. Too many students ignored the worksheet and would attempt to work through the manual until an instructor noticed that they had gone too far and stopped them. To keep everyone on track, in the future the manual will be distributed in sections. Also, a policy was developed that students could not begin working until their entire team was present or the official class time arrived. Thus if one team member arrived at class 15 minutes early, he or she could not be halfway through an activity before the rest of the team showed up.

Student Reactions to the Course

Forty-one of 102 registered students completed an on-line end of course evaluation at the end of the semester. Students in the first mini-mester had a 47% response rate, students in the second mini-mester had a 44% response rate, and students in the third mini-mester had a 30% response rate. The students in the first two mini-mesters rated the course a 4.6 on a 5-point scale. Students in the final mini-mester rated the course 4.2 on a 5-point scale. Comments from the students included the following:

- This was a good class for freshmen ME students.
- Best course I had this semester by far.
- Good approach for introducing mechanical engineering.

Only one comment was negative:

- Beginning so late in the semester was very inconvenient. This, just like the other freshman classes, should not be required for a transfer student.

Overall, student reaction to the course was not affected by the mini-mester time-frame.

CONCLUSIONS

Mini-mesters have potential as another way to schedule a course. The course logistics may work better when the course is designed for a mini-mester format. Challenges with mini-mesters are expected to decrease if multiple courses are taught this way.

The Introduction to Mechanical Engineering course discussed in this paper has been taught three times and is evolving into a course where freshmen learn how to do hands-on projects safely.

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Dis-assembly 2 w/ answers

Team Members Present: _____

Announcements:

Monday, Oct. 11, 6:30pm, SWE, 252 HR, Four Secrets to Finding the Perfect Job, Chik-Filet

Tuesday, Oct. 12, 6pm, ASME, 252 HR, Boeing, Free food

Continue with disassembly of the lawnmower as given below. Again, all team members should be involved in this process; take turns holding things and loosening bolts and other things. Any team with "workers" and "watchers" is not completing this exercise properly.

1. Blade and Flywheel Engagement Cable Removal

Why does the manufacturer utilize a flywheel hand brake?

As a safety precaution to the operator. If the operator lets go of the handbrake, it will stop the engine. If the operator's hand is holding the handbrake, it can not be under the lawnmower itself and therefore be hazardous.

In what two ways does the hand brake stop the engine?

It supplies a force to the flywheel, mechanical energy into heat by friction, and it grounds the spark drive, so no more spark is supplied to the engine.

2. Cylinder Head Removal

3. Fuel Tank Removal. If you did not remove the fuel tank bolts previously, you need to do that now.

What does the throttle body do?

The throttle body controls the amount of fuel and air mixture getting to the engine and thus the speed of the engine.

Instructor's Signature: _____

Figure 1. Worksheet for Dis-assembly Class 2

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