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Flipping the Engineering Mechanics Classroom: A Survey of Instructional Approaches

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Introduction and Motivation:

A flipped classroom seeks to increase engagement and center student-teacher interaction by moving the lecture outside of the designated class time and bringing problem solving, or homework, into the classroom [1]. Through this central design element, the model seeks to deemphasize the instructor and instead center the student through student-student and student-instructor interactions [2].

The flipped classroom model offers many benefits to students [3], [4] including:

- allowing students to move at their own pace both with lectures and often in class,
- allowing students to pause or rewatch the lecture as needed,
- moving lectures toward universal design with close captioning and other accommodations,
- allowing class time to be used for active and hands-on learning,
- allowing students and instructors to get to know each other better through more interaction,
- and allowing for higher level learning in the classroom.

Engineering mechanics courses feature fewer derivations and more straight-forward concepts than upper-level engineering classes, which makes them perfect for a flipped class where the class-time can focus on learning problem solving.

Though the traditional lecture is still more prevalent in the engineering mechanics classroom, an increasing number of mechanics educators are employing the flipped classroom strategy [5]. Though these implementations all share the core design of moving the lecture out of the class and problem solving into the class, there are a multitude of smaller design choices and contextual elements that come into play. Rather than focusing on any one implementation of the flipped classroom model, the authors of this paper seek to gather data, through a survey distributed to the members of the engineering mechanics division, on the contexts in which the flipped classrooms are being implemented, the instructional design choices made by the instructors, the experiences of the instructors in teaching these courses, and the lessons learned over time. By compiling this information, the authors seek to present a number of different strategies to implement a flipped classroom and provide advice to aspiring flipped classroom instructors on the design choices that may work best for their contexts.

Literature Review:

The idea of the flipped classroom has been around for many years, first emerging in the 1980's [6] and gaining popularity in the US throughout the 1990's and 2000's [1], [7]. The central aspect of the flipped classroom is the idea of moving the lecture outside of the classroom, and moving the more active problem solving into the classroom [1]. This technique is primarily grounded in the constructivist model of education that was also emerging around this time, and can be more broadly categorized as one of many active learning strategies that seeks to get students actively thinking and interacting in the classroom, rather than just passively listening [2].

Over the years an extensive amount of literature has examined the perceptions and effects of the flipped classroom approach. Student perceptions of the approach are on the average positive, though there is a consistent minority that has a negative perception of the strategy [8]. Students tend to have a more favorable attitude towards flipped classes when they have moved on to other classes than when they are in them. Flipping the class has been shown to have a moderate positive impact on student learning across a variety of grade levels and subject areas [9].

In the engineering education literature in particular, Karabult-Ilgu et al. [5] observed a spike in the amount of research starting at about 2012. This presumably corresponds with a spike in adoption amongst engineering educators around the same time. As with the more general analyses, the flipped classroom approach has generally been met with positive student perceptions [2] and has been linked to significant positive learning outcomes [3], [4], [5], [10]. The implementation of a flipped classroom approach has also been shown significantly decrease DFW rates in class [11]. Some authors have noticed particularly significant gains among low achieving students [3] and among women in engineering [12].

Though the benefits of employing a flipped classroom are well established, there are barriers to adoption, most notably the upfront work by the instructor in creating the videos and instructional materials necessary to run the class [5]. Additionally, student evaluations can be lower in flipped classes as students struggle to adapt and new professors whose jobs depend on these ratings may be loath to even try such a delivery method.

Methods:

This work sought to explore how different mechanics instructors implemented a flipped classroom model in their own unique contexts, and to explore what was and was not working for those various contexts, with and end goal of providing advice those who are considering flipping their own mechanics classroom. To accomplish this, we needed to develop a survey instrument to gather data and get the survey instrument out to instructors who are employing a flipped classroom model in mechanics courses.

<u>Developing the Survey:</u>

As there was no pre-existing survey available examining the different design choices for a flipped classroom, the authors developed the survey themselves. Both authors have taught using a flipped classroom model for a number of years, though with very different institutional contexts. That experience was put to use in the question development, which centered around the following four sections.

1. Setting and Context
2. Pre-Class Activities
3. In-Class Activities
4. Future Outlook and Advice

The survey instrument was anonymous, with no names or institution names collected. A screening question was put at the beginning to ensure that only instructors who have used a flipped classroom approach in an engineering mechanics class completed the survey, and to establish implied consent to gather the data.

The survey was developed jointly by the authors and administered through Qualtrics with branching questions to ensure survey respondents were only asked relevant questions. The authors tested the survey themselves before administering it, and also went through the IRB review process for the survey and larger study. The full survey instrument can be found in Appendix 1.

Administering the Survey:

In order to reach mechanics instructors, the authors emailed out requests to the ASEE Mechanics Division mailing list, as well as distributing it to out two local university engineering email lists. Two weeks after the initial invitations, a second follow up invitation was sent. Though the population of mechanics instructors using a flipped classroom is limited, it was hoped that the authors could get twenty or so instructors in order to get a representative sample.

Results and Discussion:

The survey was administered November to December 2024, and had a total of 39 responses. After cleaning the data and removing anyone who had not taught a mechanics class using a flipped classroom approach, as well as anyone who did not complete the survey we were left with a total of 24 complete responses. As we are examining a very niche population, this represented a good sample of mechanics instructors.

Setting Questions:

The first, non-screening question asked about the mechanics courses being taught. As show in Figure 1, the core Statics, Dynamics, and Strength of Materials courses were most popular, though there was a good mix of subjects overall. The number of responses (shown on the y axis) add up to more than 24 because 13 of the 24 respondents reporting using a flipped classroom approach in more than one mechanics course.

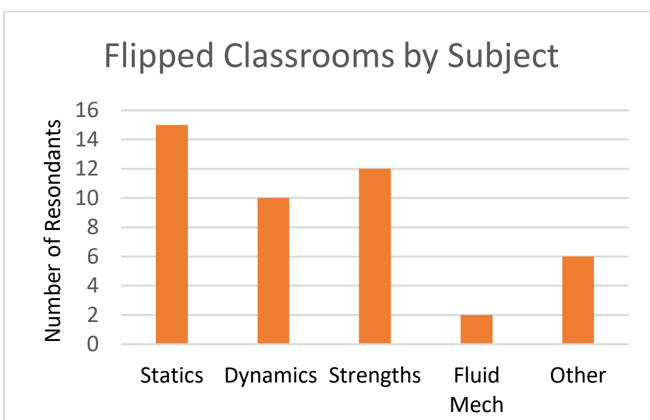

Figure 1: Responses to "What mechanics courses have you taught using a flipped classroom approach?"

Next, we asked how much of the course was flipped as opposed to a traditional lecture the last time they taught, and we found that nearly all (21 out of 24 respondents) reported flipping half or more of the class periods. There were just two respondents who reported flipping two weeks or less and a single respondent that reported flipping more than two weeks but less than half the class. This indicates that the vast majority of our respondents have significantly incorporated a flipped classroom approach, with just a few dipping their toes in.

The next question asked about class size, and as can been seen in Figure 2, there were a range of class sizes going from less than 20 students to more than 100. Most typical was the 20-40 student range, though it can be noted that the flipped classroom approach has been used with a variety of class sizes.

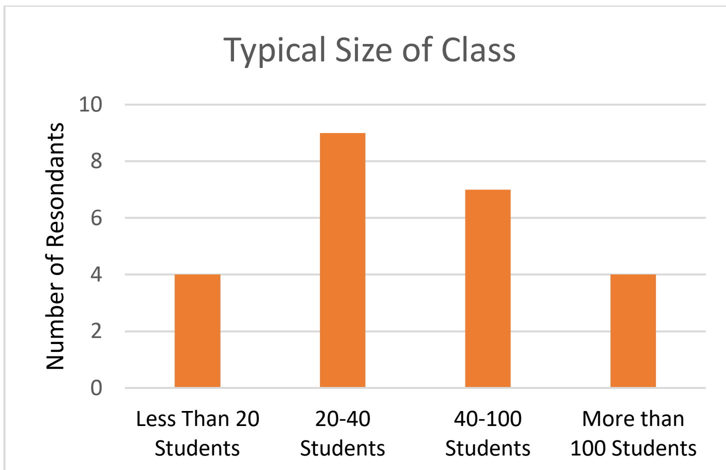

Figure 2: Responses to "How large is the typical class you have taught using a flipped classroom approach?"

The following questions asked about single-section versus multi-section the mechanics courses taught, with 15 of the 24 respondents having multiple sections of the mechanics courses, and 9 of 24 only having a single section of the courses they teach. Among the respondents with multiple sections, there was a perfectly even split between high coordination between sections, loose coordination between sections, and no coordination between sections. Again, this indicates that the flipped classroom approach is being used in a variety of instructional contexts.

The final questions in this section focused on teaching assistants. Of the responses we had, 2 respondents reported having graduate teaching assistants, 7 reported having undergraduate teaching assistants, and 15 reported having no teaching assistants. These teaching assistants helped with a fairly even mix of classroom administration and grading when they were available. When looking back at class sizes, there was a high level of overlap between large class sizes (40 or more students) and teaching assistant help. All reported teaching assistants were associated with class sizes of 40 or more, and all but 2 instructors who reported class sizes of 40 or more had teaching assistants.

Pre-Class Activities:

The next section focused on pre-class activities including the pre-class "lecture" and any quizzes that may be used.

The first question in the section focused on the mode of instruction. As can be seen in Figure 3, none of the instructors reported using just text, some reported using just videos, but most reported using a combination of videos and written text.

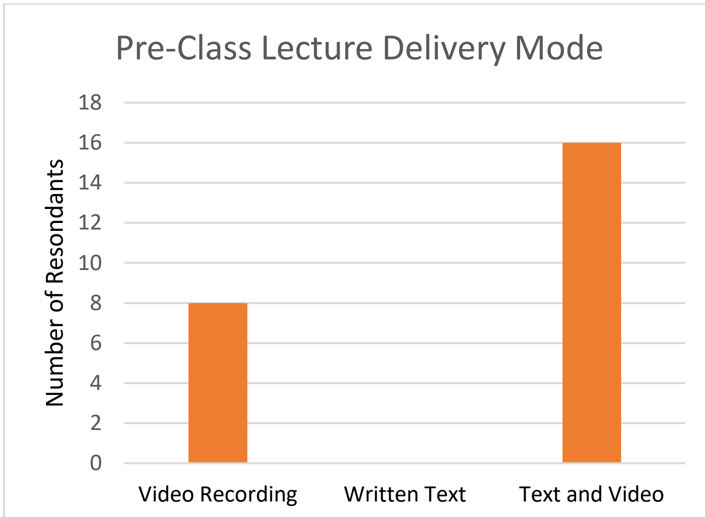

Figure 3: Responses to "What modes of instruction do you use for the pre-class lecture?"

When asked if instructors created one long video or multiple shorter videos per class, 20 of the 24 responses reported using a modular approach with multiple shorter videos. This matches the advice given in previous literature [11], advising instructors to keep videos short and modular. In terms of worked examples included in the videos, 3 respondents reported no worked problems in the videos, with a rest evenly split between 1-2 and 3+ problems in the pre-class materials. It appears that most instructors model at least some problem solving in the pre-class activities.

In terms of pre-class quizzes to ensure the students did the work before class, 9 out of 24 instructors reported having no pre-class quiz, 11 out of 24 reported using an online quiz, and 4 out of 24 reported using a short paper quiz at the beginning of class. This split ties into the aspect of accountability, which is discussed in more detail later.

In-Class Activities:

We asked, "At the beginning of class do you have any sort of overview or short lecture?" As seen in Figure 4, most instructors did have an overview at the start of class, though it was generally a short overview.

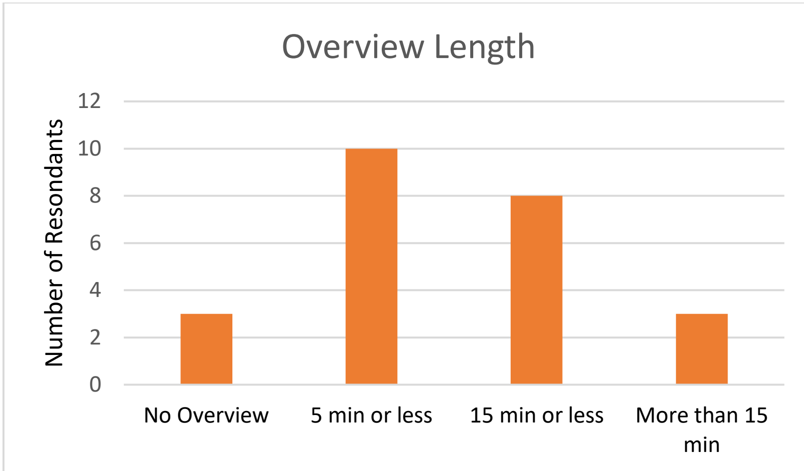

Figure 4: Responses to "At the beginning of class do you have any sort of overview or short lecture?"

This matches with the literature, which does recommend starting with a short review before moving into problem solving [4].

When asked if the instructor did any worked problems in front of the class, the responses were more evenly split, with 9 of 24 reporting no worked problems in front of the class, 7of 24 reporting doing a single worked problem, and 8 of 24 reporting doing multiple worked problems in front of the class. Modeling problem solving can be important for student learning, but our surveyed faculty seem to agree that they must leave time for the student-centered active learning.

The next question asked if attendance was taken and considered part of the grade. In the responses, 11 of 24 instructors reported not taking attendance, 6 of 24 reported taking attendance but not as part of the grade, and 7 of 24 instructors reported counting attendance as part of the grade. This result indicates that the majority of instructors are taking attendance, and roughly 30% are including this as part of the grade. Though counting attendance as part of the grade may provoke philosophical pushback from college instructors and students, the truth is that students cannot participate in the active learning and often group activities if they are regularly not attending. As will be discussed more later, getting students to attend and engage in class is a common challenge with the flipped classroom approach.

Next up in the survey was the question of teams. As seen in Figure 5, a little more than half of the instructors reported having required teams, with another 9 instructors reporting having optional teams. Only 2 instructors reporting having no teams in class.

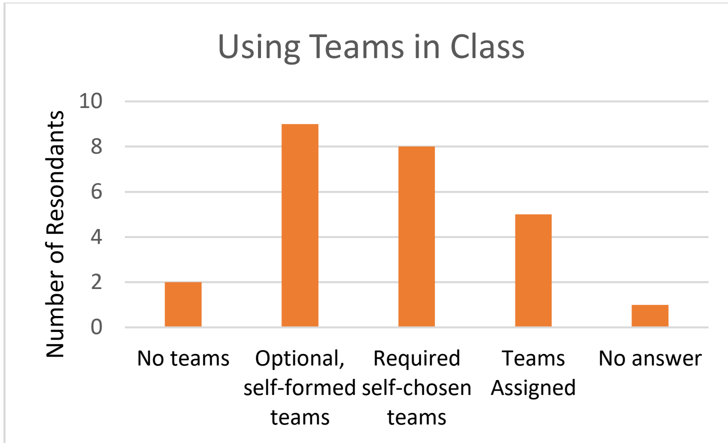

Figure 5: Responses to "When students solve problems in class, do you have them work in teams? If so, how are teams formed?"

We asked, "In class, what do students do their work on?" and received a wide range of responses which included some combination of paper, tablets, computers, or white boards. So long as work was being done, there were many possible setups that worked for instructors. This result should be encouraging to new faculty considering a flipped class: there seems to be no need to provide any specific kind of technology or materials for a flipped class to be successful.

We asked whether in-class work was collected and separately whether it was graded. Responses were varied. With regard to collecting the in-class work, 12 of 24 instructors reported collecting all the work done in class, either on paper or electronically, 7 of 24 instructors reported not collecting the work, and the remaining 5 of 24 instructors reported collecting just the answers, employing self-grading, or grading based on visual inspection and completion alone.

As seen in Figure 6, most instructors have some percentage of the grade associated with the work done in class, though this seems to be a small percentage, as would be expected for a formative assessment. There are 7 of 24 instructors that do not assign any points to the work done class. When examining the potential relationship between class size and homework collection and grading there does not appear to be any sort of correlation.

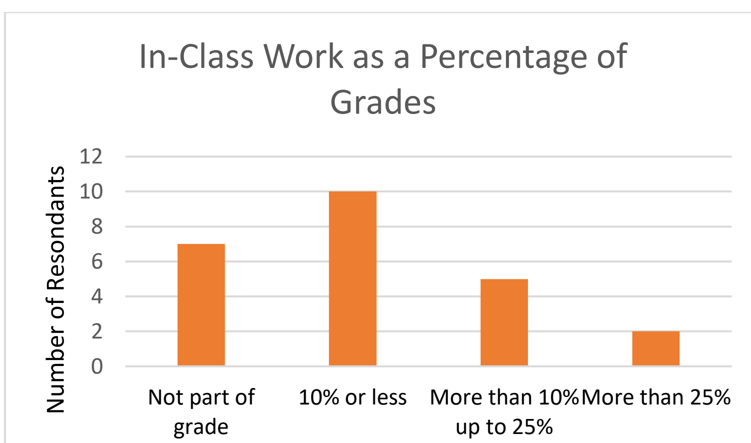

Figure 6: Responses to "In terms of student assessment, what percentage of the problem solving done in class counts for the student's grade? (Do not include exams)"

Future Outlook and Advice:

When instructors were asked if they intended to keep using the flipped classroom approach in the future, and 20 out of 24 instructors reported that they intended to keep the flipped classroom approach. 3 out of 24 were unsure, and only 1 of 24 reported that they were not planning on using the flipped classroom approach in the future. With a question asking if they would recommend the flipped classroom approach to others, 21 of 24 instructors reported that they would recommend the approach. Overall, the perception of the flipped classroom approach among those using it is clearly positive.

We then asked open-ended questions about the positive and negative aspects of using the flipped classroom approach. In terms of the positive aspects, the most commonly mentioned idea was that the instructors got to know where the students struggled most and could directly engage them in that moment. This idea was mentioned by 8 of the 24 instructors. Some other common positive aspects of using the approach included greater student engagement, the ability to have students helping and teaching each other, being able to reuse the materials (particularly for instructors with multiple sections), allowing for self-paced learning, and being able to cover content in more depth.

In terms of the negatives, the two most common ideas raised were issues getting students to do the prep work or watching videos before class and getting students to be engaged in class. Instructors mentioned that when students do the work and are engaged the system works well, but getting all the students onboard can be an issue. Some other negatives mentioned include the large amount of prep work required to set up the class the first time, as well as the large amount of ongoing work to engage with and assess students, particularly in the larger classes.

We asked instructors how they sold the idea of the flipped classroom to students who may be skeptical of the method. Though some instructors reported not needing to sell the method to students since they already had other flipped classes, most of the instructors did report doing something to sell the method to their students. Most commonly this was to highlight the positives, either by citing research that shows the method works, or by simply highlighting the positive aspects including being able to rewatch the lectures, having the instructor and classmates available for questions while engaging with the content, and providing more practice with the kind of problem solving that will be on the tests. Another common thread in this section was the advice to be clear with expectations and the format early on. A few instructors told students that the course format isn't more or less work than a traditional lecture just structured differently. That being said, it is still a new structure for many students, so making everything clear at the start of the semester is important to get students started on the right foot.

Finally, we asked what advice the instructors would have for others looking to adopt the flipped classroom approach for themselves. Responses to these questions varied quite a bit, but in general the responses could be organized into three separate threads.

First, many instructors noted that setting up a flipped classroom takes a lot of time and effort. The work is not done after this initial setup, but getting everything set up the first time can be daunting. The surveyed instructors suggested that the first time a class is flipped, the instructor must work bit by bit and persevere through the process. Related to the upkeep of the content, many instructors noted that breaking out things into smaller videos initially and making things modular is not only better for the students, but also makes it easier to make revisions down the line if needed.

Second, our surveyed instructors recommended doing everything possible to hold students accountable for their own learning including being persuasive about the flip and being explicit about expectations. The flipped classroom struggles to succeed if too many students do not watch the videos before class or are not engaging with the problem solving in class. Suggestions included being comfortable with silence and letting students struggle with the concepts a little before jumping in to lecturing. Alternatively, surveys also pointed out the importance of getting around to everyone in a timely enough manner, ensuring that they are not left struggling without help for too long. There is an important balance between being available to help, but still having the students problem solve for themselves.

Third, surveyed instructors encouraged faculty to seek feedback from experienced instructors and from the students. The comments included the importance of building on the experience of other instructors as especially helpful at the beginning of designing a flipped classroom. Instructors pointed out that once the class is started, it's important to use the time you have with the students to gather feedback from them. Instructors were encouraged to continue examining how the videos or the problems in class might be improved upon to help students through common misconceptions or issues.

Conclusions and Future Work:

An increasing number of faculty are finding that a flipped classroom is useful in teaching Engineering Mechanics courses. As authors who have seen the flipped classroom model work, and who are invested in getting others onboard, we are heartened to find that people are trying this format and sticking with it. Additionally, the vast majority of surveyed faculty who teach using a flipped classroom recommend it to others. The paper offers insight into the broad range of institutional contexts in which the flipped classroom model has been employed and offers insight into what may work for other instructors hoping to make the flip for themselves.

Computing is taking another generational leap with artificial intelligence (AI) which can solve the basic Engineering Mechanics problems in Statics, Dynamics and Strengths of Materials. AI will likely compound the issues we have had with online solutions and sites such as Chegg. With the flipped classroom model, we can encourage students to learn problem-solving in an arena where authorized help is immediately available from faculty and possibly TAs and hopefully mitigate some of these impending issues.

On a more positive outlook, instructional technologies are also advancing quickly. It's never been easier to create or edit videos, automated assessment systems can offer instantaneous feedback, and AI may soon be able to supplement the guidance offered by the instructor or TA in the classroom. All of these factors could help improve the learning experience for students in flipped classrooms in the future.

Though we offer a snapshot of the flipped classroom in mechanics courses in this paper, there are limitations and future work to be done. In this paper we've chosen to examine a limited subset of instructors, and as a result have a limited sample size. We did not have a large enough sample to establish statistical significance for many of the observations, but instead offer guidance to future studies that may examine some of these questions with greater sample sizes available. Should the population of instructors using a flipped classroom approach grow, this would make future work easier. Additionally, as technology continues to shape the classroom, future studies will certainly be warranted examining these new contexts.

References:

[1] M. J. Lage, G. J. Platt, and M. Treglia, "Inverting the Classroom: A Gateway to Creating an Inclusive Learning Environment," *The Journal of Economic Education*, vol. 31, no. 1, pp. 30–43, Jan. 2000, doi: 10.1080/00220480009596759.

[2] J. Bishop and M. A. Verleger, "The flipped classroom: A survey of the research," in *2013 ASEE annual conference & exposition*, 2013, pp. 23–1200. Accessed: Jan. 02, 2025. [Online]. Available: https://aktuelt.osloskolen.no/SysSiteAssets/laringsteknologi/dokumenter/the-flipped-classroom-a-survey-of-the-research.pdf

[3] B. Kerr, "The flipped classroom in engineering education: A survey of the research," in *2015 International Conference on Interactive Collaborative Learning (ICL)*, Sep. 2015, pp. 815–818. doi: 10.1109/ICL.2015.7318133.

[4] C. K. Lo and K. F. Hew, "The impact of flipped classrooms on student achievement in engineering education: A meta-analysis of 10 years of research," *Journal of Engineering Education*, vol. 108, no. 4, pp. 523–546, 2019, doi: 10.1002/jee.20293.

[5] A. Karabulut-Ilgu, N. Jaramillo Cherrez, and C. T. Jahren, "A systematic review of research on the flipped learning method in engineering education," *British Journal of Educational Technology*, vol. 49, no. 3, pp. 398–411, 2018, doi: 10.1111/bjet.12548.

[6] M. Nechkina, "Increasing the Effectiveness of a Lesson," *Communist*, vol. 2, p. 51, 1984.

[7] A. King, "From Sage on the Stage to Guide on the Side," *College Teaching*, vol. 41, no. 1, pp. 30–35, Jan. 1993, doi: 10.1080/87567555.1993.9926781.

[8] C. K. Lo and K. F. Hew, "A critical review of flipped classroom challenges in K-12 education: possible solutions and recommendations for future research," *RPTEL*, vol. 12, no. 1, p. 4, Jan. 2017, doi: 10.1186/s41039-016-0044-2.

[9] P. Strelan, A. Osborn, and E. Palmer, "The flipped classroom: A meta-analysis of effects on student performance across disciplines and education levels," *Educational Research Review*, vol. 30, p. 100314, 2020.

[10] A. K. Howard and M. T. Stimpson, “Online-Only Statics Compared to a Flipped Classroom,” in *2017 ASEE Annual Conference & Exposition*, Columbus, OH, 2017. Accessed: Jan. 14, 2025. [Online]. Available: https://peer.asee.org/28724.pdf
[11] A. K. T. Howard, “Flipped Classroom – Ten Years Later,” presented at the 2019 ASEE Annual Conference & Exposition, Jun. 2019. Accessed: Jan. 02, 2025. [Online]. Available: https://peer.asee.org/flipped-classroom-ten-years-later
[12] M. Chiquito, R. Castedo, A. P. Santos, L. M. López, and C. Alarcón, “Flipped classroom in engineering: The influence of gender,” *Computer Applications in Engineering Education*, vol. 28, no. 1, pp. 80–89, 2020, doi: 10.1002/cae.22176.

Appendix 1: Distributed Survey

Study: Flipping the Engineering Mechanics Classroom: A Survey of Instructional Approaches

This study seeks to explore the use of flipped classroom strategies in the engineering mechanics classroom. The general idea behind a flipped classroom is that it moves the lecture outside of class time, by having students watch a video lecture or complete a reading before class, and then uses class time to actively engage in problem solving, effectively moving homework into the classroom. Research has shown multiple advantages to this instructional strategy, and although it is still not the standard, flipped classrooms have become more common in engineering over the past decade. While the central design element of the flipped classroom remains constant, there are multiple instructional design choices the instructor must make in implementing this strategy. This survey seeks to gather information from instructors using a flipped classroom approach in engineering mechanics courses on the contexts and approaches they have found to be most effective. This information will then be used to explore the different strategies that instructors have found to be effective and the contexts in which these strategies are being used. Through this analysis, the authors hope to offer a guidance to other mechanics educators that may be making the switch to a flipped classroom themselves.

If you are teaching or have recently taught an engineering mechanics class using a flipped classroom approach, we would appreciate your time and response. All data collected will be anonymous and filling out the survey will be considered consent to use your data in this research study.

Thank you,

Principle Investigators: Dr. Jacob Moore, Penn State Mont Alto (jmoore@psu.edu) and Dr. Anna Howard, NC State University (akhoward@ncsu.edu)

Screening Question:

1. In the past five years have you used a flipped classroom approach (for at least one class period) in an engineering mechanics course?
    - Yes
    - No

(If no, the survey will end)

Setting Questions:

2. What mechanics courses have you taught using a flipped classroom approach? (check all that apply)
    - Statics
    - Dynamics
    - Strength of Materials / Mechanics of Materials
    - Fluid Mechanics

- Other (please specify)

3. The last time you taught a mechanics class using a flipped classroom approach, how much of the class did you run as a flipped class as opposed to a more traditional lecture.

    - Just flipped a few class sessions (up to two weeks).
    - Flipped more than two weeks, but less than half of the course.
    - Flipped more than half of the class periods.

4. How large is the typical class you have taught using a flipped classroom approach?

    - Less than 20 students
    - 20 - 40 students
    - 40 – 100 students
    - More than 100 students

5. Are there multiple sections of the mechanics courses you teach?

    - Yes
    - No

(if no, skip the next question)

6. Is there central coordination between sections in the mechanics courses you teach (common materials, common exams, team teaching, etc.)

    - Yes, the sections are highly coordinated.
    - Yes, there is loose coordination.
    - No, there is no coordination between sections.

7. Do you have teaching assistants helping with the class?

    - Yes, I have graduate teaching assistants.
    - Yes, I have undergraduate teaching assistants.
    - No, I do not have teaching assistants.

(in no skip the next questions)

8. How do your teaching assistants help you?

    - They help in the classroom and with grading.
    - They just help in the classroom.
    - They just help with grading.

Pre-Class Activities:

9. What modes of instruction do you use for the pre-class “lecture”?

    - Video Recording
    - Written Text
    - Written Text and Video

(if just the written text skip the next question)

10. Do you have students watch one big video before class, or is the video broken up into modular elements.

    - One big recording.
    - Videos are broken up into smaller modules.

11. Are worked example problems included in the pre-class videos/text?

    - No worked problems, just the concepts and equations are discussed.
    - There are typically one or two problems in the pre-class videos/reading.
    - There are typically three or more worked problems in the pre-class videos/reading.

12. Do you use a quiz of some sort to ensure that students complete the pre-class video/reading?

    - No quiz, students are just expected to complete the reading before class.
    - There is an online quiz student are expected to complete before class.
    - There is a short in-person quiz given at the beginning of class.

In-Class Activities:

13. At the beginning of class do you have any sort of overview or short lecture?

    - I do not have any review of the material at the start of class.
    - I speak for five minutes or less.
    - I speak for 15 minutes or less.
    - I speak for more than 15 minutes.

14. Do you do any worked problems in front of the class?

    - I do not work any problems for the class.
    - I work a single problem for the class.
    - I work multiple problems for the class.

15. Do you take attendance in class?

    - No
    - Yes, but it is not part of the grade.
    - Yes, and it is part of the grade.

16. When students solve problems in class, do you have them work in teams? If so, how are teams formed?

    - No, they do not work in teams.
    - They can work in teams if they choose, but are not required to work in teams.
    - Yes, they work in teams of their own choosing.
    - Yes, teams are assigned.

(If no, skip the next question)

17. Do you switch teams around?

    - No, the teams are kept constant all semester.
    - Teams are only modified if the students make the switch (or request a switch)
    - The teams are switched up a few times.
    - The teams are switched up once a week or more.

18. In class, what do students do their work on?

    - On paper.
    - On the computer.
    - On a whiteboard.
    - Other (please specify)

19. How is student work for class collected?

    - Student work for class is not collected.
    - Some limited subset of the work is collected.
    - Students submit all answers (but not the intermediate work) online.
    - Students submit all their work on paper.
    - Students submit all their work online.
    - Other (fill in the blank)

20. In terms of student assessment, what percentage of the problem solving done in class counts for the student's grade? (Do not include exams)
    - The work done in class is not counted as part of the course grade.
    - The work done in class is 10% or less of the course grade.
    - The work done in class is more than 10% of the course grade, and up to 25%.
    - The work done in class is more than 25% of the course grade.

Future Outlook and Advice:

21. Do you plan on continuing to use a flipped classroom approach in the future?
    - Yes
    - Undecided
    - No
22. Would you recommend other mechanics educators adopt a flipped classroom approach?
    - Yes
    - No
23. Do you believe students learn more of the content in a flipped classroom environment or in a traditional lecture environment?
    - More in a flipped classroom.
    - About the same in both environments.
    - More in a traditional lecture.
24. As an instructor, what are the positive aspects of using a flipped classroom approach?
25. As an instructor, what are the negative aspects of using a flipped classroom approach?
26. How do you sell the idea of a flipped classroom approach to students who may be skeptical of the new method of teaching?
27. What piece of advice would you offer to an instructor looking to flip their own class?
28. Is there anything else you feel is important that wasn't discussed?