Last week, Brani said that even though items are different each other, we got new two factors on two data, and so we can compare instructor results with students results.

-Could I combine our methodology part (before result part) with those of the instructor data?

Data Sources

We surveyed a sample of 515 Georgia Tech students in three courses, and the overall response rate was 40.02% (515/1287).

- (Q : Our data is suitable?

Before running EFA, we examined whether our dataset is suitable for EFA, following An and Sean (2013).

First, we checked if there is a patterned relationship among our variables with the Bartlett's Test of Sphericity. This test shows that we have a patterned relationships if p is lower than 0.0001. We obtained a significant statistics. (Chi^2: 3918.437; p:.000)

Also, as a follow-up, we checked the absence of multicollinearity with Determinant score. Our determinant score was 0.002, which is above the rule of thumb of .00001 as an absence of multicollinearity.

Thirdly, we confirmed an acceptable Kaiser-Meyer-Olkin measures (KMO:0.897), which shows that our dataset is suitable for EFA.

- (Q: the requirements for Factor Analysis?

To perform a EFA, there has to be multivariate normality within the data (Child, 2006). But, we have left-skewed data. Even though various transformations such as Box-Cox transformation were performed, they were not successful. Instead, we also performed Principal Axis Factor, which is recommended when the data violate the assumption of multivariate normality (Costello & Osborne, 2005).

Also, a factor with EFA should have at least 3 variables. A factor with 2 variables is only considered reliable when the variables are highly correlated with each another ($r > 0.7$) but fairly uncorrelated with other variables (Tabachnick & Fidell, 2007). Since we had only 2 factors with more than 3 variables, our analysis was adjustable.

Thirdly, we removed the missing values, and checked the sample size. Comrey and Lee (1992) indicated the ratio of participants to variables should be at least 10:1. So, we should have at least 240 because the number of variables is 24. Since we have 515 data, which is more than 240, our data was adaptable for EFA. (A larger sample size will diminish the error in data and so EFA generally works better with larger sample size (Stevens, 2002)).

- (Q: Do PIPS items group together into valid, reliable, and measurable variables?)

Walter et al.(2016) explained three types of validity.

1) Content and face validity: They field-tested the PIPS with a sample of nonparticipating instructors (N=5), and a panel of education researchers at another institution (N=4). But, as the analysis with instructor data, we only tested the PIPS with Gatech data.
2) Construct Validity (Reliablity): We include respective construct reliabilities in Table 2.

Factor Analysis

We conducted the explanatory factor analysis(EFA). Factors in the 2-factor model include one factor that describes "instructor-centered practice (IC)" (N=8), and another that describes "student-centered practice (SC)" (N=13). In Table 2, unlike Walter et al. (2006), Q6, Q7, and Q18 were removed, which were also different results from ones with Instructor data, and Q17 was loaded with different factor; Q17 with the factor related to SC practice. Our solution was validated by moderate to good model fit statistics in Table1. We evaluated the goodness of fit of our models by using the root-mean-square error of approximation (RMSEA; Steiger, 2000), a comparative fit index (CFI) (Hu and Bentler, 1999), and chi-square/df (Bollen, 1989). The statistics of our model and Walter et al.'s model are comparable.

Table1. PIPS model fit statistics for 2 factors (2F) with Instructor- and Student data

	Student
Chi-square(χ^2)	806.76
df	151
Chi-square/ *df*	5.34
CFI	0.803
RMSEA	0.076
N(Number of Observations)	515

Table2. PIPS factor reliability scores, model fit statistics, and items by factor with Instructor- and Student data

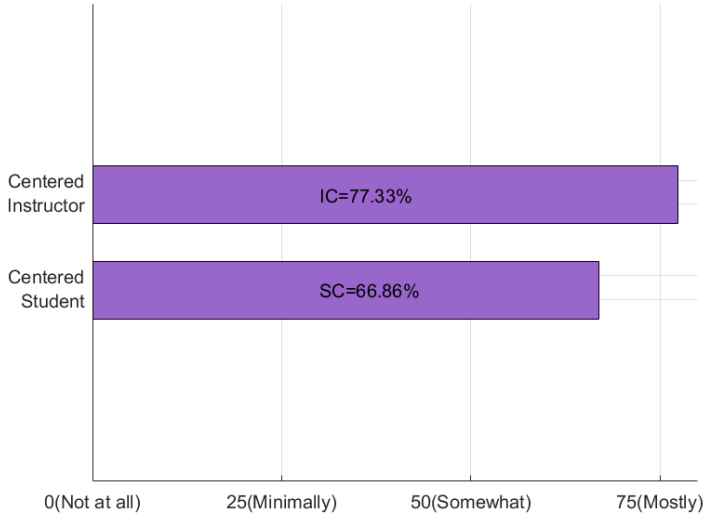
	Factor 1:Instructor-centered practice	Factor 2: Student-centered practice
Student Data		
Reliability(Instructor/Student data)	0.76	0.9
Number of items	8	13
Eigenvalue	2.480	5.711
Percent variance explained	11.085%	30.510%
Items	Q1,Q3,Q5,Q11,Q21,Q22, Q23,Q24	Q2,Q4,Q8,Q9,Q10,Q12,Q13,Q14,Q15,Q16, Q17,Q19,Q20

Result

1. PIPS Histogram

As shown in the instructor data, we presented the histogram with PIPS 2 factors. Figure 1 shows a significant difference between IC- and SC- score. There is a significant correlation between IC- and SC- score (r= -0.2723, p= 3.2912e-10) as a result of a promax rotation in our analysis.

FIGURE 1. Averaged PIPS 2F Scores



2. PIPS Scatter Plot

Figure 2 represents the scatter plot for individual 2F PIPS scores in a variety of the sampled departments. There were total of 486 students (N=486) in the departments (N: BME=69, CHBE=84, CEE=32, ECE=112, ISYE=74, MSE=39, ME=76). 29 data sets were duplicated for the students who were in two departments. Figure 3 shows the mean value of the departments in instructor-centered scores from Figure 2. We found significant differences in the mean score of each department for SC practice (p: 7.3198e-04), and IC practice (p: 1.0353e-05). As shown in Figure 3, BME is depicted as the highest SC practice score, and the lowest IC score. In contrast, MSE appears to be the highest IC practice score.

(There is no information about which department has the highest- and the lowest SC, IC scores in Walter.et. al(2016). So we are not able to compare our results with the ones in Walter. et. al (2016))

Figure2. PIPS Scores in the 9 Sampled Departments

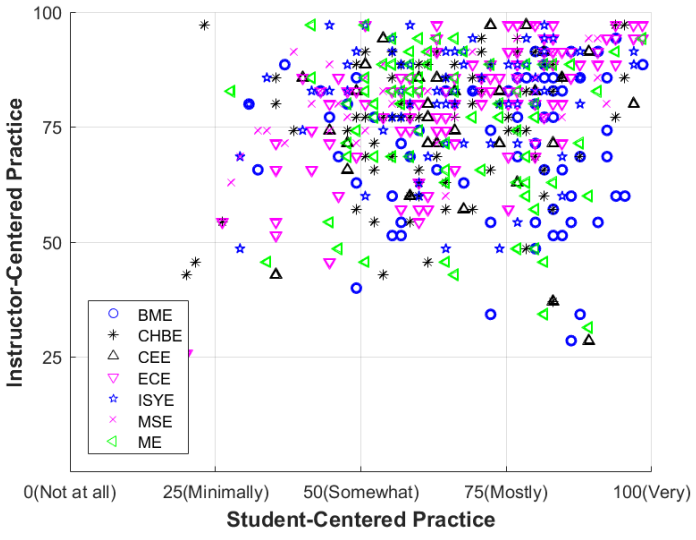
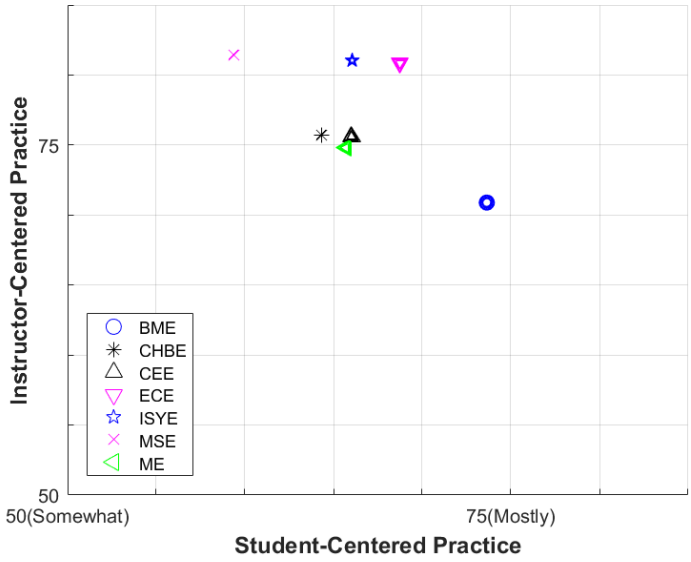


Figure3. The Averaged PIPS Scores in the 9 Sampled Departments



In figure 4, PIPS 2F scores are scattered based on courses in each department. There were total of 457 students (N=457) dividing into courses for the each department.(N: BME=54, CEE=23, CHBE=65, CHE=7, COE=39, CS=18, ECE=102 , ISYE=53, MAT=9, ME=55, MSE=26, PHY=6). Eliminated were PIPS scores where the number of the course was below 3 and duplicate data for the student who was in two departments. (N=58). The figure 5 shows the mean value of instructor- and student-centered scores in the respective departments from the figure 4. Significant differences were obtained in the mean score of SC- and IC- practice score (SC practice (p: 6.4858e-07), IC practice (1.1118e-04)). In Figure 5, while BME is depicted as the highest SC practice score, PHYS (Physics) appears to be the highest IC practice.

(Analysis for courses was newly added. So we are not able to compare our results with the ones in Walter. et. al (2016))

Figure4. PIPS Scores for Courses in the Each Department

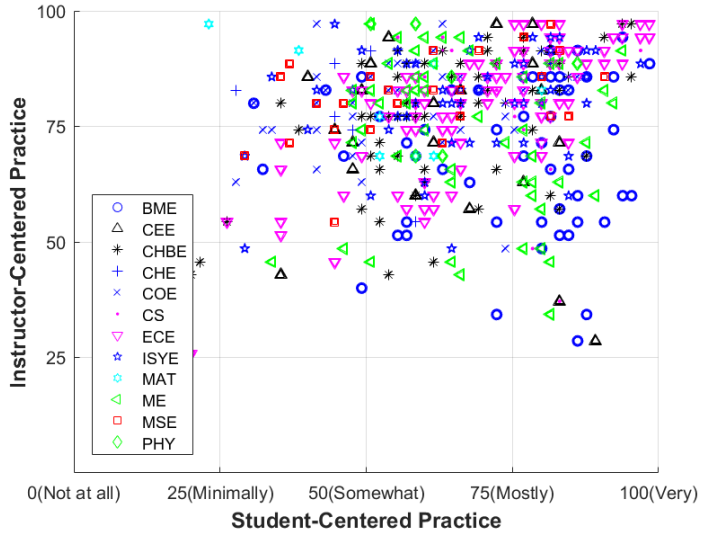
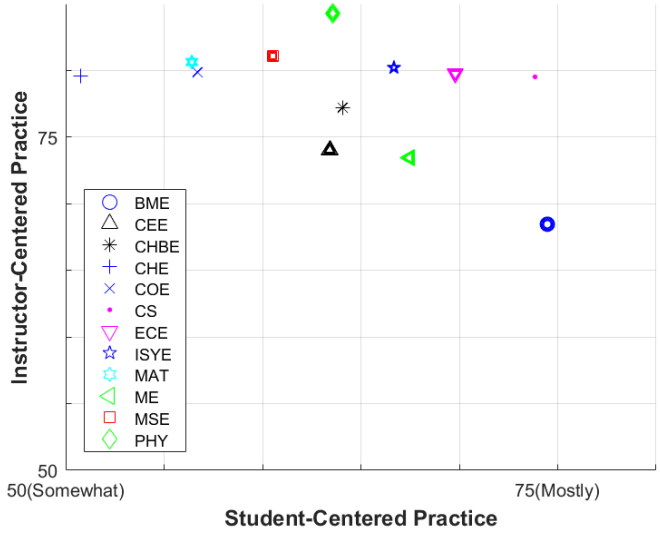


Figure5. The Averaged PIPS Scores for Courses in the Each Department



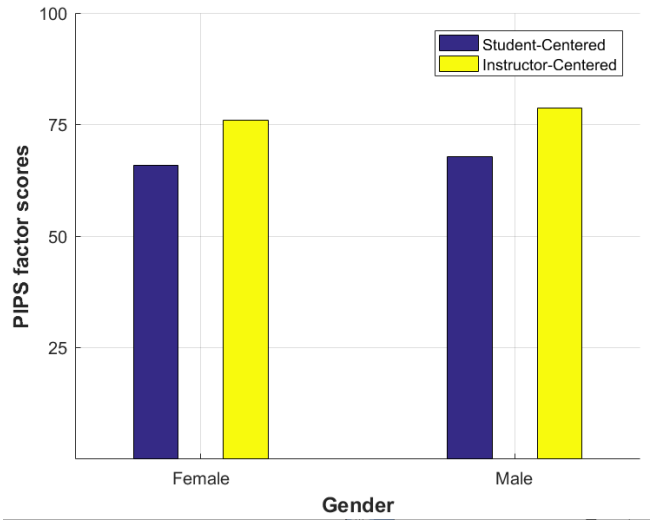
3. Demographic Differences

We examined whether there exists demographic differences in SC and IC scores, as generated by the 2F PIPS model. We ran two sample t-tests and ANOVA comparisons to explore demographic differences between and among PIPS scores for different instructor groups (Gender, Academic standing, International or not, the weekly contact hours).

1) By Gender

We explored the student data (N=257 female; N=256 male; N=2 no answer) to verify whether there exists a significant difference. We acquired the significant difference between gender for the mean of the IC scores with students data (p: 0.0276), which is consistent with Walter et al. (2016). In contrast, there was no significant difference between gender for the mean of SC (p: 0.2464) in our data. Thus, we can conclude that male students described their courses as instructor-centered practice more than female ones.

Figure6. The Averaged PIPS scores by Gender



2) How time is spent in class: doing lecture, small group, individualized instruction, and other instruction

We found that the lecture-based pedagogies were negatively correlated with SC practice, and positively with IC practice. For the small group, and the individual group, students felt that there was a negative correlation with IC, but a positive correlation with SC, which are consistent with the findings in Walter et al. (2016).

Table3. Pearson correlations among PIPS, and participant estimations of how time is spent in class: doing lecture, small group work, individualized instruction, and other instruction

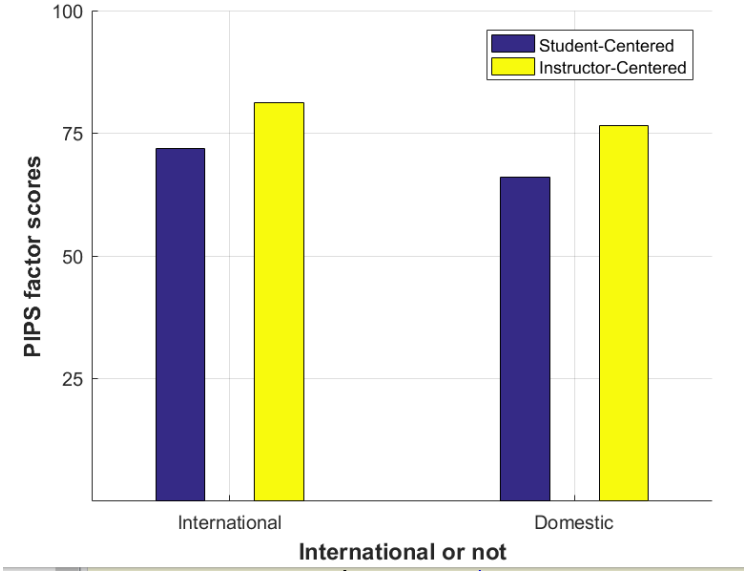
	IC	SC	Lecture	Small group	Individual	Others
SC	-0.2723** (3.2912e-10)	1	-0.4078** (6.6799e-21)	0.1520** (7.7725e-04)	0.3801** (3.7204e-18)	0.0974* (0.0317)
IC	1		0.2924** (4.8999e-11)	-0.0576 (0.2047)	-0.3275** (1.3065e-13)	-0.0206 (0.6498)

3) Academic standing

The data is following according to the academic standing (N=42 Freshman; N=73 Sophomore; N=149 Junior; N=222 Senior) There were no significant correlation between mean scores based on academic standing for SC(p: 0.1448) and IC practice(p: 0.5854).

4) By International or not

The data is following by International or not: N=73 International; N=486 Not international)
International students significantly felt more than domestic students that their courses had SC and IC practice, because Mean scores for SC and IC practice were significantly different (p: 0.0047/ p: 0.0103).



5) The weekly contact hours you participate in Lecture/lab/discussion/others

Table6. PIPS factor correlations with class size, years teaching, and years in the higher education

	Lecture	Lab	Combined	Discussion	Others
SC	-0.0215 (0.6381)	0.2258** (5.4575e-07)	0.1284** (0.0048)	0.2049** (5.7467e-06)	0.0541 (0.2355)
IC	0.3486** (3.2473e-15)	-0.1818** (5.9612e-05)	0.0038 (0.9344)	0.0309 (0.4989)	-0.1298** (0.0043)

We found that the lecture-based pedagogy was positively correlated with IC practice. In contrast, for the Lab-based teaching, there was the positive correlation with SC, but the negative one with IC. For the combined and discussion group, students felt that their hours they participated in the combined and discussion are positively related with student-centered practice. For others, they thought that it was instruct-centered practice, where others group mainly contains homework, office hour, and lab report.

The list of 'Others' for Table 6.

A problem solving sessions

activities

Asking about homework, lecture notes...

assignment

Assignments & Project

Assignments, Readings, etc

attending weekly office hours

being in lab other than the lab assigned period to do work

Completing lab at home, completing homework, studying material

Daily study sessions throughout the week to work through homework problems.

discussion with classmates

Discussion with friends and helping others with projects

Doing homework and studying

Doing homework, readings, and going to office hours

exam preparation

Extra time in lab

Going to TA/PLUS review sessions

Group discussions. Doing assignments.

Group Meetings outside of class

Group meetings outside of class

Group meetings outside of PBL time to work on our research project

Group PLUS sessions

Group project

Group Project Meetings

Group Study

group study sessions with the TA, homework, working on the group project

Group work, office hours, lecture attendance

Help Desk

Home Work and studying for tests

Homework & Meeting with Group Project Members

homework / exam review sessions

Homework and doubt clarifications in office hours

Homework and readings

Homework and Studying

Homework and studying

homework and studying

Homework Coding Problems

Homework Discussion

Homework Groups and Office Hours

Homework office hours

Homework problems, studying material for tests
Homework took, on average, 5 hours to complete a week and on weeks where we had tests, I would typically spend that same amount of time studying.

Homework, group study, office hours

Homework, Helping out other students

Homework, Office Hours

Homework, office hours

Homework, office hours, group study

Homework, projects

Homework, Projects, Group Projects

Homework, reading, studying

Homework, Reading, Studying, Office Hours

Homework, reviewing lecture notes

Homework, Study

Homework, Studying, and Reading.

Homework, Tests

Homeworks, Studying at home for tests

hw, prelab, studying for test

I go to office hours and have study groups with other classmates

I would be in study groups with other students or be with professors in office hours

IMPACT lecture sessions

Independent team work with professor available to answer questions, machine shop work

independent, group studying

Individual studying

Lab demos at the end of the semester (not official lab experiments)

Lab for projects

Lab report writing and analysis

Lab reports, homework, exam prep

Meeting the TAs

Meeting with TA fpr additional assistance on assignments

Meetings with groupmates

Mostly doing homework or prelab assignments.
My professor set up a few projects instead of exams for the students, so that we need to put a lot of effort on the class to make sure these project are finished.

My TAs provide office hours, as well as extended recitation sessions.

N/A

Office hour

Office hours and homework with other people in the class

office hours and studying

Office Hours and unofficial recitation hours

Office hours, homework

Office hours, homework, etc.

Office Hours, Review Sessions, Study Groups

Office hours, studying, homework

Office Hours/ TA help

Office Hours/Help Desk

Office Hours; Recitations

Office hours; TA hours etc

Online homework through MyMathLab

Online Lecture Videos

Open lab, working on the assignments and the machine

Open TA hours

Out of class group meetings

Outside of class lecture materials (video lectures)

Outside of class meetings with team.

Outside reading, meeting to prep for presentations

Outside work for class (solidworks, etc)

partners

personal study at home reading the book

Piazza: posting and answering questions

PLUS

Problem sets

Problem Solving Sessions

Problem Solving Studio

Problem Solving Studio

Problem Solving Studio

Professor and TA office hours

Professor's Office Hours

Projects

Projects

Quizes

Reading/studying/homework

Readings and Papers

Recommended guest lectures

Reports & Assignments

Reviewing for the old stuffs.

Studio Hours

Studio hours

study groups

Study with fellow students

Study/hw groups

studying

Studying

Studying

Studying - homework and office hours

Studying a lot for exams

Studying and doing homework

Studying and homework

Studying and homework

Studying by myself

Studying, doing homeworks, working on other related problems, reading the textbook.

Studying, homework

Studying, homework, and group projects

Summary and Review

TA Office Hours

TA office hours, individual study.

TA office hours, or after class

Team meetings and individual work

These are hours I spend going to see the Professsor or GTAs for just about any issue I am encountering.

This course required 12-15 hours per week of outside work.

Throughout the course of the semester, my group met outside of class at least twice a week and sometimes more

Video Lectures

Visiting Office Hours (If that counts?)

Visiting professor and TA's in office hours

Watching Video Lectures

Weekly Homework, ITS, Lab Prep, Lab Homework, Studying

Weekly homeworks/assignments, projects

Working in groups and knowing alot of information for the jop professional job sote

Working on group projects or individual readings.

working on homework and studying the material

Working on homework or studying

Working on Homeworks

Working on our project beyond class time

Working on project

Working on team and individual projects

Working on the robot for the competition

Working with friends on assignments, going to office hours, messing with the mathematics

Working with others on assigned projects

The list of ‘Others’ for Table 3

A lot of discussion with students while lecturing

All lecture-based notes. We did one in-class group activity, but otherwise just took notes from the board for every class period. At the time when I took it, it was not a required class, but it had designated sections for my major because it was a popular choice (and they didn't want to make us buy the materials if we wouldn't use them in the future). Now however, it is essentially a requirement.
Class consisted of three different modules, with each of them focusing on different lecture methods (some were more lecture-based, others were more group-based, etc.)

Class should be curved. The class average is around 70%

Class time consisted of reviewing material, learning new material, and working a few practice problems.

Class was taught in standard lecture style with professor explaining concepts and then doing problems on the whiteboard.
CS 1371 is a very difficult class and requires a significant amount of time to complete the homework assignments. Kantwon is a good teacher and is passionate about the subject.

Despite the lack of mix in how students participate the professor is very engaging.
Digital design lab, most of time spent in lab, TAs give short information at beginning and answer questions along the way/give checkoffs.

Energy Systems by Dr. Realff (since it's a special topic course)

Example parts were passed around
He lectured but left plenty of room for questions. He also didn't waste our time. He had 1.5 hours but would only spend as long as he needed to go over the material and then dismiss us and stay after for questions. He encouraged participation by handing out small extra credit to people who caught a mistake on the slides or answered a question correctly or asked a really good question. He also was funny and therefore engaging.
I just wish to communicate the description of the class did not adequately list the required prerequisites. It was very difficult due to the lack of communication.

I loved taking this course. Project and the homework helped me understand the topics.
I particularly like the way that our professor has set up the class. He teaches us all the material, but there is always time to address questions and have discussions on the topics.
I took this class over the summer at GT Lorraine. The times are indicative of four consecutive days of class throughout the week in addition to recitation and group study session.
In this class, different faculty come to discuss each branch of engineering every week. They provide a presentation to students, in hopes to making their declaration of their major easier Students ask questions at the end about the major.

Independent work mostly meant trying to answer practice problems before exams

Instructor would ask a question and we would work on the answer individually.
ISYE 4232 (Advanced Stochastic) is usually a course which discusses the continuation of the materials from ISYE 3232 (Stochastic). However, this semester's instructor designed a course with emphasis on algorithms, recursion, dynamic programming, and stochastic dynamic programming. The course discussed the materials which I have heavy interest in personally. Therefore, I invest numerous hours in order to understand in depth and conduct individual literature searches for further understandings. According to my past experience in watching lectures and reading notes offered by MIT opencourseware, I have realized that the course is constructed in an extremely similar way. Such fact augmented my interest and provided more motivation regarding class participation and urge for further understandings through individual studying.

It had different modules and each module had its own instructor.

It is a huge lecture of 300 students.

It is entirely an exam based class, with seven total exams

It may not seem like a good class based on these percentages but Min Zhou is a phenominal professor.
It was a flipped class with videos on Coursera. We watched the assigned videos before the class, took pop quizzes, and worked on worksheets in small groups relating the the videos. Dr. Whiteman came around to help us and went over the videos.

It was a flipped classroom.

It was a group-work based class with two days a week being small groups and one day a week being lecture.

It was a special topics course.

It was a very good class

It's a group-based class

Its flipped classroom

Lecture is lecture, homework is done at home

Most class time is spent with the professor lecturing but occasionally we are given some time to work on problems in groups.
My professor use take home exams and projects to switch the traditional exams in the class. I think this is really helpful for the students to learn the skills of Autocad. The skill class like this is really important to make sure the student participate in the class and spend enough time on the project instead of just taking the exam and remember stuff and formulas.
Outside of "contact hours" this course is an unreasonable amount of work for a three credit course, but in terms of it's value for learning Mechanical Engineering no other class comes close.

PBL course, mostly group work.
Primarily was just a regular lecture, but with pop in class exercises that could be done individually or with two other students next to you.

Professor lectured the entire time

Professor lectures the entire class. Very few instances of group work

Q3.16

Really engaging professor - I liked that he asked us questions.

Sometimes He would lecture for the first half and have us work in groups on a related problem for the rest of lecture
Sometimes the professor asks some questions to students. For example, he asked about some conceptual true/false questions. Students should answered to the questions with the smile for true and nodding the head for false like that.

Team Based Class: students were split up into teams to build a robot.
The class is a new course offered in Georgia Tech ECE department. It is about high voltage engineering, and it is combined by experiment and lectures.
The class is a traditional lecture based class - we sit down and write things while he talks, but he is very open to any questions (even those that are slightly off-topic, as long as they are somewhat related).
The class is about making an integrated chip. You more than half of the time on homework and making the actual chip. It's really cool to get hands on training in a clean room.

The class is focused on the professor lecturing, expecting questions. When not in class students should read / review.

The class was a typical lecture for 3 hours a week, with a homework assignment due every 1-2 weeks.

The class was almost entirely lecture based and we were responsible for memorizing the material outside of lecture.

The classes after spring break are all students presenting and then students and professors asking questions.

The individual and small group work is mostly working on homework or studying.

The instructor taught the whole class but it was interactive not solely a lecture.
The instructor used notes handouts with fill in the blanks, which were a nice balance of preprinted notes and having to write everything down. I could focus on what was being said instead of trying to write everything down, but having to fill in the blanks made me think about what the answers might be and kept me attentive.

The professor would teach, and she would give examples for us to work on in groups before going over them as a class.
The teacher does interactive examples with the students frequently but generally drives the solution himself with some input from the students.

The teacher would lecture and throughout lecture we would occasionally break into groups to complete short practice problems

There are very few classes at Tech that I enjoy. I enjoyed THIS class immensely. Below, please find a little blurb about William Pilcher- the heroic TA who carried our entire class through an insanely fun and informative semester. Dr. Pokutta from Emory is also excellent and a brilliant teacher- incredibly informative and always had the patience to explain concepts to me. I was in her office no less than once per week, and in William's office even more frequently. They were immensely helpful resources and made my entire Fall 2016 semester spectacular. Phenomenal class, ONLY because the professor and the TA- were both exceedingly wonderful.

Good afternoon! I hope you're doing well. I have filled out the Graduate TA Nomination, but I wanted to send you an email as well- because this particular TA deserves every single medal.

William Pilcher was my biomechanics (BME 3400) TA, and he guided me through an incredibly harsh time this past semester. Not only was he exceptional at his job- explaining concepts thoroughly, giving ample guidance, great recitation classes- he also saw me through a period where I was feeling less-than-worthy of my goals and ambitions.

I was absent from school for a week, after I found out my good friend had hung himself. During this week- I simply didnâ€™t have the energy or stamina to worry about anything academic- I emailed William and Dr. Pokutta and they were immediately incredibly understanding and gracious. When I came back, after missing lectures and recitations and reviews- William gave me a 1-on-1 run-down of the entire week. It took quite a few hours, as I had missed an entire unit (BME moves quickly).

I cannot thank William enough for his discretion in the matter, and his generosity with his time. There were many times where I went to his office, without previous appointment, and ended up taking up an hour of his time. Sometimes, this was right before lunch/right before a test/right before one of his classes. He never once turned me away, and I bothered him on average, twice a week. Biomechanics was an interesting class to me- I thought it was exceptionally well-taught and well-organized. I donâ€™t say that about many GT classes, as I am usually incredibly cynical when it comes to the policies and the teaching directives at this school.

There would always be time by the end of the period, before a test that we realize that the class was vastly behind which made studying for the tests somewhat difficult.

there's a section for just MSE majors...idk why they don't just make a separate course (at least a separate title from "MSE

2001")

there's lecture & lab and lab you have 1 lab partner

This class had a very large workload.
This class is called Separation Processes. It is one of three classes known as the trifecta (a tough semester for CHBE majors). I took this class last fall. It was extremely well-structured, with constructive homeworks, two typical exams, and one group project. These problem-solving activities facilitated learning so that I was eager to come to class to learn more.

This class is probably my favorite one this semester. I really like how it is taught

This class is very good. Comprehensive and interesting
This class was a rapid fire course on 5 or 6 different programming platforms. In class, we would work individually along with the professor learning syntax of the language and building/solving problems. Outside of class we would complete extensions on the in class assignment. These extensions were somewhat open ended, which left room for fun and creativity. The professor also had realistic, yet challenging expectations. This class really made me feel confident that I could quickly pick up a language and complete projects on a deadline.
This is a group based class. Dr. Brown will lecture/speak to us as a group and then we break up into groups to work on our group project by dividing and conquering.

This is a group project based design class

This is a reversed style class.

This is an advanced PhD level class, which does not have any tests. There are only homework, and a term project.

This is for lecture only
This is the introduction to biomedical engineering problems and was pretty much a strictly problem based learning class. So some of the work (mainly research) was individual while a majority of the work was a collaboration between groupmates
this was a flipped classroom and absolutely the wrong way to teach a matlab course. It was a good idea, maybe rough execution. My peers and I struggled with this set up more than the material. It detracted from the course

This was a flipped classroom.

This was a group class activity

This was very much a lecture class, but the "lab" portion was us working with an MBED device in class.

Very interesting class in which a wide range of material is presented.

Very much a project based class outside of class and a lecture class
Very strong discussion based class. Because it was so small, the instructor facilitated fantastic discussions while also giving us sufficient support and background information to be involved in the discussions

We derive formulas and do examples.

We often have class discussions that involve the whole class, not just the professor lecturing.
When new concepts are introduced in lecture, there is often a brief group work portion in class-- and it usually entails playing with objects to give examples of their properties under various types of stresses (since the class is about deformable bodies and dynamics). Recitation is run by going through 2 of the week's homework problems. The TA breaks the problem up into subsections and students solve them in small groups, then come up to the board and go over it as a class.