CALSTEP RESEARCH SUMMARY
MATERIALS COURSE, MONTEREY PENINSULA COLLEGE, FALL 2015

Scope of research: The research included a survey conducted at the end of the semester and interviews with students and the faculty team

Key Research Findings

This was a very difficult class for many students to take and for the instructional team to deliver. It is not entirely clear how much of the difficulty resulted from the fact that (a) the instructors had not previously delivered the course and (b) the lab component was delivered at a college that did not have lab facilities

The bigger question is what is required to offer this course and how effectively it can be delivered as a hybrid where students complete the lecture online and the lab activities face-to-face, or partially so.

In a related question, it is not clear how many CA community college students intending to transfer in engineering need or could strengthen their transfer applications by having completed Materials (lecture and lab); how many and which students geographically have access to these courses; and how to build capacity statewide through online/hybrid delivery to ensure that all students have access to the course.

The overall impression from the survey and student interviews was that students who were highly self-motivated and dedicated learned a tremendous amount from this class and completed the course feeling that the experience had been extremely time-consuming and difficult, but worthwhile. Other students complained about being confused and struggling throughout the semester, noting that it was clear to them that the instructor and TA were learning the material as the class was advancing just like they were. In considering the student characteristics, it seems that the class included students with a very large number of units and another group with a moderate number of units. Perhaps more importantly, one group of students worked little outside of school or not at all, while another group worked 20 hours/week or more. It is not clear whether the students who worked more also struggled more with the course requirements. However, given the investment of time required to fully understand the course, students with heavy work commitments would clearly face a greater challenge in terms of doing well.

Among students who completed the survey most would not recommend this course to a friend.

There was widespread agreement that the highlight was the field trip to Cañada College where students finally got an opportunity to obtain hands-on experience. Overall, it seems that the limited access to a lab served as an impediment to learning for many of the students.

For the lecture part of the class, one of the main difficulties reported concerned the variety of lecturers used. The students would have preferred to have only one or at the most two lecturers. They liked Professor Erik Dunmire and the Howdy guy the best because they

established learning objectives up front and presented information that was clearly linked to the problem sets. Overall, most students found the video lectures to be “effective” for helping them understand the material and most survey respondents reported watching at least 75% of the videos on average. Students also overwhelmingly said that the quizzes motivated them to watch the videos.

Nine of ten students said they used test preparation study guides” all the time or frequently. Another major resource for the course was the Internet where students searched for additional information and answers to their many questions. Many students noted that they learned the most from doing problems together.

Still, many students had trouble being online students for the lecture part of the class. They suggested shorter videos, more use of YouTube, and emphasized how important it was for them to be able to fast forward through the material. The students would also like more indexing of the recordings so that it is easier to go conduct a search for a specific topic/subject.

Students had trouble with the labs and most students felt they did not have sufficient guidance on how to lab assignments. The survey respondents were split on whether the lab and the lecture were connected, although most students agreed that the labs taught them additional skills and concepts not covered in the text book. There was consensus that the class required a high level of fluency in Excel that many students did not have and that the implication was that, too often, the focus during labs was on how to make Excel work instead of on the content.

While many students expressed some frustration with the class, there was widespread acknowledgement that Professor Rebold offered the class because he knew that students needed it to transfer and appreciation of the considerable effort he put into the course.

Recommendations:

Before students enroll:
Make sure students know how to be successful in hybrid courses. Review what is required, challenges to anticipate, resources to access.
Teach students to more effectively watch video lectures. For example, instruct them to write down questions as they go along.
Provide information up front about how much time is required to really learn the material (a few interviewees volunteered to appear in mini-videos providing such testimony)
Make sure students understand how important it is to not fall behind
Review the requirements in terms of Excel knowledge required and consider encouraging students to take a crash course in Excel prior to enrolling
Review requirements for chemistry – some students seemed to think more chemistry knowledge would have made the class more manageable

During class:

Try to limit the number of video lecturers, index the videos so it is easier to navigate and find information, and break longer lectures into modular units
Provide more examples of how to solve problems step-by-step
Encourage students to form study groups/teams
Provide and grow a list of resources students can access on the Internet to supplement class resources

Bigger Picture:
Find out how many colleges around the state need to offer a course in Materials. Create – possibly at ELC – a map of where there is access and no access to required and high priority transfer courses for students. For example, where in the state do students NOT have access to Materials course at this time
Engage in wider conversation about which formats can work for Materials – should it be offered by colleges without labs – how much access to labs from neighboring colleges is optimal/minimal requirement – should the course be offered as a lecture with an optional lab component? If so, should some colleges statewide offer the lab?

SUMMARY REPORT

The Course and the Research Activities

Course delivery: When the Materials instructor withdrew from Monterey Peninsula College (MPC) for the Fall 2015 semester because of family issues, Professor Tom Rebold stepped in to teach the course. Professor Rebold explained it was the first time he had taught Materials noting he would have cancelled the class if it had not been for the fact that "so many students needed it [the class] to transfer or improve their transfer appeal." He also said that he would probably not have offered the class if it had not been for the fact that he at the last minute was able to recruit former MPC and current UCLA student, Adam Doorenbos to serve as TA/co-teacher.

The course model was online lectures and problem sets with face-to-face labs at MPC. The online lectures were a combination of video lectures produced by Erik Dunmire at College of Marin and other online material. Problem sets were developed by Erik Dunmire (correct?)

Unlike College of Marin where Erik Dunmire taught his Materials course, MPC does not have lab facilities for Materials. There was one field trip to Cañada College where the class conducted an experiment using the college's lab facilities.

Research activities:

Survey design: The survey was designed by Eva Schiorring (CALSTEP's External Evaluator) along with Professor Rebold and Mr. Doorenbos. Input was provided by Erik Dunmire and Amelito Enriquez.

Survey administration and collection of additional data: Students were asked to complete the survey online on December 11, 2015 during their final class meeting. A power surge or failure that occurred while students were completing the surveys erased some survey responses and almost certainly explains why only 6 students completed the entire survey.

The survey responses by topic break down as follows:

Agreement to participate (question 1)	17 (100%)
Background information (question 2-10)	15 (88%)
Effort made and learning outcome (question 11 – 13)	13 (76%)
Videos (question 14-18)	11 (65%)
Course content (question 19-24)	10 (59%)
Team work (question 25-26)	9 (53%)
Labs (question 27-29)	9 (53%)
Overall impressions and ideas (questions 30-35)	7 (41%)
Additional information for general CALSTEP data collection purposes (questions 36-40)	6 (35%)

The reader should bear in mind that the summary findings for each question becomes less representative of the overall class as fewer responses are submitted.

Interviews: Professor Rebold was interviewed in September and November 2015. TA Adam Doorenbos was interviewed in November 2015**.**
Four students, identified by Professor Rebold to represent a cross-selection of student experiences in the course, were interviewed in January 2016. The purpose of the student surveys was to try to compensate for the loss of information resulting from the power surge and lost survey information.

Summary of Survey Findings	
Background Information (88% response rate)	
#2 Gender	• Male-67%(10) • Female-20%(3) • Prefer not to state-13% (2)
#3 Ethnicity/Race	• Asian-7%(1) • Filipino-7%(1) • Hispanic-7%(1) • White-47%(7) • Multi-racial--27%(4) • Prefer not to state-7%(1)
#4 # of semesters of attending a community college	• Range: [3,15] • Average: 7 3 respondents had been enrolled for 10 semesters or more and 7 for 5 semesters or less
#5 Enrollment by units all semesters	• Range: [51,240] 6 respondents had accumulated 99 or more units with one student noting they had accumulated “at least 240 units.” 4 students were in the lowest number of units category of 50-59.
#6 Hours/week working	• Range: [0,30] • Average: 15 2 students did not work and 2 students worked 4-5 hours/week. 5 students worked between 12-16 hours/week and 6 students worked 20 or more hours per week.
#7 & #8 Did students have jobs related to engineering (or math/physics)	4 students were bartenders, 2 were valets, and 2 were waiters; 3 students were tutors, including an MPC STEM tutor; 1 student was a swimming coach. One of the students

	had three jobs, holding two different jobs as a waitress and also serving as a nanny. Two students only reported having jobs related to engineering/STEM
#9 Reason for taking the Materials course	• The course is required for all transfer students in my major at my desired university-40%(6) • Completing this course may increase my chance of being accepted into my #1 transfer institution-33%(5) • I have to take the class at some point and it is less expensive to take it at a community college-13%(2) • Completing the course at a community college will allow me to graduate from university in fewer semesters-7%(1)
	•
#10 What would students have done if the Materials class had not been offered?	3 respondents said that their transfer plans would have been compromised without the class. "*I many not have been able to transfer to certain UCs. Chances at other schools would have been diminished. The availability of this class really increases our opportunities*" 2 respondents pointed to the content, noting that they had learned a lot from the class: "I would have been a lot less prepared for transfer [without the class]," one student noted. Another student wrote that: "I would not have been exposed to this field of study and would not know how much other subjects tie into one core subject." Other students said they would have had to take the class after transfer. One student noted the additional cost of doing so and one student said he would have had to transfer with fewer units completed. Two students said they might have been happier not taking the class because it was hard and they would have had to take another class instead that fit their major better.
Effort and Learning (76% response rate)	
#11. Average hours spent/week on both lecture and lab	Lecture/video viewing time ranged from 1 to 8 hours per week (see table below) with an average of 3 hours of lecture/video viewing and 4 hours of lab preparation and work. The effort invested varied most in terms of time spent on lecture/video viewing with most students (7) spending 2-3 hours per week and 3 students spending 4-5 hours per week. The student who indicated he spent the most time (8 hours) on the lecture/videos spent the least amount of time on the lab (1 hour) and may have misunderstood the question.

<table>
<tr><td></td><td>It terms of total time spent on the class, the average was 7 hours with 4 students spending 9-10 hours and 2 students spending 5 hours per week</td></tr>
<tr><td>#12 Hours student EXPECTED to spend before the class started</td><td>
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<tr><th></th><th>Actual Lec/Video</th><th>Actual Lab</th><th>Actual total</th><th>Expected</th><th>Dif Total Expected</th></tr>
<tr><td>Student</td><td>2</td><td>4</td><td>6</td><td>4</td><td>2</td></tr>
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<tr><td>Total</td><td>40</td><td>54</td><td>94</td><td>86</td><td>8</td></tr>
<tr><td>Average</td><td>3</td><td>4</td><td>7</td><td>7</td><td></td></tr>
</table>

The average time actually spent and the average time students expected to spend came out the same a 7 hours/week. Nine students underestimated how much time they would spend on the class while four overestimated the time commitment they had to make.</td></tr>
<tr><td>13 Hours student WOULD spend on the class if they could start over, if this was the only class they were taking this semester AND if they wanted to do as well as possible</td><td>
Range: [4,30] – Average=13 hours
Eleven of 13 respondents indicated they would spend 8 hours or more per week on the class if they could start over and this was their only class. Among these students, eight respondents thought they would spend 10 or more hours on the class per week and several of their class mates indicated that they would dedicate more than 15 hours to the class per week, including one student who said he felt he would need to spend 30 hours/week to understand the concepts.</td></tr>
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The Videos (65% response rate)	
#14 On average how much of each video lesson playlist did the student watch?	• The entire lesson-18%(2) • More than 75% but not the entire lesson-36%(4) • 25%-just under 50%-9%(1) • Less than 25%-18%(2) • Less than 18%- 9%(1)
#15 Did quizzes motivate student to better prepare for class?	• Yes-73%(8) • Not Sure-18%(2) • No-9%(1
#16 What did the student do when watching videos**?**	The activity most students reported doing when watching videos was "taking notes" and "stopping and repeating things they did not understand by scrolling back (5 of 11 students reported they "always" performed these activities when watching the videos) All survey respondents--11 of 11 -indicated they "never" write down questions while watching videos. In a distant second and third place among activities that a larger number of students "never" did was "email professor Rebold or Adam" (6 of 11) or contact a friend in the class (5 of 11)
#17 How effective did the student think the videos were for helping them understand the material	• Effective-73%(8) • Not effective-9%(1) • Other18%(2) In comments, 4 students pointed out that the different instructors featured on the videos made it harder for them to follow/understand the material and two students pointed out that the effectiveness of the video often depended on who was delivering the lecture: *"[The videos were]….helpful for understanding some of the concepts, but nothing technical (math portions). Also found that homework, labs, exams, and the book seemed different from the lecture videos. Also difficult when videos are coming from many different institutions (UCD, UoT, UT A&M, Cal Poly, College of Marin, etc.)".* *"The videos alone were not efficient enough for us to comprehend what we needed to prior to lab. They were extremely helpful but there tended to be some lack of relation between what the videos would focus on and what the labs would focus on, although they were on the same subject."* 3 students had nothing but positive things to say about the videos:

	"The videos were a concise way of conveying the content so that we could understand them."
#18 Students' ideas for making the videos more effective	Several students spoke of how long some of the videos were and three of 11 respondents proposed a modular approach and more use of YouTube. Students also wanted more consistency in the delivery. "*More YouTube and only one instructor*,"one student noted. Several students said they had managed by fast forwarding. Some students felt that the videos did not always correlate to the lab. "*Get lectures and videos from the same source so that they focus in on the same topics and we don't spend a lot of time just trying to comprehend the lab.*" Another students wrote: *"I wish Eric made all the videos because I like his pace and he is the one who writes the exams. I like his way of explaining because the homework problems related directly to the stuff he talked* about." Two students mentioned that they would have liked for it to be easier to search for and find information. One student proposed a weekly debriefing: "*Maybe a night from 6-9 pm where we come in for a debrief about what each video says and how to start the homework."*
Course Content (59% response rate)	
#19 How much did students feel they learned from each activity	90% (9 of 10) students feel they learned the most from participating in the field trip and the lab activity at Canada College. Seven of these students rated the field trip a "5" on a scale from "1" to "5" where "5" is "learned the most." Five students gave the following three activities a total of five "4" and "5" ratings with most of the ratings being a "4": "Finding my own information," "test preparation study guide," and "being in class completing the quizzes." The activities that most students felt they learned the least from included preparing for the lab and competing lab data analysis and exercises; these 2 activities were given a "1" or "2" rating (with "1" being learned the least) by 6 of 10 students.
20 What did the students think were the most effective ways to learn	Five of eleven respondents felt they had learned the most from working on problem sets and most of them said that the most learning had taken place when they done so in a group with other students and access to help from the instructor and TA. "*The review sections tended to be most helpful for learning because we were able to apply the information we had been working on in the labs*." "*I found that if I could explain the material to another students, I had successfully learned the lesson*."

#21& 22 What were the hardest concepts for students to understand? What made them difficult?	Phase-diagrams were mentioned by four among 11 respondents. Crystallography came in second place with three students finding it difficult. Three students mentioned doing calculations, "excel" and developing stress strain graphs noting "*I get mixed up on how to calculate certain numbers on the graph*" and "*Using excel effectively is difficult*."
#23 How often did student use different resources to help learn the material?	Half of the respondents indicated they used Internet research they conducted on their own "all the time." Three students used Internet research "frequently." Nine of ten students said they used test preparation study guides" all the time or frequently. Eight of ten students gave similar ratings to "study group" At the other end of the spectrum, 5 students said they did not use drop in sessions with Adam and with one additional student indicating he used this resource "rarely." Seven of 10 students indicated they only rarely (4) or never (3) emailed with or came to office hours with Mr. Rebold.
24 Possible time for additional class meeting	• MWF 8 am - 9 am-60%(6) • M / TH 2pm-5pm -10%(1) • TU 6 pm - 9 pm-30%(3) • W 2 pm - 5 pm-60%(6) • TU/TH 6:30 pm - 8 pm-40%(4) • TH 6 pm - 9 pm-40%(4) •
Team Work (53% response rate)	
#25 How often did you work in teams?	• Always-78% (7) • Sometimes-22%(2)
#26 what did you like the most about team work?	Most students liked the lessons learned from team work. 6 students gave the highest ratings (4 and 5) to indicate they felt they liked what they learned from " having to explain concepts to those who were less prepared than themselves." "Learning to solve problems together" and "learning to be part of a team" received the two highest ratings from 5 students. Only 1-2 students indicated that they did not like the lessons learned from being part of a team. As an example, two students indicated they had liked the least to "learn from making mistakes" while working with others.
Labs (53% response rate)	
#27: Agreement with statements related to the labs	

	Six of 9 students disagreed (1) or strongly disagreed (5) that they had sufficient guidance on how to do the labs, Three students disagreed and 1 strongly disagreed that there was a strong connection between the lecture/class components and the lab activities while 4 agreed that there was such connection. Three students strongly disagreed that they understood the lab learning objectives before and after the lab. Five students agreed they understood the objectives after the lab while 3 agreed they did so before the lab. Five students agreed that the labs taught them additional skills and concepts not covered in the text book while 2 strongly disagreed and 1 disagreed with this statement.
#28: What did you like the most about the field/lab experience at Canada?	The most popular activity in the class was the Canada site visit (see below). In comments, students highlighted the positive impact of the lab experience on their learning: *It was the best part of the class. The machines and environment were awesome.* *We actually got to use the concepts we had learned in class in a real materials lab* *I loved the hands-on experience. Getting to learn how to use the equipment in the lab was handy and I was talking about it to all of my peers.*
Overall Impressions and Ideas (41% response rate)	
#30 Like best about the class	Three students pointed to the field trip to Canada (although one wrote about the dinner after the experiment); Two pointed to Professor Rebold and one said the class would help him meet transfer requirements
#31 Like the least about the class	Students pointed to the class being disorganized and several said they often felt confused and that the class was difficult. One student was surprised about the need for advanced chemistry given the prerequisite.
#32 Ideas for improvement	The suggestions all concerned the delivery format and instruction. Students wanted an actual lecturer (1) , actual labs (1) and less confusing instruction (2). Two students wanted less emphasis on excel

#34 & 35 Would you recommend the class to a friend? Why or why not?	• Recommend-14%(1) • Not recommend-71%(5) • Other -14% (1) *I would suggest to a friend to have more advanced chemistry knowledge before attempting the class. Also to watch all the videos and take notes*
Additional Information for Engineering Students (35% response rate)	
38Have you visited Engineering department in the universities you are considering to transfer?	Yes-50%(3) No-50%(3)
40 Importance of reasons for being the engineer	5 of 6 students regarded as the most important reasons for becoming engineers that: "Job prospects for engineers are good", "Engineers create things", and "Engineers can work all over the world" as the most important reasons. The least important reasons for becoming engineers were: "people look up to engineers" and "my family wants me to become an engineer.".

Key findings from student interviews

The interviewees agreed that the class was extremely difficult and required a very big effort that involved many more hours of study than they had anticipated. One of three felt it has been well worth the effort: "*I feel I learned a ton"* adding that he felt he would have a huge advantage if he has to take the class again after transferring. Two other interviewees underscored that they had felt confused a lot although one of them also expressed that he would be very well prepared for another materials class if he has to take one post-transfer.

As was the case in the survey, all the interviewees identified as a highlight the site visit to Canada. "*It was applicable and you could really understand what was happening. It was not just calculations*," one student said.

The interviewees generally liked the videos, although one student said he never got used to the online delivery. Erik and the Howdy Guy were the favorites while "*other videos did not really seem to relate*." One student said that he like how Erik and the Howdy Guy "*identified objectives for their lectures at the beginning*

Students felt that there was an expected level of familiarity with Excel that many students did not have and this made the class very difficult for them. One student said that struggling with Excel "*took away from the content of the lab – I was so busy figuring out how to make Excel work that I lost sense of the content*. "

Key findings from interviews w instructional team

This was the first time professor Rebold delivered this class. He did so after having to step in and take over from another MPC instructor who with short notice decided to not teach at all during the Fall semester. Professor Rebold came close to canceling the class, but then found that Adam Doorenboos, an outstanding student who had studied with him before transferring to UCLA was in the area and willing to serve as TA/Co-instructor. Adam proved invaluable, according to Professor Rebold who advised everybody else considering teaching the course to find a grad student who can co-teach. As a starting point, they may want to talk to four-year colleges about hiring one of their students in Master's/Ph.D. program

The course was very difficult to deliver from the instructors' perspective. They both struggled with the lab assignments and spent much more time preparing for class than they had expected. Professor Rebold said that "this is a hard class to deliver online/as a hybrid" and wondered about the possibility of offering only the lecture component (and not the lab). The decision to move forward with the course as a 4-unit hybrid on-line lecture- in-person lab was largely due to Professor Rebold's commitment to his students. As several of them pointed out in the student survey, they needed the course to transfer or to strengthen their transfer candidacy with their top transfer institutions.

Another question raised is whether the lab can be offered by schools that do not have lab facilities on campus. In the past, MPC students have used the nearby Naval Academy's facilities, but with a large class this may not be feasible. The one site visit to Cañada was extremely valuable, but the students had only that one opportunity for hands-on application. The question is what to do next time if enrollment remains high

TA/Co-Instructor, Adam Doorenboos had the following advice to others considering teaching the class:
-before you teach the class, go through every step of the labs, planning to spend 5 hour per lab
-take the class before you teach the class – may want to try as online student
-make sure students have at least a basic level of knowledge of Excel or another data analysis program requiring plotting, line fitting, data operations
-make sure students have read the lab notes and watched the videos before you do the lab experiments (but how do you ensure that everybody is thus prepared?)
-use animation – the more the better to help visualization. One challenge from not having access to a lab, Adam added, was that "you just have the printout and the computer screen" but you don't "see things happening."

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