

SKILLFUL TEACHER PROJECT

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0 - Introduction. I found the Skillful Teacher course to be a really challenging and provocative experience. The course gave me plenty of concepts and ideas to think about. Though I did not agree with every single detail that was taught in the class, I did find myself reflecting quite a bit on some of my own presuppositions about teaching theory and practice. I found the conversations with colleagues and instructors helpful in reframing some of my previous assumptions as well as in solidifying some of the better practices and philosophies I have adopted over the years in my teaching.

For the purposes of this project, I wanted to examine three areas which I found particularly interesting in the course. I have categorized these areas as 1) Data and Reflection; 2) Formative Assessment; and 3) Feedback. Each section below outlines an attempt at applying the ideas to a particular scenario in the classroom. One important factor to note is that the second half of the 2019-2020 academic year was interrupted by the outbreak of the COVID19 virus. Therefore, the content in sections 1 and 2 was developed in the context of online learning, while the content in section 3 was developed in a traditional classroom setting.

1 - Data & Reflection using Google Forms (Math 433, Math 454, Physical Computing). One example that Deb Reed showed us during the class involved a mathematics teacher in Boston who constantly collected data during the course of the school year. Her classroom was filled with posters of graphs of various aspects of her class - student views on pacing, goals for improving assessment performance, etc. The teacher collected data very often and used it to change her practice in real-time in response to student needs. She would also track the data over time to see if her methods were successful in improving student outcomes. I found the idea very interesting and wanted to apply it on a small scale during the online learning environment which resulted from the school closure in the Spring. To that end, I sent all my students a Google Form which asked them to provide feedback on the schedule and work expectations for the online learning system I developed for them. The overall feedback happened to be quite positive, but there were several comments which helped me refine and improve the online learning system to make it helpful to my students. Among the changes I implemented which I learned from the gathered data were:

- (1) Assigning no more than 3 assignments per week (two formative, and one summative).

- (2) Providing videos in addition to transcribed notes to facilitate learning.
- (3) Adding an additional online office hour per class per week to help those who would like more contact with the teacher.

The data collected from the survey is attached at the end of this document for reference.

2 - Formative Assessment Using DeltaMath (Math 433). An important lesson I learned from the Skillful Teacher class was on the priority of using formative assessment to continually gather data about how well students are understanding during instruction. When we shifted to online learning, formative assessment took an extra level of priority since I was unable to see my students in person to evaluate how best to help them. As a way for students to practice their trigonometry skills in addition to the homework, I selected the DeltaMath software platform to provide a weekly formative problem set for students to practice with. There were several reasons why I chose DeltaMath. First, the platform is self-grading and gives students feedback right away. In addition, it provides step-by-step answer keys for the students to look through to find their mistake. Finally, it gives additional attempts in order for students to go back and fix wrong answers. I used DeltaMath once a week with my Math 433 students, and it appears to have helped them gain more confidence and perform better on the summative assessments. Below is feedback from four students from my classes:

“The assignments without grade penalty were extremely helpful, because I did not have to worry about the consequences of incorrect answers, giving me the motivation to practice. As I was adjusting to learning math through the computer as well as the more complicated trig problems I thought that the Delta Math was a great way to practice. If I was confused on a question, I was able to repeat similar problems until I understood it without worrying about how it would affect my grade, helping me understand the material as well. When I got a question wrong, I wanted to do better. I became more motivated to go over what I did not understand, and once I was getting questions correct, I wanted to practice more. This practice eventually helped me concentrate on the information, which later made me understand the problems. If the assignment contributed to the final grade, I would not have practiced more because I would have been afraid I was losing points that I did not need to. Instead of focusing on getting a good grade, I was focusing on learning the material, which eventually worked to my benefit in later, graded assignments. By not having to worry about the consequences incorrect answers would have on my grade. I practiced more, which ultimately helped me understand the material and do better on graded assignments.” - Math 433 Student

The Delta Math quizzes we took were somewhat effective in allowing us to practice. When I didn't know how to complete a question I was

able to watch the video or look at an example problem to help explain it to me. It also showed me what I did and didn't know about the current topic; however, I wasn't as motivated. I went right into the "quiz" without studying like I would typically do. Since it was not graded I didn't try as hard as usual, but an assignment like this could help me study for something that is graded. When I went to study for the graded quiz I went back to the earlier Delta Math to continue my practicing. I thought this was very helpful to review and complete problems that I had not seen before. Overall, assignments like this can be helpful to practice for something that is graded." - Math 433 Student

"Using Delta math and having the ability to practice and apply the concepts we learned in class with infinite tries was very helpful for my conceptual understanding of trigonometry. Oftentimes I feel with tests you study not to understand the topic, but to get the question right on the test. With the inherent stress and pressure to succeed in high school, finding ways to practice your conceptual understanding, through platforms like delta math, I think can be really helpful. Being able to practice applying a certain mathematical concept with infinite tries really allowed me to make sure not only I understood the topic, but mastered it. I found the platform delta math to be great in being able to practice specific areas of trig that we learned in class, and test my knowledge. Furthermore, without the stress of getting a question wrong and being penalized I found myself digging much deeper into my notes and understanding not only to produce the right answer, but understand why that's the answer. Using these kinds of platforms that allow infinite tries really allow a student to become more aware of their strengths and weaknesses. After using delta math I found myself understanding certain subtopics that I needed more work on without being penalized for it. I also think psychologically I was more likely to answer a given question correctly and dig deeper into my understanding of the topic because I didn't have the idea of being penalized for a mistake in the back of my mind. I personally think these kinds of assessments that aren't graded are really beneficial and allow me to understand trig more." - Math 433 Student

"Personally, I think that one of the main causes of stress and anxiety for students, regardless of the current situation, is that of grades and how they can impact the future. No matter how small, even if it's just a 5 question quiz, we always think of large-scale consequences that can result from only getting a single question wrong. A formative assessment, such as the DeltaMath practice, has definitely helped to alleviate that pressure and in turn has increased my capacity to learn and absorb information at a faster rate. Infinite chances to get the question right coupled with tutorials on how to complete the questions has made DeltaMath a great program, even if it is not always user-friendly. After a few rounds of practice, I was able to familiarize myself with all the specifics of

the program. Moreover, having practice questions in the form of a quiz (even though they don't count as a quiz) has prepared me for future assessments on the subject. Overall, DeltaMath is a great program that can be used to give formative assessments to better understand a given topic." - Math 433 Student

3 - Criteria Analysis (Math 454). I found the discussion on giving feedback to students particularly thought-provoking. In particular, I was struck by the fact that often my assignments are not as clear as they could be. In my calculus class, I wanted to give a formative assessment on the topic of optimization. I thought this would be a great way to test the idea of providing clear criteria beforehand and then providing feedback that is nonjudgmental and objective based solely on the criteria. Below is the outline of the criteria and problem that I gave my students, along with my own reflection after having conducted the exercise.

- (1) **OBJECTIVE:** By the end of the lesson, I would like students to be able to understand how calculus applies to optimization problems. They should be able to demonstrate this understanding by taking the problem and setting up a function which models the optimization scenario; taking the derivative of this function and algebraically manipulating the derivative to identify the critical points of the function; finally, performing number line analysis to show that one of the critical points is the correct optimizer and presenting a concluding final answer to the problem.
- (2) **CRITERIA FOR SUCCESS:** The complete student solution must include:
 - (a) An opening sentence which identifies the goal of the problem (i.e. the quantity that needs to be optimized).
 - (b) A well-defined function of one variable which describes the quantity specified in (a).
 - (c) A correctly-computed derivative of the function in (b).
 - (d) Identified critical points of the function via the derivative in (c).
 - (e) Perform number line analysis and identify the correct optimizer.
 - (f) Concluding sentence with final answer to the problem.
- (3) The formative assessment was the following problem (with 15 minutes of time in class to complete it):

Problem. The combined perimeter of a circle and a square is 16. Find the dimensions of the circle and square which produce a minimum total area.

- (4) **REFLECTION:** This exercise turned out to be extremely valuable for me in shaping the way that I think about giving feedback to my students. In many ways, mathematics is very suited to giving feedback as opposed to guidance or evaluation, because by its nature, most of the type of problem-solving required to be successful can be broken down into a systematic

procedure. I have used this kind of a rubric whenever I have graded examinations and other final cumulative assessments. However, I have not made a conscious effort to do this during formative assessment. In particular, with this exercise, I was making a conscious effort to carefully spell out the steps and expectations I wanted to see when the students handed me their assignments. Most of them were able to meet these expectations not only because they had the technical ability, but because they had clarity on what I was asking of them. What I realized through this exercise was that in most instances in my classroom when doing formative assessment (for example in homework), I am not as careful about spelling out my particular expectations, and therefore the students are sometimes unclear about what needs to be done. However, I do find this to be a point of tension to carefully navigate, because as a teacher, I also strongly value creativity and out-of-the-box thinking when working on problems. Sometimes, I feel that spelling things out too much can be a hindrance in terms of developing good thinking and problem-solving ability (particularly in mathematics). But this was a helpful corrective exercise for me in helping me see the importance of being clear about criteria in a way that is helpful for students. I will be much more conscious about striking the balance well between being clear but not spoon-feeding in such a way as to inhibit creativity.

Which course are you in?		What do you like about our learning structure so far?		What would you like to change about our learning structure?	
Main 433	It's good	No real changes needed			
Main 433	I like the ability to ask questions and to further in detail about problems.	Nothing in particular. Would rather be at school.			
Main 433	I can take the notes at my own pace and I am able to spend extra time on anything I am confused about so I can understand everything fully.	Nothing. I think it's good.			
Main 433	The fact that we have a schedule of work one day and zoom the next. It's very consistent and I appreciate that!	I like how it's going			
Main 434	I like the pace and the ability to ask questions. I also like the feedback given on our homework assignments.	I think that it would be helpful to post a homework answer key with the steps and answers			
Main 434	That we get all the assignments at the start of the week. You provide videos and notes explaining the topic.	More review of how to do problems.			
Main 433	I enjoy that our meetings are recorded just for asking questions instead of trying to catch full lessons.	The work is very very challenging and I feel like two days is sometimes not enough to do it.			
Main 433	That we can do stuff on our own schedule so far I feel like an evening 11:15 after than 10 in school	nothing			
Main 433	I like how structured our learning is - I like knowing beforehand the exact times of our Zooms and when homework are due. Takes away the stress of having to worry about an unknown due dates.	Especially as we start learning more new things I would appreciate if you post more videos of explanations of our lessons. I know for some people, me included, it's easier to learn things by listening to someone's voice as ap			
Main 434	Helps me learn at my own pace. I think it's clear I get myself distracted in the classroom, so this helps me, to a degree	I actually like it as it is now. I think it's the best that can be done with a poor system to begin with. The way this has been working is far beyond what I had expected though. I think 2 homeworks and the ability math is actually			
Main 433	(I pressed the submit button before finishing by accident, my phone bugged!) as I was saying, this helps me go at my own pace and work with my personal distractions. It's no secret I get myself distracted during class time				
Main 433	I like how we alternate work and zoom days so we have time to process the material and prepare questions.	I like our structure but the class how it is!			
Main 433	I like that the work is due every few days instead of daily. Also I like that most of the work is posted in the beginning of the week so I can do it quickly.	Nothing much, but I sort of like morning classes better because it motivates me to get up. Many people probably don't feel the same, though.			
Main 434	I like getting assignments before each class	I don't think there's anything I'd change it's going well now			
Main 434	The comprehensive lecture notes	Sometimes it is hard to read your notes during live zooms and I feel like sometimes we rush through questions too much during zooms			
Main 433	I like the amount of work we are being given. I think it's a good amount of material to the point where we are learning new topics, but not too fast. I also like how we are given Monday as our day to process and review material	I think the biggest problem comes from the Zooms. I feel as though they aren't effective. We only have 25 minutes and I think it's unfair how certain people ask multiple questions throughout the period, taking up a lot of time			
Main 434	I can do the work on my own time	Go through the lesson in a zoom call even if the call is optional			
Physical Computing	Everything	Nothing			
Main 433	Overall, I think the structure is great in my opinion. Learning the concepts based on lecture notes is a lot more effective than synchronous learning, especially considering the size of our class and the fact that classes are only	I think it would be helpful to hold office hours during one of our other designated class times during the week. In our section, there's one student I think you know who who usually takes up most of the class time to ask their c			
Main 433	I like that we have time on our own to take notes, and we can take as much time as we can, and then ask you any questions we still have. It helps with the issue of short Zoom classes and going too fast in the so short period	The only thing I would like to change is getting emails when things are posted. I don't know if it is possible for School Wires or Delta Math, but on Google Classroom we get notified every time we get an assignment, which is			
Main 434	that we go over homework	maybe teach the lesson the beginning of the week then Tuesday zoom) and then we can have homework due based off that? It's a little hard to learn the lesson from notes personally)			
Main 433	Not too much work, and allows bits of time for assignments	Maybe teaching the material over zoom would help. It's hard to self teach sometimes			
Main 433	Online lecturing, lecture notes are helpful	Possibly making sure to go over the homework for each lecture, rather than focusing on new material			
Main 433	I think that understanding the challenges we are facing, it is very good for the situation we are in. I feel like at least in math, I have been able to mostly understand the subjects we are learning.	I wish that teachers could do more lessons, so that the topics could be taught more thoroughly. I do not feel like two 25 minute sessions per week is enough to teach complicated subjects well.			
Physical Computing	Very fair amount of work which teachers and enforces at a perfect ratio	No complaints right now... maybe google classroom would be easier but it's not necessary			
Main 433	The set schedule where we can attempt the lesson by ourself and use our zoom as a review.	Nothing, seems to be working well and I am understanding the lessons.			
Main 433	I like how you answer our questions on the homework (during class)				
Main 433	I like the schedule we have. It makes it very easy and allows time to process				
Main 433	I like how we can do assignments on our own time and how we have class periods to ask questions.	It would be great if we had video lessons in addition to our do now notes because it's sometimes hard to understand just the notes.			
Main 434	I like that you post everything at the beginning of the week so we have time to do the assignments at the beginning of the week and (if we do them) actually have questions related to that work for our Zoom calls.	Maybe there could be video lessons on the notes to help us understand them a little bit more			
Main 434	Work	Nothing, it's great!			
Main 433	Well organized. I always know what I have to do and when it's due	Nothing, just offer office hours to help if they need it and make sure you give our answer keys to the homework so we can properly check it over			
Main 433	I like that the program is structured weekly and does not particularly change around. Many of my other teachers change the days they are teaching week to week and this can be frustrating and hard to keep up with.	For the most part I think math has been one of the most productive classes in terms of learning and there isn't much I would change.			
Main 433	I like that we have two days to complete the lesson/work, and that there is an appropriate amount of work.	If I was able to change anything, I would change how the notes are delivered. I think that sometimes it's hard to comprehend your notes on the lesson, and I think that some would agree that a screenshot, or video would be r			
Physical Computing	I like our consistent scheduling and how our assignments are always assigned a few days before it's due so that I don't have to work last minute on projects/HW.	I believe that longer periods (35 or something mins long) would be more productive rather than trying to cram everything into 25 min long periods. Less people but longer periods.			
Main 433	I like the time at which our classes meet	I wouldn't change anything			
Main 433	I don't think anything needs to change.				
Main 434	Amount nothing because I find it hard to focus in class and its easier to be taught through a lecture video than a live zoom class	For me it would be easier if the lesson was taught over a lecture video			
Main 434	I like how our class time is spent going over homework questions	I like this 2 day class structure where we do a do now and homework and then go over it in class. It seems to make the most sense given the limited time			
Main 433	I enjoy that we have class two times per week and that we are allowed to ask questions about the homework during those two class times.	I would like to change the way the weekly notes are presented. I know that it is a lot of work for you, but I find it extremely helpful when I hear you talk out how to do a problem rather than looking at a paragraph explaining the			
Main 433	That we go into the lesson and the homework and we can ask any questions.	To have the topic explained slightly more clearly during zoom class			
Main 433	It's pretty good overall	I wish HW could be done solely using a digital device			

Dr. K Online Learning Feedback