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Emphasizing Experience and Refelction during Online Math HW

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Emphasizing Experience and Reflection during Online Math HW IP Final Project

During math class, students are asked to listen, read, write, speak and think in order to interact with the content. Best practices (and our own experiences as learners) dictate that none of the first four are particularly meaningful without the last, and so, to facilitate each student's learning process, we as the professors employ a variety of tools. We structure our lessons in a way that tie in the content with what students already know, we use example problems that call back to previous solutions, present the answers in various visual forms and math notations and ask probing questions during the lesson. Most of all, we encourage collaboration during the class work time and often redirect clarifying questions to students' peers, only jumping in when totally necessary.

To truly master the math content, students must practice outside of class as well, hence why we assign homework. For all but the most conscientious students, however, homework doesn't always achieve the goal of reinforcing the material through thought and reflection. Often, students fail to read the entire question, forget to use their notes and examples when stuck and most likely, merely follow rote processes without any more consideration as to how each step fits into the larger problem and why it is important (or in some cases, not important!). Much of this can be attributed to a lack of reflection on the work students are doing and is often the reason why students may perform poorly on quizzes and tests weeks down the road.

When students are in class, we as pedagogues use a variety of tools to facilitate meaningful student reflection, and we're able to praise what we see as quality and quickly correct what isn't valuable. Once students leave and are no longer under our watchful gaze, how can we ensure that students are still thinking and reflecting on the homework they are doing?

To answer that above question, both myself and the students in my Spring 2018 Stats and Pre-Calc classes made small changes in the way we did things to emphasize two particularly relevant facets of the Ignatian Pedagogy Paradigm: experience and reflection. To facilitate a higher awareness of experience, I emphasized at the beginning of class and throughout the semester to students that they should use their notes and classwork as a guide but not a crutch, so they could practice the application of new skills and synthesize them into their toolkit. To do the same for reflection, I provided multiple tools for students to meaningfully check their work (desmos.com, wolframalpha.com, Microsoft Excel), but required that they write down their work/reasoning as well. To take it a step further, I also showed students examples of good notes from previous semesters, I modeled good note-taking during each lesson in the structure of each slide in my presentations, I had students bring in their computers to use the websites and applications as a way to check their classwork, and perhaps most importantly, I collected their written HW and looked through it after each class. None of these changes were particularly drastic, but going into the semester, I as the professor felt that if I demonstrated my own steady commitment to collecting homework

and giving students tools to use at home, students would value the IPP principles behind these tactics.

To evaluate the efficacy of the actions I took and asked students to take, I asked students to respond to a four-part question during the last exam of the semester, which helped ensure that students would answer the questions thoughtfully and clearly. I did not feel it appropriate to do any quantitative self-assessment based on students' grades, as there are too many contributing factors when it comes to a course's grade distribution, not least of which is my own increasing familiarity with Arrupe's students and how best to fit in the skills and content of my courses with their own pre-deposited knowledge. The students' qualitative responses provided lots of meaningful feedback and areas for growth.

The four-part reflection question was the following: "Reflect on the HW assignments you've completed on MathXL and written on paper. (1) How much does MathXL help reinforce the concepts you've learned in class? (2) When you're doing the HW, do you merely repeat the steps from the classwork/example, or do you think meaningfully about what the question is asking and try to answer it before looking at your work? (3) Do you think writing down the HW helps you think and reflect on the new concepts, and why or why not? (4) If you were the professor, what would you do differently in terms of the HW?" I did specify that I wanted at least four sentences as a response, and almost all students answered all four questions and dedicated a sentence to each.

The student responses were well thought out, and after some of my own reflection on not just what each student wrote but also how it tied in with how well they did in the course and my own perception of their progress, I came to two conclusions. Firstly, and quite obviously, more confident math learners self-reported that they were more reflective and attuned to their HW experience than did struggling math learners. In addition, nearly all students self-reported that the writing down of the HW was a meaningful task when it came to learning the new math skills/content.

The Pre-Calc class I taught this Spring was small, with only 11 students, and contained a surprisingly diverse set of math learners in what is not an introductory class for Arrupe students. Most of the students had taken courses with me before and so were familiar with my routines and insistence on the value of writing down the HW. In fact, all appreciated that I now collected the written HW each class, as in the past I had somewhat arbitrarily chosen when to do so. The students in this Pre-Calc class were asked to do an objectively large amount of HW, and while all of them rose to that challenge, I as the professor found that the two to four hours of work that students often needed to spend after each class might have been a bit too much.

A few student responses were indicative of the larger sentiments of the class. Most students understood very clearly that the HW on “MathXL, in [their] opinion, is just a way to practice what we did in class,” something that is of utmost importance for math learners to buy into. Many students did reflect that they “do think about what the question is asking,” but a few of the students who didn’t do as well in the class reported “try[ing] to merely repeat the steps from the classwork” without focusing on why they

were being done in that situation and what other ways might also work and/or be more efficient. A few students reported that “there are times where I can do the problem without the need of my notes, though there are times where I have to back because I forgot how to do certain steps,” which demonstrates quite clearly how most students, in my experience, learn math at the college level. Two students admitted that they “always did [their] work with [MathXL] because [they] liked doing it,” which is wonderful and slightly indicative of the thought students put into the work so that it often rose above boring rote practice.

The two Statistics classes, with over twenty students each, showed a similarly diverse set of responses about the HW, which was also on MathXL. Stats HW is more reading-dependent and content-heavy than that of the skill-based Pre-Calc. Paired with the fact that the course is currently a requirement for all Arrupe graduates, Stats students have often struggled more on the HW because it requires close reading and attention to details in which students may often not be as innately interested. Homework perseverance in the two Stats classes, however, was quantitatively higher this semester than in semesters past, and the sentiments that students had in their reflections aligned with that.

One student wrote: “at first, I try to do my work without notes, [but] if it gets too difficult, I use my notes.” The same student felt that writing down the HW helped him think and reflect on what he was doing and the writing down made the steps stick in his head better. Another reflected that her approach was largely what I was trying to avoid; she said that “when I’m doing the HW I just repeat the steps from the classwork and don’t really give much thought.” Since she does write them down, it helps during the

open-notes quizzes or tests because she “can look back at my work to figure out how to do it again.” This signals to me that the student was not mastering the material before the test and oftentimes was just matching previously written work with a question that looked similar – a recipe for memorizing the processes of but not understanding math!

A non-insignificant number of students did use the word “memorize” in their reflections, a sign to me that I still have work to do in helping students meaningfully connect the new topics of the class to their existing understanding. One student wrote a four-sentence reflection that I found to be both very honest and indicative of the sentiments of a large chunk of the students: “The Math HW helps me practice and writing it out helps me because I have something to look back at. I do repeat the steps from the classwork onto the HW, but I also think about [what I’m doing]. I never really liked writing out the HW because I always thought it was extra. But, with this [last] unit [on Hypothesis Testing], I feel like it is essential that I wrote it down because if I do not draw the graph for the Rejection Regions, I do not get it right [there’s also a drawing of the graph, which is a bell curve with shaded ends]. I wouldn’t do anything differently because this HW has helped me practice.” This student verbalized an understanding that math learning goes beyond the rote, and while it is often more convenient and less work to merely copy steps on homework, it leads to a lack of understanding on tests and quizzes, so the student does try to think deeply about both the minutiae and bigger picture to comprehend the content and skills more deeply.

Where do I as the professor go from here? Certainly, I will continue to ask students to write down the homework, model what doing that well looks like and follow

through with collecting it myself, because it has led to enhanced reflection on the part of the students. Less clear is how I can continue to push all learners to move beyond the rote into the synthesis and understanding of the math content and skills in my Stats and Pre-Calc classes while their doing the HW. As I discovered from their reflections, students are at different places in their approach to math, and while in class, I often pair them up heterogeneously so that more struggling learners can watch and even participate in the higher order thinking some of their classmates are doing, that is not feasible or even desirable for individual HW. Additionally, on tests and quizzes, I've found that open notes encourage students to be more organized and thoughtful in their work before the test and also puts some of the more apprehensive math learners at ease, two positives I don't want to remove.

Finding answers to the question of how to help students more deeply engage and experience the material is without a doubt a lifelong quest. The solution I will put into practice this summer is a small one that will meet each student where they are in their understanding and comfort with learning math and will hopefully be a spring board to even more exploration towards this goal. Quite simply, I will ask students to pick one question or problem they worked on for each HW assignment and literally explain their work in a few sentences – both the how and why – to a five-year-old. In doing this, I hope that students will think more deeply about how what they're learning fits in to what they already know. I look forward to seeing how this application will enhance student understanding and heighten the Ignatian value of experience in my classroom!