

CRCRTH 650 Mathematical Thinking

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Hybrid, 2017 Fall

Note: lettered responses represent the same individual across the questions, so that all “a)” responses come from the same person, and so on.

1. Start with an evaluation of yourself. What were your personal goals in taking this course? Did you achieve them? How would you have proceeded differently if you were doing this course again? What have been your major personal obstacles to learning more from this course?

- a) I was hoping to achieve some greater clarity around mathematical thinking. I was a bit intimidated at the beginning of the course, and feel that the approach, and inquiry driven worked helped me do some good, new thinking without making me feel that I was at a major disadvantage having not gone particularly far in traditional mathematics in high school / college.
- b) My personal goals were to gain a deeper appreciation (and understanding) of mathematical thinking. If I were to take this course again, I would tell myself not to worry about previous math competencies, or a lack thereof.
- c) I did not deliberately start this course with goals, other than to keep an open mind about the course content and see how it would play out (this was my first non-summer course, and first class with a synchronous component, in the CCT program). I do believe that I achieved the goal of keeping an open mind, as my ideas around what is "mathematical thinking" (and the stigma around math that I walked in with) have definitely shifted. I have learned a lot and I am keen to continue. If I were doing this course again - I would likely try and connect with other students in the course, outside of class time. Many weeks I commented in plus-deltas that I liked the collaboration/partner work the most. The one-on-one conversations were great and I would probably have felt encouraged by sharing experiences with others. My major personal obstacles to keep me from learning more - nothing major - other than time to devote to the course. I would have liked to not have so many professional and personal obligations this Fall, which have taken me away from coursework and extra readings more than I would like. I rarely had time to do the additional, optional readings.
- d) My personal goals in taking this course were to learn more about the definition of "mathematical thinking" and how this applied to my life. I believe that I did, and learned that mathematical thinking has a very wide definition that can vary from person to person. If I took this course again I think I would expand my research and not be so literal. My major obstacles were being so literal in all the explorations, I wish I could have researched broader issues such as diversity in math and science classrooms.
- e) This course, like my goal overall in the program, is to develop as a teacher. Mathematical thinking provided another context within to reflect on my practice, think critically about my practice, identify areas for growth, explore that thinking and come up with a tangible new idea to weave into my work. I did achieve at least some of this. I have a better vision of how I engage in mathematical thinking myself and in my work with students. I also can see a path toward more and better collaboration with math teachers. I started the class with a more general approach to math thinking, with no real connection to education. I think I might just dive right in to education if I did it again. Personal obstacles all relate to life complexities and busy schedules. I always have more reading that I dig up than time to sift through.
- f) I was not originally planning to take this course, so my plan was to approach it with an open mind and see what was there to be explored. I feel like I did this, and it led to connections and extensions I could not have predicted. If I could take the course again, I would try to be a little bit more active on the blog. Every time I engaged with the blog it was very rewarding, but I could not get to it as much as I would have liked. I did not really experience any personal obstacles relative to the course, though this was my first semester with a baby of my own.

1. Self-evaluation (continued). What have you learned about what you have to do to make a course stimulating and productive (with respect to the format of this course: face-to-face, online, hybrid)?

- a) I've done several courses, so there wasn't precisely a take-away for me in this area. However, I was pleasantly surprised at how many interpersonal connections.
- b) I have learned that with the right leadership and expectations, self-guided inquiries with peer support and feedback are quite stimulating.
- c) As above - that I really need to maximize time to connect with classmates. If it's not going to happen in class time, then through email/Google Hangout/other means - I know I am most motivated when I can connect with other students and share experiences.
- d) Meeting online and being able to see and discuss topics with other students was very impactful. I was able to grow my ideas and thoughts through these discussions. I also was able to hear topics from other students that I would have never thought to research.
- e) Finding connection between the material and my world is what I find stimulating. Class discussion helps to push those ideas as I relate to what people are saying about their work. I find it helps to be looking at the people that are talking. Cameras on.
- f) I found this course very stimulating. Peter did a great job of maintaining a center around mathematical thinking while allowing each student's individual inquiries connect to the concept on their own terms. This really opened up the content of the course. I did not have to do much, the course itself was stimulating as an online experience. Connection with the instructor is always motivating, so maybe a few more meetings in the syllabus would be nice.

2. General Evaluation of course. What was special about this course (+positive and/or -negative)? How did the course meet or not meet your expectations? In what ways do you think this course could be improved?

- a) Some of the breakout activities took too much computational work before I was able to extract meaning.
- b) This course exceeded my expectations. The trust in individual motivation and discipline made for a personalization of this course that I was not expecting. The end result was a course that was completely relevant to my life.
- c) This course met my expectations in terms of the project-based nature of the assignments. I really liked working my way through the CEs, having the opportunity for peer and teacher feedback in a variety of ways, etc. The activities sometimes met my expectations, when they involved collaboration within class time. I think the course could be improved by being more efficient with class time (I sometimes felt that the online conversation was stilted or had awkward pauses - maybe if the chat functionality was used more, it would help?), and spending more time on peer activities and less time on some of the discussion components. I would probably do more of a 40/60 split of time (favouring activities) instead of 50/50.
- d) I think what was special were the discussions we had as a class around mathematical thinking and the collaborative explorations we conducted. Each person had a very unique point of view that you were able to learn from. I think this course exceeded my expectations due to the fact that I learned so much more than what I had assumed we would from reading the course description. I think perhaps the activities could have been explained in greater detail. Because we were an online class it was hard to tell if people were having difficulties with the activity, so having a more in depth lecture or explanation before may have helped.
- e) I liked working on three CEs that all had different approach to mathematical thinking, as opposed to one larger CE. I felt that the CEs built on each other and became more and more actionable in my professional work. The activities incorporated different aspects of mathematical thinking but I sometimes struggled with the mechanics of the activity and then lost out on the reflection afterwards.
- f) The balance between a focus on mathematical thinking and the students' own inquiries was expertly achieved. In contrast to Research and Engagement, which felt more chaotic and less anchored, this

course felt like it had something solid to be learned in the process of personal inquiry, and what could be learned grew and evolved over the semester. This course exceeded my expectations, which were that the experience would revolve around analytical, quantitative thinking in a psychology framework. The exploration was very rewarding. Improvements...I don't know. The class activities ranged from rewarding to requiring too much foreknowledge to be functional to feeling kind of out of the blue content-wise. Maybe substitute some brief required reading some weeks and discuss that instead of an activity?

2. General evaluation (continued). In what ways did your attitude to doing the course change through the semester? How does it compare with other graduate courses? What would be your overall recommendation to prospective students?

- a) I think this course is quite representative of the ideals of CCT. Practicing good thinking, engaging a reflective dialogue processes, and making meaning that ties back to personal growth.
- b) My overall recommendation would be to take advantage of the creative opportunities to pursue personal interests related to mathematical thinking.
- c) I don't think my attitude really changed about the course, I still feel open-minded about it and interested in the content. I can't compare to other graduate courses in a fair way as this felt like my first "real" one. My overall recommendation to prospective students would be to take the course and make the most of the activities and project work!
- d) I was intimidated by the course at first being that this was my first CCT course. I did not want to share my thoughts in fear of not being able to keep up with my classmates. But I felt that we formed a great rapport with one another that we were able to share our thoughts and ideas no matter how out there they may be. I have only taken a total of two graduate courses, and the other did not have an actual class meetings, so I did appreciate being able to connect with other students and Peter.
- e) Once I could see the CE work having an potential impact on teaching and learning my engagement also turned to excitement. I started the class wondering where the connection would be and end the class with a likely meaningful shift in what I do in my job. I would tell prospective students to follow the line of inquiry and see where it goes but keep in mind why that line of inquiry is important to you.
- f) I kept being surprised at how far we were allowed to explore, so my attitude went from neutral to positive after the first CE. This course was in my top 5 for all my courses and top 3 for CCT courses. Of the classes I have taken with Peter, this syllabus was by far the most straightforward and constructive to engage with. Recommendation: take this course

3. Evaluation in relation to the course description. Read the course description/goals below. Comment on how well the goals expressed in the syllabus were met. Make general and specific suggestions about how these could be better met.

Course Objectives

By the end of the semester, you will have:

- *a set of tools, experiences, activities, knowledge of publications, and an enhanced disposition to self-directed lifelong inquiry around:*
 - *your own mathematical thinking; and*
 - *what is needed to teach or guide others re: the above in ways that might depart markedly from your previous schooling and experience.*
- *a critical understanding of collaborative explorations and allied approaches to project-based learning in relation to participants re-engaging with themselves as avid learners and inquirers*

- a) The exploration activities were conceptually strong, but often took some trouble-shooting, or some significant calculations in order to get to the meaning.
- b) The aforementioned goals were all met. I came away with clear, self-identified goals to increase my own capacities of mathematical thinking as well as those of others. I do believe that the "project-based learning", while completely helpful regarding the flexibility in research areas, could have been expanded

on, as I found most of my learning garnered from outside the course meetings was based on reading scholarly journals.

- c) The CEs definitely layered in the opportunity to meet these goals, and I feel the course met them well. In general, the three major projects were the best vehicles for me to meet these goals; in order to complete them effectively, it would be impossible not to delve into publications, tools, etc. and expand upon ways of thinking regarding mathematical thinking. One specific suggestion re. how they could be better met would be in the weekly activities - there were some weekly activities that did not seem to closely build towards these goals, or their outcome(s) were not always clear. Perhaps in each weekly activity, it could be clearly stated what the take-home idea(s) or student learning outcome(s) are, and then in the plus-delta we could reflect on whether it achieved that for us...? Then activities could be tweaked to better support learning.
- d) I think these goals were met through the completion of each collaborative exploration. Being able to focus on mathematical topics that were of interest to us helped grow my mathematical thinking. I think the most difficult was establishing the tools needed to teach or guide others. This was difficult because I am definitely not an expert in the topics I researched, so my guide could have been greatly improved by more insight.
- e) Yes, I think those statements relate well to what I am taking away from the class.
- f) I feel like all the course goals were met for me. I wonder if it would be helpful for their to be a tiny bit more scaffolding around mathematical thinking from the professor's perspective. Maybe some more required readings. Or maybe for each CE the professor could explore how mathematical thinking might emerge in other CCT courses like metacognition or research and engagement, and then share that with the class as contents. Maybe more focus on blog comments and less on number of posts would bring students into the blog more. CEs: Three inquiries over a semester is a perfect number. Inquiries had time to settle and be reflected on, and it didn't feel like our revisions were piling on top of our new inquiries, which I have experienced in other CCT courses. Because of that, I think the minimum word count could be upped by a few hundred words. Also, maybe the CEs could be an overall word count. Personally, I would have liked to double the size of my CE2 rather than jump to CE3...perhaps with instructor approval some inquiries could be expanded further instead of having to jump to a new one.

4. Synthetic statement (1 or 2 paragraphs). Building on your comments from Qs 1-3, compose a synthetic statement (1 or 2 paragraphs) evaluating this course. (Imagine readers who might not be willing to wade through all the answers to Qs 1-3, but are willing to read more than simply the numerical averages of standard course evaluations.) Please make comments that help the instructor develop the course in the future and that enable some third party appreciate the course's strengths and weaknesses. Among other things you might comment on the overall content and progression of classes, the session activities, and the use of mentors to support the learning in the course.

- a) The course is a great way to extend your thinking practices into a realm that can be anxiety provoking for many people. It's simultaneously challenging and reassuring. Ultimately, the conclusion you'll reach is simply that the principles of good thinking can carry you into all kinds of unexpected areas.
- b) There was never a class meeting or project compilation that I did not find interesting. This is coming from a person who has historically never been interested in math, say for its ability to assist scientific exploration. The clear objectives and comfortability I felt in expressing my thoughts generated a course I would recommend to all students in the CCT program. Mathematical thinking envelops innumerable arenas of life- it is just your job to figure out what interests you most! The support from mentors (required office hours, immediate email response, overall flexibility and understanding) was greatly appreciated. Course lessons, while often brief, were able to highlight main principles of mathematical thinking, and were usually open-ended enough that personal interpretations to life situations were easily possible for all students.
- c) The most surprising thing about the mathematical thinking course for me was that you don't really need to do much math to be successful in it. In fact, the course may seem at first to be a bit theoretical or even

philosophical in nature. I appreciated that by the completion of the course, I came to see mathematical thinking as a lens through which to view problems, rather than being intimidated by the idea of a course that might need me to get excited about algebra or computations. A strength of the course is that it is project-based and many weeks are given to develop ideas, get peer feedback, and engage in material. Layered over these major projects were weekly, in-class activities as well as blogging opportunities to share ideas and learnings in smaller pieces. There is great diversity of topics and I found myself seeing the content in many different facets of my day-to-day life. Because the course does spend time exploring ideas (and sometimes getting philosophical), the weekly seminar discussions can sometimes be meandering or seem unclear. I found it helpful to connect with other students and realize I wasn't always the only one "lost"! Carving out office hours also was helpful to put my mind at ease about this meandering path of learning. I would recommend Mathematical Thinking to other students for sure, and have enjoyed my experience - I'll continue to think about the ideas presented in the months (and maybe years) to come.

- d) This course allowed students to hypothesis and research their own ideas of what mathematical thinking is. Because of this, many topics were explored, leading to long discussions that could have continued for hours. This course was extremely stimulating in that respect. You would come in with a certain topic that you researched and leave wanting to learn about something completely different. I really appreciated all the conversations we had regarding diversity in math and science classrooms. I am not sure if this was the intention, but sometimes that class activities felt as though they took away from the discussion instead of adding to it. It was a bit challenging to focus on the activities after having such an engaging conversation with the class. An improvement would be to have maybe a 10 - 20 minute lecture explaining the concepts of the activity before diving right in. The later activities had this aspect, and I found it much easier to understand and complete the task.
- e) Mathematical thinking presents the concept in a way that challenges you to define it in your context but also to place your context up against the view of your classmates. The structure of the class provides you the opportunity to complete 3 cycles of research and reporting that all build on each other. The outcome of the class is a new perspective on mathematical thinking in your life and work with a view towards how you will apply that perspective in the future.
- f) This course belies any notion of what a prospective student thinks "mathematical thinking" is. Perhaps it is the contrast between the usual cognitive baggage of math and the subjective and exploratory shape the course takes that makes the experience so salient. This course allows the student to explore mathematical thinking on their own terms, from equality in STEM fields to video game learning to the psychology of analytic thinking...a lot of discovery is possible in this course. Not only can students learn through their own exploration, but the peer sharing and feedback allow students to learn from each others' discoveries as well. The instructor feedback is also very constructive, helping students better explore their inquiry and be more competent academics in general. The blog associated with the course allows for a fun way to learn about what classmates are doing, though it can become so vast that engaging with it begins to feel tedious by the end of the course. Overall, this was one of the best course experiences I've had in the CCT program.

I give permission for my response to Question 4 to be included anonymously in the compilation posted to the CCT wiki (and thus viewable to the public).

- a) Yes
- b) Yes
- c) Yes
- d) Yes
- e) Yes
- f) Yes

Using the scale below, overall, how would you evaluate this course?

1. Very Poor 2. Poor 3. Average 4. Good 5. Excellent

- a) 4. Good
- b) 5. Excellent
- c) 4. Good
- d) 4. Good
- e) 5. Excellent
- f) 5. Excellent

Using the scale below, overall, how would you evaluate this instructor?

1. Very Poor 2. Poor 3. Average 4. Good 5. Excellent

- a) 5. Excellent
- b) 5. Excellent
- c) 4. Good
- d) 5. Excellent
- e) 5. Excellent
- f) 5. Excellent