Teaching Dossier

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1 Teaching Philosophy

The most memorable chocolate I have ever received was after my first job as an instructor, when a student gifted me a bag of 'KitKat Minis' as a thank you for helping them with the course. Of course, it wasn't the gift itself that was important (though it was tasty), rather it was the acknowledgement that I had a meaningful impact on that student's education.

This is the goal I still strive for today. When a student engages in mathematical learning, it is rarely the case that they find it easy. I still remember this as a student myself: the many hours of being frustrated and confused, trying to understand some mathematical concept. But I also remember the moments of pure joy when I finally found and understood the solution. It was these moments that drove me to keep studying mathematics. Now, whenever I receive the opportunity to teach, I am eager to share this joy with students, so that they may also appreciate the beauty of doing mathematics.

I have had the opportunity to teach a few times, and along the way, I have discovered certain key aspects which I find to be particularly important to the way I teach. While these ideas are not new, and there are other facets to my teaching, I do believe they provide a strong foundation to my role as a mathematical educator.

1.1 Repetition

To start with, I believe that repetition is important. This does not necessarily mean repeating the same words verbatim; there are many different forms of repetition. For instance, one could summarise a previous lecture with a few key ideas, or one could apply the same method to multiple different problems, these are both forms of repetition.

I also believe that no two students learn the same way. So when I teach, I will use this kind of repetition to explain the same concept in different ways. This has the added benefit that students receive a wide variety of tools to tackle a problem, and they can use whichever tool suits them or fits the problem the best.

To give a personal example, when I was tutoring students who were working on a GCD problem, many were struggling to develop an intuition for what the GCD operation meant. Together, we went over a couple of different ways to think about it. One way involved drawing a lattice and comparing that to set operations; in another we thought about prime factorisations; and in a third we worked directly with the definition using divisibility. This enabled the students to interpret the problem in many different ways, and each student could employ their own preferred method (or even multiple methods) to solve their assignment questions.

1.2 Example First

I also love to teach using examples. Mathematics has an (arguably deserved) reputation of being incredibly abstract, but even the most intangible theorems are rooted in an observed pattern of examples. Consequently, I strongly believe that this is the way we should teach: example first.

As educators, we know the material rather intricately, so there is a temptation to do this backwards; to present the theorem and then give examples, as this often feels more elegant. A classic instance of this is in group theory. The definition of a group is a (relatively) simple one, and yet it so elegantly summarises a host of examples observed in many different fields. While we are eager to share this amazing discovery with our students, without underlying examples, this beauty is lost. As a result, the theory may feel distant and confusing to students. Even when the aforementioned examples are introduced, they often seem ad-hoc and contrived, rather than a part of a cohesive whole.

Let me provide an example from my own experience. In a multi-variable calculus course, I was introducing the change of variables method in higher dimensions. We computed the integral of $x^2 + y^2$ over an annulus centred at the origin in the naive way using Cartesian coordinates. This was a rather tedious computation, so I proceeded to ask if there was a better way, perhaps integrating radially instead. With this motivation, I introduced the notion of change of variables, and students were enthused! We then solved the same problem using this new method, and it was clear how this was a useful tool, rather than a random 'trick' to remember.

1.3 Motivation & Amiability

During a conversation about my teaching review with Brian Forrest, he asked me a question that I thought was rather profound:

What proportion of a student's success is directly attributed to their lecturer?

After a brief discussion, we both agreed that actually, this number is probably rather low. Students are ultimately responsible for their own learning: if a particular student refuses to learn, you cannot force the knowledge upon them. However therein lies the opportunity. Most students *do* want to learn the material, they just may find it difficult. So as lecturers, I believe we should also focus on motivating students, not just presenting the content.

There are many aspects to student motivation, and I think amiability is an important one. By being friendly and approachable, students no longer feel stuck and helpless when they reach a road-block. Instead, they are likely to be motivated to ask for help, and then push through the obstacle. Furthermore, whenever I read reviews from students, be it for myself or others, by far the most common piece of feedback I see is how 'kind' the teacher is. I often find that feedback is often positive, even for hard courses, if the lecturer in question is an empathetic and friendly individual.

Of course, there is also the added benefit that a friendly attitude will make the entire experience more light-hearted and pleasant. It is perhaps an obvious thing to state, but sometimes it can be easy to forget after many weeks of the same routine.

1.4 Conclusion

These are some of the pedagogical ideas about mathematical education that I highly value. I believe that examples are necessary to provide a concrete foundation to any abstract reasoning, that examining these examples from multiple angles is necessary for student engagement, and that repetition helps solidify these ideas. Finally I think it is essential to be a kind, friendly and empathetic individual. I find teaching to be an incredibly rewarding experience, and I hope I am able to share my love of mathematics to as many people as possible.

2 Teaching Experience

2.1 Training

MATH900

MATH900 is a course offering at the University of Waterloo (for credit) that is an introduction to instructional work specifically for mathematics courses, which I completed in the winter of 2023. This course ran weekly. Some weeks there would be a presentation on a certain aspect of teaching, occasionally followed by a group discussion. Other weeks were more practical: one week we had to prepare mock assessments, other weeks we had to present mini-lectures to a small group of peers. In the penultimate week, we were tasked with guest lecturing a real course, and we would receive feedback from the instructor of the course. I lectured for Blake Madill, whose teaching review I have attached as an appendix, please see Section D.

Math Circles

While I was lecturing for MATH237, I participated in a program known as ‘Math Circles’. This was an initiative where you would sign up and review two other lecturers, and in return, two (possibly different) lecturers would review your lectures as well. This was largely an informal process, and it would be up to the individuals to determine how the reviews were done. As well as getting feedback on my own teaching, this was a good experience to observe others, and to see what I could incorporate into my own work. I received a teaching review from Faisal Al-Faisal, which I’ve also included in Section D.

New Instructor Foundations Program

I have also taken the New Instructor Foundations Program, which is designed and run by the Centre for Teaching Excellence at the University of Waterloo. It ran for three half-days, and focused on different aspects of designing and running a course: from writing the course outline to handling student requests. This was taken as preparation for the MATH237 course I was teaching. Details of the program may be found here.

2.2 Instructional

As part of the Pure Mathematics PhD program at the University of Waterloo, we are offered two opportunities to work as an instructor. My first opportunity was in the spring of 2022 for MATH136, a first-year linear algebra course. The second opportunity was a year later in the fall of 2023, where I lectured for MATH237, a second-year multivariable calculus course.

MATH136: Linear Algebra 1

While I had delivered tutorials to classes prior as an assistant, this was my first experience as an instructor for a course. This was an offering in the spring semester, so there were significantly less students: I was one of three instructors teaching a section, of which mine had 39 students. Between us instructors, we had to manage the course; my responsibilities included (among others) the writing of assignments and exam questions, handling student inquiries, and running lectures three times weekly. As the junior staff member the latter two were new to me, however with a little guidance, the course ran smoothly.

To me, perhaps the most important experience from this course was the midterm. Each instructor wrote roughly a third of the midterm, and while we coordinated to make sure we covered different material, we failed to vet the exam as a whole. As a result, the midterm was difficult for students, and we received many complaints particularly on the length of the midterm. This served as a learning experience for me, and likely for the other instructors as well. When we wrote the final exam, we were significantly more careful with the number of 'difficult' questions included in the exam, and we ran multiple 'test runs' with the final to make sure that students would have enough time to complete the exam.

Other tasks included running office hours and replying to questions on the online platform 'Piazza'. I was active on this platform, and many students seemed appreciative of the answers and feedback they were receiving on there. One student in particular sent me the following email:

> *Hello professor!*
>
> *Earlier in the term I got really behind in MATH 136, and you gave me some advice on catching up (on Piazza). Later down the line, once I had caught up, I asked for any exam preparation tips and your suggestions, particularly of attempting the questions even if I thought I could do them helped a lot too. As it turns out, there were quite a few questions where doing that helped me realize I needed to review something related to it. That made my review a lot more effective, and I ended up passing the course, so I wanted to give my appreciations. Thank you very much!*

Office hours provided a similar environment, although this was now in-person and synchronous. Several students showed up regularly to these office hours, and they were quite grateful for the time, as I often ran a little overtime to make sure that students walked away feeling satisfied with their experience. I also made sure to run additional hours before the exam, as students would naturally have more questions around that time.

MATH237: Calculus 3

The configuration for this course was a little different to the previous course. There were 4 sections, where I was teaching the smallest section, whereas the other 3 were taught by an experienced instructor who had run the course for several years. I was also unfortunate to have been placed in a rather awkwardly spaced lecture theatre on the other side of campus. As such, lecture attendance was rather low: typically about 15 students of the 40 or so enrolled.

The low attendance rate presented some unique challenges. It seemed more difficult to retain student engagement, though this may have been in part also due to the lecture room. As a result, I opted for a more interactive teaching style. For instance, I would more frequently ask (and encourage) questions from students. I also set aside some time in each lecture to give students a problem to solve, after which a volunteer would present their solution.

I also often remained after class to answer student questions. Most students would ask the occasional question, and this presented a nice opportunity to engage with them directly. A few students became ‘regulars’ and I believe these impromptu question sessions helped motivate them further. Upon looking at the course evaluations, I noticed two comments which I believe to be from these students (though there is of course no way to be sure):

> *“The instructor was great, we had many discussions about the material and stuff beyond the course”*

and

> *“Aleksa Vujicic explained everything extremely clearly, and was happy to clarify any doubts. He is an amazing instructor.”*

I believe these quotes demonstrate that this method proved to be an effective motivator for these students.

I have received two teaching reviews for this course from Brian Forrest and Faisal Al-Faisal, I have attached these in Section D.

Other Instructional Work

As I mentioned previously, I guest lectured as part of the MATH900 course. I have also on several occasions lectured as a substitute, either for peers or for supervising staff (both with compensation). While these have been less formally observed, I have received positive feedback every time, be it from the relieved lecturer, or from the students directly.

I also have occasionally run private tutoring. This is of course a different environment, but draws upon many of the same skills as instructional work.

2.3 Teaching Assistant (TA)

I completed my undergraduate and Master’s degree at Victoria University of Wellington, and my PhD degree at the University of Waterloo. At both of these institutions, I worked as a teaching assistant for a wide range of courses. I worked consistently during 2014–2019 at Victoria, and 2022–2025 at Waterloo. In almost all appointments, my primary responsibility was marking and proctoring. However, this occasionally included other tasks, such as running tutorials or responding to student questions.

As I have been doing this for some time now, I have been an assistant for a wide variety of courses, I have listed a sample below to demonstrate this.

- ENGR121 (2015): a mathematics course for engineers.
- MATH309 (2018): course on formal logic and model theory.
- MATH135 (2022): an introduction to proofs.
- PMATH810 (2023): graduate course on Banach algebras.
- MATH600 (2025): using mathematical software, a course for high school teachers.

Tutoring Centre

Of all the TA appointments, I would like to highlight my experience as a tutor for the tutoring centre. This was an offering at the University of Waterloo, and it was a partially student-led initiative to provide undergraduates (especially first and second year students) the opportunity to ask questions in a more casual environment, similar to a helpdesk. I have been a tutor there for four different semesters.

The tutoring centre is a unique opportunity for TAs, as it allows for more direct student interaction than a normal offering would otherwise allow. Now I have mentioned before that I strongly believe that motivation is a key factor for student success. As such, even though the tutorial centre is not an official part of any course, it is a component that can significantly impact student success. While we do not get to see their grades, we can often observe the results through more indirect means. For example, I have had students express their gratitude to me, and they will consistently show up week to week. I sometimes even get new students who were recommended to me by their friends. I once bumped into a student who recognised me, two years after I had tutored her, and she told me I was a big reason why she and her friends had passed the course.

2.4 Miscellaneous

Directed Reading Program

The Directed Reading Program is a program organised by the Women in Mathematics committee to provide support for women and other gender minorities who may be seeking careers in mathematics. This is targeted towards (though not exclusive to) more advanced undergraduate students. Details of the program may be found here.

I submitted a proposal for a reading project, and received interest from 2 students whom I supervised throughout the term. Unexpectedly, this turned out to be a bit of a challenge, as the strengths and weaknesses of the two students differed substantially. As a result. I was required to be flexible, and to quickly adapt the material to tailor each of the students needs. Unfortunately, one student had to drop partway through the program for medical reasons, however the project was successfully completed with the other student, who gave a presentation at the end of the program. The feedback I received from both students was very positive, and one of them gave me a small gift and a thank-you card at the end.

Outreach

I also participate in outreach programs whenever possible. While at Victoria University of Wellington in 2019, I participated in a program where, every week, a few of us graduate mathematics students would travel to a local high school (Porirua College) and provide tutoring support to the Year 13[1] students in preparation for the national exams[2]. We were primarily providing support for the physics and mathematics exams, though we would occasionally help with other subjects if we had any experience.

[1] This is the final year of high school in New Zealand.

[2] The NCEA exams, which are part of the requirements for university entrance in New Zealand.

On more than one occasion, you could see a penny drop in front of the student, at which point they would erupt and loudly exclaim "*Ohhhh! I get it now!*" or something to that effect. Needless to say the program was successful in that students got a lot out of the program, and that they were instilled with a new interest in mathematics and physics.

I have also participated in other outreach programs, though these have been less directly tied with mathematical tutelage. For instance, I went to a local elementary school as an 'expert' so I could judge their science fair projects. There was of course no actual judging, I was simply handing out gold stars and interacting with the kids, to give them a positive experience with doing science.

Appendices

A Sample Material

The following material I have presented on three pages. On this page, I have included a sample of my personal lecture notes for MATH237 (second-year multivariable calculus course). These were not shared with students, though they represent the content covered in my lectures. As such, they are a little untidy, but fairly organised.

The next page consists of a portion of the assignments written for MATH136 (first-year linear algebra course). Each assignment roughly corresponds to 1% of the total grade, and students had one week to complete them.

The final page is one of the questions I wrote for the MATH237 final. This was a 2.5 hour in-person exam, and was worth 50% of the grade.

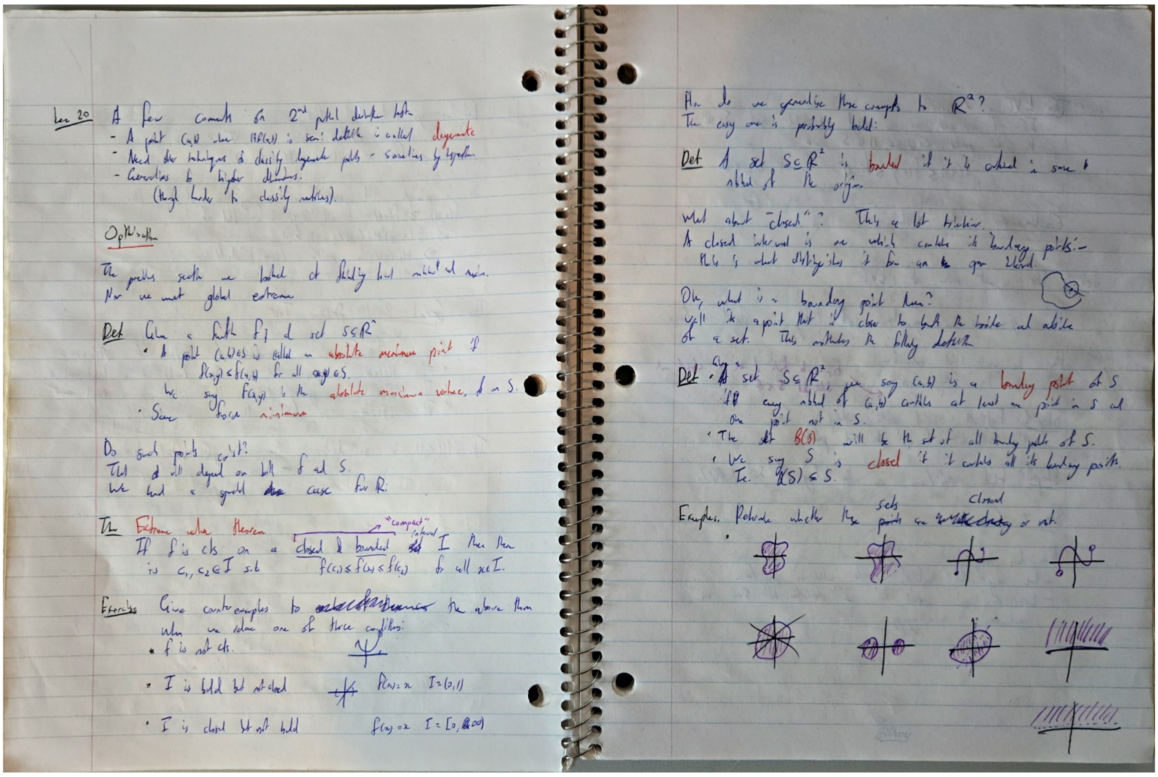

Figure 1: Sample lecture notes for MATH237.

The **coverage** for this assignment is §2.1–2.5, 3.1–3.2 (inclusive). Your solutions should not use material from any later sections. You are allowed to use material from earlier sections.

Problems

Q1. Prove that $\operatorname{Span}\left\{\begin{bmatrix}1\\1\\2\end{bmatrix}, \begin{bmatrix}1\\0\\-1\end{bmatrix}\right\} = \operatorname{Span}\left\{\begin{bmatrix}3\\1\\0\end{bmatrix}, \begin{bmatrix}1\\0\\-1\end{bmatrix}\right\}$ in $\mathbb{R}^3$.

(Remember that to prove two sets are equal, you must show that they are subsets of each other.)

Q2. Let $(1,1,0)$ and $(3,-2,1)$ be two points on a line $\mathcal{L}$ in $\mathbb{R}^3$.

(a) Find a vector equation for $\mathcal{L}$.
(b) Find parametric equations for $\mathcal{L}$.
(c) Determine whether the point $(-1,4,-1)$ is on $\mathcal{L}$.
(d) Determine whether the point $(2,0,2)$ is on $\mathcal{L}$.

Q3. Let $\mathcal{L}$ be the line $\mathbb{R}^2$ with the following equation: $\vec{\ell} = \vec{u} + t\vec{v}, t \in \mathbb{R}$, where

$$\vec{u} = \begin{bmatrix}0\\5\end{bmatrix} \quad\text{and}\quad \vec{v} = \begin{bmatrix}-2\\4\end{bmatrix}.$$

(a) Show that the vector $\vec{x} = [4 \ \ -3]^T$ lies on $\mathcal{L}$.
(b) Find a **unit** vector $\vec{n}$ which is orthogonal to $\vec{v}$.
(c) Compute $\vec{y} = \operatorname{proj}_{\vec{n}}(\vec{x})$ and show that this vector lies on $\mathcal{L}$.
(d) Prove that $\vec{y}$ is the vector on $\mathcal{L}$ with the smallest norm. That is, prove that $\|\vec{y}\| \le \|\vec{\ell}\|$ for all $\vec{\ell} \in \mathcal{L}$. (Hint: show that you can write the vectors of $\mathcal{L}$ in the form $\vec{\ell} = \vec{y} + s\vec{v}, s \in \mathbb{R}$ and use Q2a from Assignment 1).

Q4. Let $\mathcal{L}_1$ and $\mathcal{L}_2$ be two lines in $\mathbb{R}^3$ with the respective vector equations:

$$\vec{\ell}_1 = \begin{bmatrix}2\\3\\2\end{bmatrix} + t\begin{bmatrix}1\\2\\-1\end{bmatrix}, t \in \mathbb{R} \qquad\text{and}\qquad \vec{\ell}_2 = \begin{bmatrix}2\\1\\3\end{bmatrix} + t\begin{bmatrix}2\\2\\-1\end{bmatrix}, t \in \mathbb{R}.$$

(a) Find a point A which lies on the intersection of $\mathcal{L}_1$ and $\mathcal{L}_2$.
(b) Let $\mathcal{P}$ be a plane which contains both $\mathcal{L}_1$ and $\mathcal{L}_2$. Find a vector equation for $\mathcal{P}$.
(c) Find a scalar equation for $\mathcal{P}$.

Q5. (a) Determine all real values a and b such that $\begin{bmatrix}1\\3a\end{bmatrix} \notin \operatorname{Span}\left\{\begin{bmatrix}2\\2\end{bmatrix}, \begin{bmatrix}b\\4\end{bmatrix}\right\}$ in $\mathbb{R}^2$.

(b) Determine the solution set, S, to the following system of linear equations.

$$\begin{array}{rrrrcl} 2x_1 & -x_2 & +2x_3 & +4x_4 & = & 0 \\ 2x_1 & -x_2 & & +3x_4 & = & 0 \end{array}.$$

Express S as the span of one or more vectors.

The **coverage** for this assignment is §4.5–4.6, 5.1–5.7 (inclusive). Your solutions should not use material from any later sections. You are allowed to use material from earlier sections.

Problems

Q1. Let $A \in M_3(\mathbb{R})$ be the following matrix:

$$A = \begin{bmatrix}3 & 2 & 1\\2 & -1 & 0\\1 & 2 & 1\end{bmatrix}.$$

(a) Compute the inverse A^{-1}.
(b) For a fixed $\vec{b} \in \mathbb{R}^3$, how many solutions does the system $A\vec{x} = \vec{b}$ have?
(c) Solve the system $A\vec{x} = \vec{c}$ where $\vec{c} = [1 \ 1 \ 1]^T$. Do not use the Gauss-Jordan algorithm.

Q2. Let $A \in M_n(\mathbb{F})$, and suppose that $A^3 + 2A^2 - A + I_n = \mathcal{O}_n$. Prove that A is invertible. What is its inverse?

Q3. For each of the following transformations, either prove that it is linear, or find a counterexample to show it is not.

(a) The transformation $T\colon \mathbb{R}^2 \to \mathbb{R}^2$ defined by $T\left(\begin{bmatrix}x\\y\end{bmatrix}\right) = \begin{bmatrix}x+y\\xy\end{bmatrix}$.
(b) The transformation $T\colon \mathbb{R}^3 \to \mathbb{R}^2$ defined by $T\left(\begin{bmatrix}x\\y\\z\end{bmatrix}\right) = \begin{bmatrix}3x+2y+z\\x+z\end{bmatrix}$.
(c) The transformation $T\colon \mathbb{R}^2 \to \mathbb{R}^3$ defined by $T\left(\begin{bmatrix}x\\y\end{bmatrix}\right) = \begin{bmatrix}2x-y\\-x\\2+3y\end{bmatrix}$.
(d) For a fixed $\vec{z} \in \mathbb{R}^3$, the transformation $T_{\vec{z}} : \mathbb{R}^3 \to \mathbb{R}^3$ defined by $T_{\vec{z}}(\vec{x}) = \vec{z} \times \vec{x}$.

Q4. (a) Determine the kernel of the linear transformation $T_1\colon \mathbb{R}^3 \to \mathbb{R}^3$ defined by

$$T_1\left(\begin{bmatrix}x_1\\x_2\\x_3\end{bmatrix}\right) = \begin{bmatrix}x_1+2x_2+3x_3\\x_2+2x_3\\x_3\end{bmatrix}.$$

(b) Is T_1 one-to-one? Justify your answer.
(c) Determine the range of the linear transformation $T_2\colon \mathbb{R}^3 \to \mathbb{R}^2$ defined by

$$T_2\left(\begin{bmatrix}x_1\\x_2\\x_3\end{bmatrix}\right) = \begin{bmatrix}x_1+x_2\\x_1+x_2+x_3\end{bmatrix}.$$

(d) Is T_2 onto? Justify your answer.

Q5. Let $T : \mathbb{R}^n \to \mathbb{R}^m$ be a linear transformation. Suppose that there exists a map $S : \mathbb{R}^m \to \mathbb{R}^n$ with the property that that

$$S(\vec{x}) \cdot \vec{v} = \vec{x} \cdot T(\vec{v})$$

for all $\vec{x} \in \mathbb{R}^m$ and $\vec{v} \in \mathbb{R}^n$.

(a) Prove that S is a linear transformation.
(b) Since both T and S are linear, we can find matrices A and B such that $T = T_A$ and $S = T_B$. Prove that $B = A^T$.

19. A metal rod of length L has its temperature at both ends held at 0 °C. The temperature u (in degrees Celsius) at any point x along the rod at time t is given by the equation

$$u(x,t) = \sin(kx)\, e^{-mt} \tag{1}$$

where k and m are constants.

[3] (a) Find a non-zero value of k which will satisfy the boundary conditions, that is $u(0,t) = 0$, $u(L,t) = 0$. [Note: there are multiple correct choices for k, you need only provide one.]

[4] (b) It is known that temperature behaves according to the so-called heat equation

$$u_{xx}(x,t) = \alpha u_t(x,t)$$

where α is a constant. Show that with an appropriate choice of m (in terms of k and α), the formula for the rod temperature in (1) satisfies the heat equation.

B Certificates

UNIVERSITY OF WATERLOO

CENTRE FOR TEACHING EXCELLENCE
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August 16, 2023

Aleksa Vujicic
Department of Pure Mathematics

Re: New Instructor Foundations Program

Dear Aleksa,

This letter is to recognize your contributions to undergraduate teaching through your participation in the 3 half-day *New Instructor Foundations Program* for graduate student and postdoctoral instructors offered by the Centre for Teaching Excellence at the University of Waterloo from August 1-3, 2023. This 15-hour program, consisting of 10 hours of in-class time and 5 hours of out-of-class work, is focused on designing and teaching a post-secondary course.

By participating in this program, you have successfully developed your skills in three key areas: course design, assessment design, and peer feedback. Your participation in this program involved:

- aligning your course intended learning outcomes, teaching and learning activities, and assessments,
- identifying strategies that can be used to foster an inclusive learning environment and build classroom community,
- refining or designing the course assessment methods,
- enhancing your course outline,
- actively participating in peer review activities by giving and receiving feedback on course design and assessment plans,
- identifying University of Waterloo resources and people to support you in your work as an instructor, and
- building a community of graduate and postdoctoral instructors with your fellow participants.

Please consider this letter a verification of your completion of the New Instructor Foundations Program. On behalf of the University, I would like to thank you for your commitment to developing your teaching skills, and I congratulate you for completing this program.

Sincerely,

Director, Centre for Teaching Excellence
University of Waterloo

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Figure 2: Letter of completion for the New Instructor Foundation Program.

Figure 3: Certificate of completion for the Directed Reading Program.

C Course Evaluations

The following course evaluations are for the courses I taught as an instructor. They are rated on a scale from 1 (strongly disagree) to 5 (strongly agree). For the final question, the labels go from 1 (very low) to 5 (very high) instead.

Score Averages

	Question	Mean	SD	Median	Average	Overall Average
Implementation	The instructor(s) helped me to understand the course concepts.	4.1	0.7	4	**4.2** SD 0.2	**4** SD 0.3
	The instructor(s) created a supportive environment that helped me learn (Supportive environments enable students to feel included and valued regardless of any aspect of their identity).	4.4	0.8	5		
	The instructor(s) stimulated my interest in this course.	4	0.9	4		
Design	The intended learning outcomes were identified (Learning outcomes/objectives articulate what students should be able to know, do, and/or value by the end of a course).	3.9	1	4	**3.8** SD 0.3	
	The course activities prepared me for the graded work.	3.4	1.1	3.5		
	The intended learning outcomes were assessed through my graded work.	4.1	0.9	4		
Other	The course workload demands were...	3.7	0.6	4	-	

Figure 4: Summary of MATH136 feedback, with 10/39 responses.

Score Averages

	Question	Mean	SD	Median	Average	Overall Average
Implementation	The instructor(s) helped me to understand the course concepts.	4.4	1.2	5	**4.3** SD 0.3	**4.4** SD 0.2
	The instructor(s) created a supportive environment that helped me learn (Supportive environments enable students to feel included and valued regardless of any aspect of their identity).	4.6	0.8	5		
	The instructor(s) stimulated my interest in this course.	4	1.3	5		
Design	The intended learning outcomes were identified (Learning outcomes/objectives articulate what students should be able to know, do, and/or value by the end of a course).	4.6	0.5	5	**4.5** SD 0.1	
	The course activities prepared me for the graded work.	4.4	0.5	4		
	The intended learning outcomes were assessed through my graded work.	4.6	0.5	5		
Other	The course workload demands were...	2.6	0.8	3	-	

Figure 5: Summary of MATH237 feedback, with 5/32 responses.

D Teaching Reviews

I have included three teaching reviews in the following pages. The first two were completed by Brian Forrest and Faisal Al-Faisal, and were for the MATH237 course I taught. The third review was for a lecture I gave as part of MATH900, and was for a first-year linear algebra course. This review was done br Blake Madill, who was also the regular instructor for that lecture.

Peer Teaching Review for Aleksa Vujicic (Fall 2023)

Overview: This review is based on several components:

1) An approximately one hour interview via Zoom on Monday, October 2nd.
2) A visit to Aleksa's MATH 237 class (Monday, November 13th 2:30-3:20)
3) A roughly 30 minute follow-up meeting on Wednesday, November 15th.

The courses being reviewed: This semester Aleksa is teaching MATH 237. MATH 237 is the third course in the Faculty of Mathematics core Calculus sequence. The focus of the course is to provide students with an introduction to the core ideas of Multi-variable Calculus. It covers both the differential and integral aspects of the topic.

Aleksa is teaching one of four sections of MATH 237 this term. The other three are being taught by the course coordinator, a very popular senior lecturer, who is also one of the co-authors of the course notes.

The pre-lecture meeting: The course is very tightly coordinated, with all assessments and all key policy decisions being made exclusively by the course coordinator. On one hand this means less work for Aleksa in delivering the course, but it also means considerably less freedom in terms of how the content is presented and what is to be emphasized. It also means that Aleksa had to do background work to prepare for how the coordinator wanted things done. Based on the interview it seems that he took this quite seriously and before the course began, in fact in July, he went over the course notes to get a feel for what he saw in his own words to be "the big picture" items. The intent was to familiarize himself with key aspects of the course to make links to future lectures when presenting the content. When I asked him what he felt he could add in such a tightly coordinated course, his first reaction was "additional motivation".

Aleksa did mention that the course uses Piazza as a tool for student questions and that while he was not primarily responsible for monitoring the platform he did so occasionally. Instead he stated that he had regular direct communication with his students through email and via his office hours. Aleksa noted that during his office hours his students would often ask him about things external to the course including more advanced mathematical topics. In particular, he spoke of one student who asked questions about topology. I came away with the impression that Aleksa very much enjoyed these exchanges and encouraged his students to come and see him if they needed help.

Overall, I was quite impressed by what I heard from Aleksa during our meeting. He clearly sees teaching as an important part of his graduate training and possibly his future work after graduation. Aleksa has taken significant steps to prepare himself to teach for for the Faculty. In particular, he completed the 1/4-credit graduate teaching training course MATH 900 as well as the Centre for Teaching Excellence's New Instructor Foundations Program in August. In addition to these activities prior to the beginning of the course Aleksa has a also taken the time to participate in the Faculty's Teaching Circles Program which sees instructors of various levels of experience visit one another's classes to provide constructive feedback. Moreover, I found him quite animated in speaking about his class. I had a strong sense that he had invested a lot of effort in helping to foster their success.

The lecture: The class started right on time at 2:30 with 19 students out of the 37 registered in attendance. Before commenting further on the lecture it is important to note that this was a terrible room to be assigned to teach this course in particular. It is a large and very badly designed lecture theatre that has the feel of a bomb shelter. There is an upward sliding blackboard that is one modest sized panel in length. This makes it very difficult to keep reference material in the students sight including the many important diagrams that are such a key part of this course. In front of this very narrow blackboard is a large fixed desk that severely restricts the lecturer's ability to move freely. The acoustics in the room and the lighting are both very bad compared with more modern class rooms. It also did not seem to be set up so that an instructor could use any audio-visual aids in addition to the blackboard. The room was also too large for the enrolment making it challenging to achieve to the type of student engagement that I think Aleksa is capable of.

The topic for the lecture was an introduction to the Change of Variables Theorem for multiple integrals. This is perhaps one of the more difficult aspects of this course and can be quite challenging to teach. This lecture was intended to set up the main theorem which would be presented in a future class. To motivate the topic Aleksa began by reminding the class of an example of a double integral they had seen previously that had been a challenge to evaluate by the basic techniques that they had see so far. Specifically, they were to evaluate

$$\iint_D x^2 + y^2 dA$$

where D is the annulus $\{(x, y) \mid 1 \leq x^2 + y^2 \leq 2\}$. Aleksa reminded the class that this calculation was long and somewhat challenging and that after much effort they saw that this double integral had value $\frac{15\pi}{2}$. From here he indicated that a strategy to evaluate this integral would be to re-imagine D as all points with polar coordinates (r, θ) where $1 \leq r \leq 2$ and that the general process they want to use is to use "Change of Variables" to transform the integral into one taking advantage of the much simpler description of D using polar coordinates. At this point one of the students asked the question: " Does this have anything to do with substitution?". Aleksa enthusiastically acknowledged this key question with an emphatic YES, and indicated that this was where they would be going in a few minutes. This was one of several instances in the lecture where students provided important contributions. The next example occurred soon after when Aleksa asked his class to supply the resulting integral on the right from the single variable Change of Variables Theorem after the transformation $x = g(u)$

$$\int_a^b f(x)dx \overset{x=g(u)}{\longrightarrow} \int_{g(a)}^{g(b)} f(g(u))g'(u)du.$$

The next ten minutes of the lecture was a discussion on how to interpret the components of this formula in the setting of double integrals eventually leading the class to the need for a detour to talk about mappings from $\mathbb{R}^n$ to $\mathbb{R}^n$. Throughout the rest of the lecture Aleksa frequently reminded the class of core ideas from earlier in the course concerning differentiability of such functions. He stopped at regular intervals to ask if there were questions and comfortably handled those he received. As was the case earlier in the lecture the students themselves supplied some of the insight Aleksa was trying to highlight including an observation concerning the role to be played by linear approximation and the fact that "if you zoom in enough all nice mappings look linear" as well as confirming a students feeling that a change of basis matrix can be viewed as an important type of mapping.

Throughout the lecture, Aleksa succeeded in keeping the group engaged and actively participating. I did not notice anyone who was not paying attention and there was no noticeable background chatter to distract students in the class. Aleksa's pace was seem relaxed but was very appropriate for the topic. Looking back on my notes, he did cover a lot of material in the lecture. Despite the very poor class room set-up Aleksa's board work was very good. He provided a number of nice illustrative diagrams that would be helpful in understanding the content. His voice was clear and loud enough to be easily heard in the last row of this rather large lecture theatre. Aleksa also made a point of facing the whole class whenever possible while he was speaking or asking for questions.

Post-lecture and the follow-up meeting: The lectured ended on time and immediately several students approached Aleksa with questions from the lecture. Aleksa spent several minutes answering questions before moving outside the classroom where I had intended to speak to him about the lecture. At that point he indicated that he could not meet me immediately because two students wanted to speak to him about some deeper questions concerning the lecture. I later found out at our follow-up meeting that this was a regular occurrence and that these post-lecture sections could go on for quite sometime. It seems clear that Aleksa is willing to be quite generous with his time.

At the follow-up, Aleksa and I discussed how the lecture went. I mentioned that I had no concerns, but did suggest that when students asked questions or provided answers to his questions it would be a good idea to repeat them to the whole class so that others could hear, and that it would also serve to focus the class' attention on the response. This was particularly relevant in this lecture since the student involvement was on of the strong points. Aleksa was very receptive to this comment and acknowledged that it is something he should concentrate on.

One observation I made was that Aleksa seemed more reserved in the lecture than I had expected, given how enthusiastic he was in our meetings and how engaged he was in answering student questions. I pointed out that I thought that the room might play a role in this. Coincidentally, the day before our follow-up Aleksa substituted for the course coordinator, lecturing in a room with an expansive blackboard and a much better overall environment for this course. He described the experience as "freeing", a word that had come to my mind as well. He felt that being able to simply move around the room made a world of difference.

Summary: Aleksa seems genuinely interested in teaching and obviously put in significant effort to make his students experience a positive one. His technical skills in the classroom are very good and his delivery of the content was clear, easy to follow and appropriate for the course he was teaching. My sense is that Aleksa is very open to constructive comments about his teaching. His participation in Teaching Circles is further evidence of this. For a graduate student teaching a challenging course in an even more challenging environment, Aleksa handled himself very well. I see him as having a strong aptitude for teaching and would be very comfortable recommending that he be given the opportunity to teach additional classes in the future.

Summary: Brian Forrest

December 4, 2023

Private and Confidential

Observation Report for Aleksa Vujicic

Event Observed: Math 237 (Calculus 3) Lecture
Date Observed: Monday, Oct 30
Location: PAS 2038
Time: 2:30 – 3:20 PM
Number of Students Present: approx 15
Observer: Faisal Al-Faisal

Plan for Teaching Event:

Lagrange multipliers

Aspects to Maintain:

1. Good start to the lecture with a nice example that was grounded in reality (maximize profit).
2. Pace was good and explanations were clear.
3. Voice was audible. Good amount of eye contact and movement around the room. Your tone was friendly and inviting.
4. Very calm and level-headed handling of the disruptions (people walking in multiple times, and once even rudely interrupting you to tell you that this room has been double-booked for a seminar).

Targets for Change and Methods for Improvement:

1. Handwriting was a bit too small. Also be aware of shadows on the board and other potential obstructions.
2. You should always repeat questions/answers from students, as at time what they were saying wasn't audible to me at the back.
3. For a class like this, it might be worthwhile to do an explicit example before starting a proof (e.g. optimize something subject to x^2+y^2=1, so that they can conceptualize what is going in—in particular, what is meant by a "parametrization" of the constraint).
4. Try to look for more opportunities for student engagement.

Additional Comments:

Overall, I found the lecture to be well done, despite the less-than-ideal circumstances with the disruptions! You definitely handled that better than I would have.

Note that every successful lesson will demonstrate effective use of many of these elements of excellent teaching, but even the best lessons may not involve them all.

Interactive learning	
☑ Attentiveness to learners' needs	☐ Providing of feedback to learners
☑ Design of activities	☐ Checks for comprehension
☐ Facilitation of activities	☑ Asking of questions to learners
☐ Facilitation of peer-to-peer interactions	☑ Responses to learners' questions
Structure	
☑ Lesson opening or bridge-in	☐ Summary/closure
☑ Communication of learning outcomes	☑ Level of challenge for learners
☐ Pre-assessment	☑ Time management
☐ Post-assessment	
Delivery	
☑ Rapport-building with learners	☐ Use of slides, boards, or other visual aids
☑ Approachability	☐ Use of worksheets or other handouts
☑ Enthusiasm	☑ Vocal pace, volume, articulation
☑ Confidence	☑ Gestures and movement
☑ Clarity of concepts	☑ Facial expressions and eye contact

Private and Confidential

Observation Report

Event Observed: Aleksa's Math 136 Lecture
Date Observed: March 24
Location: B1 271
Time: 11:30 - 12:20
Number of Students Present: ~ 100
Observer: Blake Madill

Plan for Teaching Event: Math 136

8.7 Dimension

Aspects to Maintain:

1. Polling + interacting w/ students
2. board-work, eye contact, + body language
3. enthusiasm

Targets for Change and Methods for Improvement:

1. voice projection (or use mic)
2. holding notes is better than looking at the table.
3. time management + coverage. (~~could~~ should go faster)
4. Subscripts too small

Additional Comments:

- Greeted the class + started on time
- Started with motivating example
- Great writing / board work
- Great body language when interacting w/ class + polling
- well prepared
- waited a good "length" for questions.
- could go faster through the proof - too much repetition.
- responds super well to questions + repeats questions

Note that every successful lesson will demonstrate effective use of many of these elements of excellent teaching, but even the best lessons may not involve them all.

Interactive learning

☑ Attentiveness to learners' needs	☐ Providing of feedback to learners
☑ Design of activities	☑ Checks for comprehension
☐ Facilitation of activities	☑ Asking of questions to learners
☐ Facilitation of peer-to-peer interactions	☑ Responses to learners' questions

Structure

☑ Lesson opening or bridge-in	☐ Summary/closure Rushed
☑ Communication of learning outcomes	☑ Level of challenge for learners
☑ Pre-assessment	☐ Time management NI ☆
☐ Post-assessment	

Delivery

☑ Rapport-building with learners	☑ Use of slides, boards, or other visual aids
☑ Approachability	☐ Use of worksheets or other handouts
☑ Enthusiasm	☐ Vocal pace, volume, articulation NI ☆
☑ Confidence	☑ Gestures and movement
☑ Clarity of concepts	☑ Facial expressions and eye contact

NI = Needs Improvement.