Teaching Philosophy

I believe that one of the best learning experiences is to teach. By engaging in **open communication with students,** I can learn about what techniques work for students, where the material is challenging, and how I can modify my approach to best support their learning. I keep open communication with students by showing I am approachable and giving many opportunities to be involved in open discussion in person (availability before & after lecture, open-door office hours, encouraging questions during lecture) and online (Piazza discussion board, email, feedback survey questions at the end of activities using either TopHat or Microsoft forms). I also encourage open communication with students by posting chemistry jokes or fun chemistry facts at the beginning of the lecture next to the lecture's learning objectives, and I encourage students to submit their own as a way to contribute to the lecture. These jokes have been highly successful in breaking barriers and I have built a repertoire of hundreds of student-submitted chemistry jokes/facts.

As an instructor, I make every effort to promote discovery in the classroom & tutorial. In the classroom, I employ inquiry-based learning strategies with in-class demonstrations. Before any demonstration, I ask students to form a hypothesis (prediction) for what will happen based on their prior knowledge using in-class questioning. After, I ask if their assumptions held, -why or why not- and then ask them to re-evaluate their hypothesis based on the new observation. Sometimes if their assumptions are misguided, I use leading, scaffolded questions to help students see what prior or new knowledge they need to align with their prediction to improve it. I find this technique not only piques student interest but also helps them to connect new knowledge to their prior understanding. Some lectures will employ blended or mini-lecture flips; students will have to watch a 5-10 minute video before class of me covering the material, and then the lecture time will be spent working on practice problems that build off of the material addressed in the short video. A student emailed comment at the end of the Fall 2019 semester: *"I especially enjoyed the TopHats because they were thought provoking questions that helped solidify concepts."*

In tutorials, I employ group scratch card quizzes that build off of pre-tutorial assignments. These quizzes give students the chance to get the question right on the 2nd, 3rd or 4th attempt for a score of 3/5, 2/5 or 1/5. Not only do these quizzes have students developing their understanding while writing a quiz, but these are also **low stakes formative assessments which I find extremely important for our growth as learners**. I find getting students to discuss and defend their answers with a neighbour during these quizzes and during TopHat questions in class allows students to communicate ideas and share each other's learning. It also allows me to wander the room, address questions that students were afraid to ask in front of the class and overhear conversations that will help me better direct the class when we return to whole group discussions.

Student feedback and questioning continue to encourage me to re-evaluate my teaching practice. Looking into my dossier, you can see that I have attended many workshops about teaching and the scholarship of teaching endeavours and I have tried to employ many to improve my teaching and my students' learning of chemistry. **I find seeking and being open to feedback very important for my personal growth as an instructor**. By seeking feedback during the semester, I am modelling to students the importance of self-reflection and growth. Students see my efforts to improve during the semester and often make comments in the USRIs such as: *"[Dr. Sullivan] listens to our feedback"* & *"…adjusted the course based on feedback she received from us."* I have done activities with students towards the beginning of the semester to show the importance of a growth mindset. By openly sharing my growth as an instructor with students, I portray this growth mindset and encourage students to become more reflective and self-directed learners. Since I am usually teaching students at the beginning of their undergraduate degrees, I feel it is important to help them develop the tools to evaluate their approaches to studying and working to become more self-directed learners.

I believe that life is a journey of learning and that those around us shape our views and enrich our experience. I am thankful for the opportunities I have to connect with learners, as their curiosity and questions inspire me. As I mature as a lecturer, I know I will be continuously challenged to grow and develop my teaching strategies and techniques; I look forward to the future learning I have ahead of me as an instructor.

Summary of Courses Taught:

Although I have been involved in CHEM 201, 203, 209, 351, 357, 402 and SCIE 511, the only courses I have been involved with more than twice is the independent research project course, CHEM 402, and introductory general chemistry structure and bonding, CHEM 201. The majority of the course development I have done is in CHEM 201, which will be the focus herein.

CHEM 201: General Chemistry Structure & Bonding: *An introduction to university chemistry from theoretical and practical perspectives that focuses on an exploration of the fundamental links between electronic structure, chemical **bonding**, molecular structure and the interactions of molecules using inorganic and organic examples.* A combination of both chemistry majors and non-majors take this course. CHEM 201 and CHEM 203 are decoupled courses so students can take the two first-year chemistry courses in any order. The enrolment for CHEM 201 is around 660 students in the Fall semesters (3 sections of 220) and 480 students in the Winter semesters (2 sections of 200 and 1 section of 60-80). Spring semester is usually 1 lecture section of 80 students. Each lecture section has a different instructor; however, instructors get together to write and have cumulative exams (two term tests & a final exam). Students alternate between a 3-hour laboratories (up to 33 laboratory sections) one week and 75-min tutorials (14 sections, 7 timeslots) the other week that are taught by our graduate student teaching assistants.

Table 1.

*Duties: L=Lecture, C=Course Coordination, B=Laboratory Coordination & T=Tutorial Coordination

**TAs are the Teaching Assistants I was responsible for coordinating in each semester.

Term & Lecture Sections	Lecture size	Course size (L01-L03)	Duties*	TAs**	USRI % response rate	USRI Q1: /7		Average USRI Q2-Q12
						Section Mean	Department Mean	
W 2020 (L01)	220	500	L,C,T	6	N/A	N/A	N/A	N/A
F 2019 (L02)	220	660	L,C,T	6	71.56%	5.94	5.45	6.31
F 2019 (L01)	220				71.23%	5.90	5.45	6.28
P 2019 (L01)	95	95	L,C,B,T	3	82.80%	6.35	5.52	6.53
W 2019 (L03)	85	480	L,C,B,T	17	61.18%	6.52	5.29	6.57
W 2019 (L02)	216				73.61%	6.09	5.29	6.28
F 2018 (L03)	220	660	L,C,B,T	19	87.14%	6.16	4.65	6.32
W 2018 (L01)	204	474	L	N/A	USRIs for the department of chemistry this semester were lost by printing services.			
W 2018 (L02)	211							
F 2017 (L02)	225	636	L,C,B,T	18	77.29%	6.04	5.34	6.13
F 2017 (L01)	223				80.93%	5.99	5.34	6.05
W 2017 (L01)	211	480	L,C,B,T	14	53.85%	6.17	5.77	6.29
W 2017 (L02)	208				73.98%	6.09	5.77	6.21
F 2016 (L03)	220	665	L,C,B,T	16	66.83%	6.08	5.80	6.22
W 2016 (L03)	77	450	L,C,T	4	57.00%	6.32	5.55	6.26
W 2016 (L01)	211				67.16%	6.24	5.55	6.20
F 2015 (L03)	210	640	L,C,B,T	20	76.53%	6.16	5.50	6.21
F 2015 (L01)	215				90.29%	5.95	5.50	6.19
W 2015 (L02)	138	367	L,C,B,T	15	77.27%	5.90	5.61	6.11
F 2014 (L01)	198	630	L,C,B,T	16	80.71%	6.21	5.36	6.26
F 2014 (L03)	192				70.31%	6.10	5.36	6.19
P 2013 (L20)	69	69	L,C,B,T	3	24.62%	5.88	5.12	6.47
W 2013 (L03)	187	608	L	N/A	55.49%	5.34	5.56	6.08
F 2012 (L03)	219	656	L	N/A	76.56%	5.77	5.27	6.12
F 2012 (L02)	214				75.86%	4.91	5.27	5.66

Summary of Instruction and Lecture Redesign Based on Feedback & Reflection on Student Learning:

My lecture redesigns in CHEM 201 have targeted the main three themes outlined in my teaching philosophy. I aim to have active engagement in my classroom, and I aspire to have a class full of active learners, where we are all sharing information and learning from each other in a collaborative environment. My goal is to work with students to implement our problem-solving skills to develop the class lecture notes as a group. I also aimed to help these first-year students to develop better study skills and to become more self-reflective learners. To help the students, I need to also show growth myself and mirror how self-reflection on student feedback has helped me grow as an instructor.

The first semester as a limited term instructor, I taught CHEM 201 L02 on Mon/Wed/Fri and CHEM 201 L03 on Tues/Thurs. The first time covering new material was in L02 and I would take the time to reflect and adjust in L03. This explains the difference in the USRI scores between the two sections.

In Spring 2013, despite a low USRI response rate (external factors, flood of 2013 resulted in them being delivered in an online format without qualitative feedback), it was the first semester that I did a pilot research project by incorporating in-class assignments. These assignments provided insight into where students were struggling with the course material and how I could address these issues in class. I feel this is where I first started a dialogue with students and started to improve engagement with active learning activities.

> *"Without [in class assignments] I don't think I would have done as well in the course, as sometimes I misunderstood concepts without knowing & I am glad I found out through in class assignments rather than the exam".*

To address student comments on organization, I post a few key learning objectives at the start of lecture and concentrate on these. Initially, I brought a prepared script to the lecture; however, because I like to use student feedback in class to direct our pace, the script subsequently became redundant. The lectures became a "choose your own adventure", where if students struggle with a TopHat question, the lecture will take a different path from that when the students ace the problem. Even though lectures are now less scripted, I make sure I spend time thinking through and preparing for the possible scenarios, so it never seems like I am "writing on the spot". I have also opted to have students solving problems, noticing patterns and making conclusions about an activity, so it is more their words and not mine that are becoming our lecture template.

> *"Provided an interactive learning experience." -Student in W2018 L01.*

> *"The instructor didn't just give the answer to students she helped students learn by giving questions to make students think" -Student in W2018 L01.*

Each year, I take the time to reflect on the semester, code a large majority (if not all) of student qualitative feedback and use trends to choose a couple areas to work on improving. Even though the majority of students say things like:

> *"she was very clear on what she expected from us." -Student in W2018* L01

I still found there were students that were unaware that templates were posted to D2L, or that all Peer Mentor Review Session activity material was made available to them. I need to make sure I am more explicit about these things and ensure students are aware of the available feedback loops (class reps, discussion boards, forms, Piazza, TopHat homework etc.).

Besides reflecting myself, I aim to get students to reflect on their current understanding, whether it be through self-check quizzes, post activity reflections and other study tools or ways to evaluate their study techniques. My goal is to help first year students take ownership of their learning and develop into more self-directed learners. In

Winter 2016, I did a pilot study where I looked at introducing students to the growth versus fixed mindset[1] and other literature on study skills, including getting them to spend time on building concept maps. Feedback was mostly positive; however, not all found concept maps useful:

> *"Concept maps really helped me to connect the dots on how things are related which helped me extend my understanding based on fundamental concepts."*
>
> *"Definitely not concept maps, I really did not like that but So Much homework questions with answers helped my learning same with Top Hat questions really reinforced my learning. Good job."*

We tried to use a TopHat Textbook as a cheaper alternative to the assigned textbook ($59 versus $175) in Winter 2018. The layout of the textbook seemed disjointed and some said they struggled to find TopHat lecture questions as they had to scroll through the textbook portion of the app to find them. Looking over feedback on the TopHat textbook and Kotz textbook student views were not all positive:

> *"Did not like the TopHat textbook, but enjoyed the daily questions in class" -Student in W2018 L01*
>
> *"Textbook useless. Organic chem website and peerwise is great" -Student in W2018 L01*

Survey results did find that students would like more low-cost options and the majority would like an online low-cost textbook. In conjunction with the rest of the first-year teaching team we decided to use OpenStax (free Open Educational Resource, OER) with an optional Sapling homework platform ($60 for the two courses) starting in Fall 2018.

Over the Christmas holidays between Fall 2018 and Winter 2019, working with another professor at Memorial University, we were able to embed the OpenStax textbook as editable HTML files in D2L. Since the textbook is an OER we were able to correct typos, reword statements, hide sections of the textbook we weren't covering, and slowly update the textbook to better align with our course learning objectives. It is my intention to further improve the OpenStax resource by creating embedded interactive questions, which support student application of the material and improve metacognition. This work is being supported by a RSL and funding for student help has been pursued.

In Spring 2019, I started incorporating videos for students to watch before class. This was taking a step towards doing a more blended learning or mini-flipped classroom approach. After reading Brookfield's *"Becoming a critically reflective teacher"*[2], I reflected on the fact that no matter how much I tried to encourage students to do practice questions outside of class, it was not occurring to the extent that I hoped. In reading and hearing about flipped classrooms and blended learning, I thought if I moved some of the "lecturing" into videos to be watched outside of class time, then I could encourage more practice and applications of the material during the lecture time. This would guarantee that students in lecture were spending time actively engaged with the material and I could navigate and help direct how they go about approaching, doing practice and reflecting on their understanding. A 5-7 minute video would usually cover all the learning objectives for a lecture and then in class we would address a group worksheet, TopHat page or practice questions that address the points discussed in the video. With the small class number in Spring 2019, I was able to re-introduce in class assignments and in the qualitative feedback I asked students opinions on the in-class activities. I found that most students appreciated these activities:

> *"She had a lot of in-class activities that were useful. Throughout the activities, you got to see how your classmates do things, and therefore you're able to compare the solving strategies that they have towards a problem in comparison to yours."*
>
> *"The assignments were very helpful in my understanding of the topic, it was useful having peers to talk to about the material and the social aspect made class more enjoyable and I was more motivated to*

[1] Dweck, Carol S. ***Mindset: The New Psychology of Success,*** 2007.
[2] Brookfield, S. D. ***Becoming a critically reflective teacher,*** 2017.

attend. I would highly recommend using them in future courses, particularly because eliminating the two lowest marks shows that the prof recognized you can have an off day and still deserve to do well in the course (made assignments less stressful and more collaborative and learning focused)."

"Recommend these for ALLL classes. Stressful and challenging at times, however they prepare you for exam-writing."

Some students showed frustration in the fact that they didn't fully understand the material before the assignment, or they did not have time to complete it, but it was interesting that they still recommended them for a future semester:

"Some assignments were frustrating because we wouldn't have time to understand the material and had to complete the assignment and be graded. I would recommend them because they did help our understanding".

"The in-class assignments were a great tool to examine what we just learned, but they did occasionally seem too long."

In reviewing the qualitative USRI comments for Spring 2019, only 3 students (3.9% of the class) would not recommend the in-class assignments in the future:

"It was helpful in understanding the content but if we didn't grasp the content of the lecture immediately after class, our grades would be compromised. Not Recommended."

"I would not recommend them because they waste valuable lecture time"

"Helpful to learn from each other but not substitute for lectures or formal teaching of material"

Two view points were brought up here. One was they didn't like the possible negative impact on grades and the second point that the other two students brought up is that they wanted more traditional lecture time instead. Another student said a similar comment in relation to this and the fact that I did mini-flips with videos:

"Hard to have in class assignments on stuff you taught yourself through a video or learned the same day in lecture and are still trying to learn….forced practice is good though!"

Although this student recommended the in-class assignments, it is interesting that they perceived me presenting the lecture material in a short video before class was them "teaching themselves". As I continue to do these small flips in class, I have to think about how I am presenting them to students and investigate this view point of teaching yourself with a video, versus being taught in person in lecture.

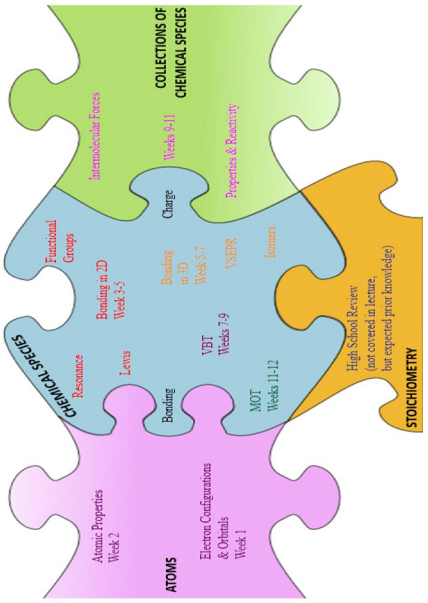
In spring 2019 when I introduced the in-class assignments, I also took time to explain my rationale on why it was important. Being a smaller cohort, I was able to convince most about the importance of doing these assignments. In Fall 2019, I was unable to mark in class assignments due to the class size (95 students increased to 440), but I converted some of these activities into group TopHat quizzes and group activities that we traded with neighbours and marked as a class, or that I collected a small sample to view on the document camera (without names). Taking feedback from the Spring semester, I shrunk the length of some of these activities so there was less of a time crunch. These activities are still a work in progress. I do not believe I was as transparent to the students in why I felt it was important for them to have them practice in class. Although this was the semester that I received the most amount of unsolicited thank-you emails and cards, at the same time overall USRI numbers dipped, when doing the same approach but with a different lecture size (220 versus 95). I agree these USRI numbers are not the best measure of teaching effectiveness and other factors play a role. A good example I have seen in my past teaching is that in Winter 2019 both CHEM 201 L02 (220 students) & L03 (80 students) had the exact same approach and material that was used, however the USRI numbers varied by 0.43 for overall instruction. I cannot wait until qualitative feedback is released from our department so that I can go beyond speculating and start seeing how I could modify this approach to have more student buy-in. I will also try to have my class representatives play a role in helping to understand

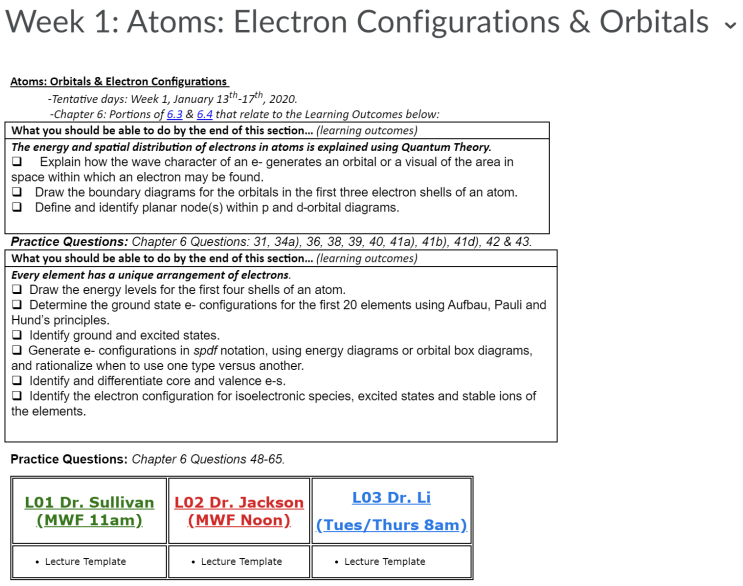
students' thoughts and opinions on this in Winter 2020. I believe doing these small flips and making time for more in-class work is beneficial to student learning, I just need to make sure I am portraying it to them in a way that they will also see the value.

Summary of Coordination Responsibilities & Highlights of Changes Implemented as a Coordinator:

In a multi-section course like CHEM 201 there are several different coordination roles and shown in Table 1 on page 2, I have been heavily involved in coordinating CHEM 201 over the years. There are three different roles for coordination: course coordination (C in Table 1), tutorial coordination (T in Table 1) and laboratory coordination (B in Table 1).

The **Course Coordinator** is responsible for scheduling weekly meetings with the instructional teaching team. During these meetings the coordinator's agenda will involve: talking with the team to determine scheduling of learning outcomes and demonstrations; as well as planning with the team the writing of midterms, exams and student reflection pieces. The course coordinator is also responsible for organization of the course syllabus, course flow and portraying information to students on the course management system (D2L). As course coordinator I have worked to portray information to students in a clear and organized format. Over the years our course concept map has undergone a few changes. Now under the lecture tab on D2L I have the following puzzle piece where each week is clickable. When a student clicks on a week they are given what learning objectives will be covered, links to the sections of the textbook that cover this information and the recommended practice problems from the textbook. I force students to scroll through this before they can click on the template found below. I find this has students more aware of the expectations and where they can go for more information and practice on the material. I used to only put this information on the first slide of the template, but I found students were not seeing this in the template.





Week 1: Atoms: Electron Configurations & Orbitals

Atoms: Orbitals & Electron Configurations

-Tentative days: Week 1, January 13th-17th, 2020.
-Chapter 6: Portions of 6.3 & 6.4 that relate to the Learning Outcomes below:

What you should be able to do by the end of this section... *(learning outcomes)*
The energy and spatial distribution of electrons in atoms is explained using Quantum Theory.
❑ Explain how the wave character of an e- generates an orbital or a visual of the area in space within which an electron may be found.
❑ Draw the boundary diagrams for the orbitals in the first three electron shells of an atom.
❑ Define and identify planar node(s) within p and d-orbital diagrams.

Practice Questions: *Chapter 6 Questions: 31, 34a), 36, 38, 39, 40, 41a), 41b), 41d), 42 & 43.*

What you should be able to do by the end of this section... *(learning outcomes)*
Every element has a unique arrangement of electrons.
❑ Draw the energy levels for the first four shells of an atom.
❑ Determine the ground state e- configurations for the first 20 elements using Aufbau, Pauli and Hund's principles.
❑ Identify ground and excited states.
❑ Generate e- configurations in *spdf* notation, using energy diagrams or orbital box diagrams, and rationalize when to use one type versus another.
❑ Identify and differentiate core and valence e-s.
❑ Identify the electron configuration for isoelectronic species, excited states and stable ions of the elements.

Practice Questions: *Chapter 6 Questions 48-65.*

L01 Dr. Sullivan (MWF 11am)	L02 Dr. Jackson (MWF Noon)	L03 Dr. Li (Tues/Thurs 8am)
• Lecture Template	• Lecture Template	• Lecture Template

Figure 1. On the left is the course puzzle piece (turned sideways to fit). Each topic/week is clickable. On the right is what students will see once they click on week 1 or the topics addressed in week 1 (electron configurations & orbitals). Clicking on "Lecture template" in the box with the instructor name takes the student to a pdf of that lecture template.

Course work redesigns – Tutorial:

An example of a Tutorial redesign that motivates students' interest, encourages collaboration, challenges learners to develop their critical thinking, is a student assessment strategy that enhances learning and facilitates feedback to support progressive learning and growth:

In order to enter a CHEM 201 tutorial, students need to complete a short, pre-tutorial assignment that shows they understand the basics before coming into the room. Before I started coordinating the course, students would enter the room and discuss their answers. After 5 minutes, the TA would give them a full answer key to the pre-tutorial. In future tutorials, students would put in less effort in the pre-tutorial assignment or discussion since they knew they would receive the answer key and could quietly copy down all the correct answers. To make students more accountable for their learning and communication within their groups, the activity was changed so students had to complete a groups scratch card quiz (IF-AT scratch cards http://www.epsteineducation.com/home/) based on the material addressed in the pre-tutorial assignment. This has led students to put more effort into the pre-tutorial and spend more time talking with their group and debating answers. The great thing with the IF-AT scratch cards is the students are given multiple attempts to get the question correct. If they do not get it right on the first attempt, they have chances to get part marks that decrease each time they choose an incorrect answer. It can get stressful and loud in the tutorial, but cheers and celebrations can also be heard when a group is finally successful in addressing a challenging question.

Aspects of the tutorial most valuable for you in tutorial evaluations, F2017:

"The group quizzes because then you get insight from other group members and it helps me understand better"

"The group quizzes really helped as they provided discussion about topics I was confused with"

The following Tutorial redesign hits on most of the points mentioned about through a simulation and has students doing post tutorial reflections:

Another significant tutorial change I wish to highlight is part of a research collaboration with Dr. Yuen-ying Carpenter. In a few semesters (Fall 2016, Spring 2017 and Spring 2019) these tutorials were run in the learning studios of the TI with the large 50 inch touchscreens; however, in other semesters we found it worked just as well having students use their own technology (phones/tablets/computers) as the students were less intimidated with the technology. The simulation (https://phet.colorado.edu/en/simulation/molecule-shapes) showed how atoms form molecules in 3D space and had intuitive controls that required no prior instruction before use. Instead of lecturing about 3D molecules, students in groups were able to use the simulation to discover them through guiding questions. Before the tutorial students practiced rotating basic shapes from the Purdue Visualization of Rotations Test[3] in an online D2L quiz as a primer for the tutorial. Initially the tutorial consisted of a group worksheet followed by a group IF-AT scratch card. However, upon reflection, I found students lacked the opportunity to practice drawing shapes and getting feedback when completing a multiple-choice quiz (requirements for using an IF-AT scratch card). Therefore, in Fall 2017, we moved to an individual worksheet where students worked in groups but needed to complete an individual worksheet. This allowed for targeted individualized feedback to each student before the second term test. After this tutorial, students completed a two-stage reflection that got them to think about their weak points within the tutorial learning objectives and how they will work on them and further prepare for the upcoming Term Test #2.

Course Work Redesigns – Laboratory:

All course work redesign implemented in the laboratory has been based on feedback not only from the students but also from the graduate student teaching assistants that are involved in teaching the laboratories. As can be seen by a summary of my educational leadership philosophy below.

An example of open communication within the laboratory I have made modifications based on feedback from the teaching team. Specifically, the graduate student teaching assistants who have been involved in also teaching laboratories for future courses gave great insight into how to modify experiments and expectations to help students be better prepared for these future courses. They are a valuable and intricate part of the team. I also use student performance on an experiment as a driving force for change. There used to be two experiments that were focused on measuring nutrients in Kool Aid. These experiments were 2-3 weeks apart, depending on scheduling, and the material from Experiment #2 was needed to complete the work for experiment #3. We found that students struggled

[3] Bodner, G. M. & Guay, R. B. "The Purdue Spatial Visualization Test", *The Chemical Educator,* **1997,** *2(4),* 1-7.

to remember what they did earlier and struggled in both experiments to do the necessary calculations. I also noticed that students were struggling to understand isomerism. Therefore, with a couple CHEM 402 research projects we combined experiments #2 & #3 into a single experiment where they work in partners, one doing what used to be experiment #2 and the other doing what used to be experiment #3. This had them working on the data together and helping each other out. This change allowed us to introduce a new experiment on isomerism, which seems to help students understand this material better than just seeing it in lecture.

Educational Leadership Philosophy

Every semester that I coordinate a large, multi-section first-year course, I oversee between 6–20 teaching assistants. I like to believe that some of these teaching assistants were like me and given the opportunity would love to better develop their teaching skills. I include the teaching assistants in as many decisions as possible when it comes to the laboratory or tutorial components of the course. In meetings I take the time to explain pedagogical reasons for why we are doing something in a particular order, even if it means slightly more work for us on the teaching end. I find it also important to make teaching assistants aware of the logistics involved with making changes and getting them to think about the impact a change may have on the course. Including graduate students in these discussions has fostered positive changes in all the experiments, whether it is clarifying the wording to a question, the steps in a procedure or modifications to our marking rubrics.

Because most of my teaching assistants are new graduate students each year, I felt it was important to be involved in developing the Teaching Assistant Training and Mentorship (TATM) program in the Department of Chemistry. Over the years, Dr. Vivian Mozol and I (with the help of a couple TAs) have shifted this from an instructor-run program to a returning graduate student organized and facilitated program. This program involves three workshops spread over the first year of a TA's teaching. One before they start on communication, a second part way through the first semester on assessment and a third on reflection of how things went and TA evaluations once they have completed their first semester of teaching.

After every semester I feel it is important for graduate students to take the time to reflect on their teaching. Something I implemented when coordinating the laboratory in Winter 2017 was getting all the teaching assistants (not just the new ones) to reflect on how things went in both the Fall and Winter semesters and make plans for the future. Similar to the teaching self-assessment process within our department, I asked all the laboratory teaching assistants to sit down with me in the Spring semester and talk about how things went and their ideas for the future.

> *"Thanks for going through my previous TA evaluations and for the meeting up. I hope the plan that we thought of today would be helpful to students!" -From a TA in the Winter 2017 semester.*

I find it is important to support students in their growth. In having peer mentors (SCIE 511 students) or CHEM 402 research students (independent chemical education research projects) I support them, so they can develop their teaching skills and implement their ideas. I facilitate their idea generation and will ask guiding questions to help them think about addressing blind spots or areas that they may not have thought about. By asking questions as a facilitator, I can slowly get the student to realize the goal they may be struggling to articulate. I find sometimes we have great ideas, but it takes time to discuss and think through them with someone to realize our main rationale or goal with an activity.

UNDERGRADUATE PROJECTS SUPERVISED at the University of Calgary:

Semester	Course	Student	Project
Winter 2020	CHEM 402	Jayar Espejo	Chemistry Teaching Assistant Beliefs & Practices. Survey teaching assistants about beliefs about teaching and what they think they do in the laboratory. Doing laboratory observations on these teaching assistants and follow-up interviews to see where what they thought they did and what they did varied.
Fall 2019	CHEM 402	Mohamed Ould Abdallahi	
Fall 2019	CHEM 402	Cooper Roe	

Fall 2019	Volunteer	Basma Akhter	Designing and implementing tutorial support sessions on laboratory and course skills based on learning theories they were learning in the SCIE 511 course.
Fall 2019	SCIE 511	Tanaeem Rehman	
Winter 2019	CHEM 402	Aasil Hassan	Developing First year experiments with light.
Winter 2019	SCIE 511	Erica Born	Designing and implementing tutorial support sessions on laboratory and course skills based on learning theories they were learning in the SCIE 511 course.
Winter 2019	SCIE 511	Ginelle Mah	
Winter 2019	CHEM 402	Hosam Abou-Salem	Looking at the impact of midterm reflections in first year chemistry courses on both attitude changes, changes in their grades and changes in study habits.
Fall 2018	CHEM 402	Mohamed Ould Abdallahi	
Fall 2018	SCIE 511	Ashley Weleschuk	Designing and implementing tutorial support sessions on laboratory and course skills based on learning theories they were learning in the SCIE 511 course.
Fall 2018	SCIE 511	Basma Akhter	
Winter 2018	SCIE 511	Judy Tran	Getting students to write & evaluate each other's exam questions anonymously using Peerwise based on learning theories she were learning in the SCIE 511 course.
Fall 2016	CHEM 402	Lauren Trautman	Developed a new experiment: *Investigating Isomers: A look at how Maleic Acid can be Isomerized to Fumaric Acid* that was implemented in CHEM 201 in Fall 2017.
Fall 2016	SCIE 511	Russel Jasper	Facilitated these students in the development of extra help sessions twice a week that involved group work and active learning based on the learning theories they were learning in the SCIE 511 course.
Fall 2016	SCIE 511	Rebecca Reid	
Fall 2015	CHEM 402	Diana Vi	Developed two new CHEM 201 experiments by making large modification to two existing experiments, implemented in the course in Winter 2016.

As can be seen above I have done quite a bit of work with SCIE 511 students, I think this contributed to why I am now involved with team teaching SCIE 511 this semester. Having peer mentors has been a beyond rewarding experience and the discussions I have had with these students has really helped me grow as an instructor and think about things differently and see better the student perspective.

Scholarship of Teaching & Learning:

As discussed, earlier courses, workshops and readings have all played a major role in influencing my scholarship of teaching and learning. There are four main research initiatives that I have taken on at the University of Calgary:

1) **Challenging Students to "Think", designing in-class assignments graded on perceived effort**

   These in-class assignments have been used in Spring 2013 & Spring 2019. The findings of the pilot project in 2013 won a poster award at the International Conference on Chemistry Education in 2014. This has influenced how I have now gone to blended learning with small flipped videos to allow for more interactive problems during class time.

2) **Taking steps to ensure students become more self-directed learners, developing metacognitive skills and reflecting on study skills**

   Initial work here and work with CHEM 402 students have shown the positive impact getting students to reflect on their learning has helped change perceptions, study tools, motivations and how they see themselves as a learner.

   "Self-reflections helped show what I needed to spend more time on…" -Student in CHEM 201 L03 W2016

I am currently collaborating with Dr. Alison Flynn on the Growth & Goals Module. A modification of this was done in the Spring 2019 semester as part of a tutorial. It got students learning what the difference between a growth versus a fixed mindset was and how they can self-reflect, build metacognitive skills, set goals and grow as a learner. We will be re-implementing this in both CHEM 201 and SCIE 511 this semester and I am curious to see the variation in how 200-level students versus 500-level students approach this.

3) **Investigating students collaborative Learning of VSEPR structures**

In collaboration with Dr. Yuen-ying Carpenter we have investigated how students interact and collaboratively learn with a simulation. The work done here has been published. This work has also inspired me to incorporate more simulations and group activity worksheets to go with these simulations. As shown earlier student feedback on these simulations has been very positive, and I feel they have had a positive impact on their learning. Having them interact with a simulation and learn as been better than rote memorization.

"The technology and space definitely helped, as I have difficulty thinking in 3D and it was only after using things such as PhET simulations and model kits that I truly understood what was going on. Group discussion was also helpful, as others would ask questions I didn't know I was also confused about." -Student tutorial Feedback from Fall 2016.

4) **Researching how Teaching Assistants Perceptions on teaching impact what they do in the laboratory and how this might relate to the training they have received.**

Research on this project is still in the preliminary stages. Results collected here will help inform how coordinators and the TATM program (Teaching Assistant Training & Mentorship Program) are modified to best support our graduate students growth as instructors.

Other efforts to improve teaching: Besides reflection on student performance and student feedback, I have made an effort to attend over 20 conferences, 60 workshops and 8 extended multi-day workshops about teaching and learning. Some of these are eluded to above about how they impacted and changed my teaching. I spent two semesters being involved in the teaching squares program in 2016. This program had faculty members break off into groups of four and coordinated times to visit each other's lectures in two visitation cycles. During these visitations we were to reflect on our own teaching while watching the other instructor teach. By sitting in the room experiencing a class as a student, my normal front of the room perspective changed. I noticed that the students who sat in groups instead of on their own were more engaged with the material. This encouraged me to encourage more group work within my lectures.

Feedback from colleagues: In many of these workshops, including the teaching squares program I had lots of great conversations about teaching with peers. In Spring 2014 at a workshop I complained that my large class size (220) restricted my ability to move freely and interact with students. A colleague asked me: "How does class size make you unable to walk?" This little bit of feedback gave me the push to get off the stage at the front of the room and interact with students during class on a more one-on-one human level. This is why I create a lot of in-class activities to allow for more chances to interact with students. When participating in the teaching square in 2016 the instructors that observed me were impressed with how I was brave enough to walk right into the middle of a row to address a student question during an activity. To me this did not seem that big, but afterwards I started to notice that the students really appreciated that ability to have a one-on-one discussion during lecture time and felt that it created a better community within the classroom. In Spring 2019 I had Dr. Amanda Musgrove visit my lecture and did a Copus observation. With this observation she noted that less than 40% of lecture time was spent with me talking, the other >60% of the time had students actively engaged in activities. The chosen lecture was in my opinion one of the lectures that I perceived I did the most lecturing in, possibly due to the demonstrations that I need to talk through. In the future I aim to reduce the amount of me talking a little further, so that students are spending more time actively engaging in activities.