CCUT Portfolio

Kyle Hansen

Contents

Preface

I am a Christian, and as a result the documents enclosed here cannot remain separate from my Christian faith, background, and convictions. Because this portfolio is not particularly geared towards a Christian audience, some of the documents have been adjusted to a more general audience. Many of the explicit references to God, Jesus, the church, or the Christian faith more broadly have mostly been scrubbed from this document for this reason. In Chapter 1, for instance, I claim that the top of one's *ordo amoris* should be "love for one another," when in reality this should say "love for God and love for one another."

However, in many places where *explicit* references to the Christian faith have been sanitized from this portfolio, the *implicit* underlying themes, motives, or intentions have remained—the goal of love for one another springs directly from love for God, after all. Some of my verbiage choices necessarily reflect this fact. For example, in an early draft of this portfolio it was suggested that the word "love" (which I employ frequently) be changed to phrases such as "mutual respect," or "kindness," or "building meaningful relationships." It was only after I heard this suggestion that I realized the need to make the background of my faith explicitly known through this preface. The suggested phrases are certainly *part* of the virtue I have in mind, but they simply do not capture the depth of the word "love" as informed by my faith and understanding of the gospel of Jesus. By "love" I typically mean the classical theological virtue of *Charity* (not to be confused with the modern word "charity" which has its own meaning). This virtue has much richer meaning than "respect" or "relational well-being" and instead this indicates a covenant relationship (a commitment) whereby we seek one another's highest good, because God has created us in the image of God.

There are likely other places where my Christian faith has integrated itself naturally into my portfolio, of which I am unaware. I have included this preface partly as an indication that what you are reading is somewhat "watered down," since I did not set out to create this portfolio with a Christian audience in mind, and to inform you of the ways in which that has happened. There will be words and phrases such as "love" which may seem improper in an academic setting, but which cannot be separated from my educational mission as an instructor.

There is, however, one notable exception to this. In an earlier draft of my portfolio, I had

completely scrubbed explicit references to my faith from Chapter 2. The result was (in my opinion) a watered down statement that expressed the importance of diversity to the discipline of mathematics, but which failed to support my personal convictions. The redaction of my faith essentially removed the spine that gives form, structure, and purpose to my commitment to justice. After some external prompting, I have decided to make this personal conviction more clear through the explicit lens of my faith. The resulting statement is somewhat longer, but provides the context for my convictions in a way that is more authentic to my vocation.

It is ultimately for God's glory, expressed through love of God and love of one another, that I live, work, and rest. That conviction has necessarily bled into the pages which follow, both implicitly and explicitly, and I genuine pray that I haven't "watered down" the dish of this portfolio too much. I invite you to take everything with a grain of salt,[1] seasoning to taste as you see fit. After all, "if salt loses its saltiness it is no longer good for anything."[2]

K.D.H.

February, 2025

[1] This phrase colloquially means "to be skeptical of something"—that is not the meaning employed here, this is just meant to be a little play on the image of salt/watered-down-ness.

[2] Matthew 5:13

Acknowledgments

I am indebted to a number of mentors, instructors, guides, readers, and friends who made this portfolio what it is.

Thank you first to Lisa Berry and Olga Faccani for your support and guidance in the CCUT program, for leading me through the LTAI and equipping me with a broad and powerful pedagogy toolkit. Your reading and critiques of an early draft of this portfolio caught a number of grammatical and typographical errors, and pointed out a number of places where I did not say either what I meant, or where I made unfounded and unjust assumptions.

I am additionally grateful to the anonymous reviewers whose feedback on an earlier draft of this portfolio have helped to provide more context and specificity throughout the current product. Thank you all for your generous sacrifice of time in reading and evaluating my portfolio. As a mathematician, it can be difficult for me to work outside of the realm of abstraction; the reminder that a compelling story is "shown" rather than "told" is one that I constantly need, and I greatly appreciate your advice in this matter.

My deepest thanks to the faculty at Westmont College who trusted me to instruct my very first class, and then continued to trust me in the years that followed. Thank you specifically to Russ Howell and Anna Aboud for sacrificing many hours to grow me as an instructor.

Thank you, Peter Garfield, for allowing me to serve as a lead TA and simultaneously mentoring me as an instructor more broadly. Thank you, Peter Rojas for giving me direction and resources for understanding and embracing neurodiversity in the classroom.

Soli Deo Gloria.

Chapter 1

Teaching Philosophy

Saint Augustine claims that a proper *ordo amoris* or "hierarchy of desires" leads to a virtuous life. In a contemporary echo of this, literary critic Gayatri Spivak defines the goal of education as the "non-coercive rearrangement of desires." The professor's role in this task, according to Dr. Greg Spencer[3] is to be demanding, personable, and inspiring. These same ideals form the backbone of my philosophy of education. By holding them to high and attainable academic standards and equipping them with a broad set of tools, I aim for my students to develop a lifelong commitment of love[4] for one another and service to the world around them.

I believe that a student who leaves the classroom with an active love for one another at the top of their *ordo amoris* is a student who leaves properly equipped to serve the world. As an instructor, I believe in the importance of modeling this active love whenever possible. For example, when a student suffered a public anxiety attack mid-class, I gave brief instructions to the rest of the class and then walked with this student to the counseling center, waiting with them until professional help was available. I worked afterward with trained support to empower the anxious student to return to the classroom, during which I realized how little I know about neurodiversity-informed pedagogy. I recently met a professor from Santa Barbara City College who has extensive experience in developing courses with such students in mind, and he is mentoring me in building classes where the strengths of every student can be discovered and actualized.

I believe in the importance of groupwork as a tool for building meaningful relationships among students with classmates whose backgrounds are different from their own. When forming in-class groups, I partner students so that a variety of voices are heard in each group, and so that every student can speak with confidence. Western society has historically reserved mathematics for white men like myself, suppressing the voices (among others) of women and people of color. By paying

[3]Professor Emeritus of Communication Studies, Westmont College
[4]See Preface

attention to which students are comfortable working with one another, I curate groups in which students from marginalized backgrounds may safely and fully engage with the class authentically, thus contributing to a diversity of backgrounds that enriches mathematics.

Spivak suggests that a rearrangement of one's *ordo amoris* ought to be "non-coercive." Since a diverse body of students will learn in a wide variety of ways, this naturally implies that students should be provided with a broad pedagogical toolkit. To aid in this I divide course material between work which is done "dependent/independent" of the instructor, as well as between "active/passive" tasks. For instance, reading a textbook is "passive-independent" work, while in-class group activity is "active-dependent." I cover the core class material with as many of the "active/passive" and "dependent/independent" quadrants as possible, without unnecessary redundancy. I have seen that by incorporating this practice into my teaching, students develop new modes of learning while absorbing the material in the ways most effective to them.

In my class, "dependent" opportunities include activities like discussing a question posed on the board with peers at the start of class, recapping prior material, and working in teams on in-class activities and worksheets while I provide guidance. Over the term, students may also collaborate on the board, present their solutions to the class, and field questions from their peers. "Independent" work complements these tasks with a mix of active and passive learning. For example, assigned readings guide students "passively" through related examples, while "active" tasks include low-stakes homework assignments and collaborative LaTeX projects leading up to exams. My courses culminate in a final group project where students independently explore a topic of their choice, present their findings, and submit a written summary, using the tools they've developed throughout the term.

In contrast to a people-pleasing professor who teaches to a test, Spencer suggests that the ideal instructor will challenge, encourage, and empower students by means of a demanding, personable, and inspiring relationship. I believe that this paradigm for student-professor relationships naturally leads students to rearrange their *ordo amoris* in a non-coercive manner. I believe an instructor's standards should be clear, high, and attainable, and so I design homework with multiple levels of difficulty so that students can both master the necessary material and push themselves to higher goals. I thoroughly explain where students are unclear, I demonstrate where they have excelled, and I give specific suggestions for adjusting their work. Besides teaching them a professional tool, typeset LaTeX assignments help students review crucial material for exams and deepen their understanding through challenging problems. These projects are graded both on "substance" and on "style." I scrutinize not just the mathematical content while grading, but also the use of "math-mode" on every variable name. After their very first typeset assignment is returned, students are allowed to turn in a second draft; they learn my high standards for these assignments and are given the opportunity to readjust their own standards without penalty. Though I have a reputation as a grader

with high standards, I am also known to provide substantial feedback and to grade fairly, giving students the chance to meet these demands. In typeset assignments, for example, I first read through the document without making any markings. On my second read through, I write full sentences, commenting on where items are unclear or confusing, as well as encouraging students where they have met the standards of the discipline. In these comments, I provide specific suggestions for how they might be phrased in the surrounding context, so that their work remains truly their own, while still learning the standards of rigorous written mathematics.

In addition to high standards, I believe in the importance of being personable and helping students find joy and purpose in their coursework. For instance, in the typeset assignments mentioned above, students are given the opportunity to turn in a revised copy of their work after receiving initial comments. By implementing the feedback that I provide, they are allowed to demonstrate their mastery of the material, to clearly articulate the arguments they are presenting, and to write up their arguments according to the standards of the discipline, directly tying into the course learning outcomes (see Sample Syllabus). Moreover, before the course begins, I find out which topics students are eager to explore and highlight these as they come up throughout the term. When exams roll around I bake cookies for my students, which softens anxieties by reminding them that I stand behind them—not just in a place of authority, but in encouragement as well. Students on sports teams or in choir find me at some of their events, while still others find me volunteering around campus and in local initiatives. I have seen these practices build a community where we stand alongside each other, absorbed in common joys both inside and outside the classroom. To further build community with students, I also offer the opportunity to sign up for lunch with me throughout the term either as a group or individually. Inside the classroom, on the other hand, I build trust and normalizing mistake-making by telling stories about my own challenges when learning certain topics.

These ideals are not unattainable. After one final exam, I received a handwritten note that said "This was the hardest class I've taken I think ever. I aced the final." The student recognized that the course was challenging, but was still inspired to attain deeper mastery of the material. I keep this pinned next to my office door as a reminder that one's education has the power to restructure one's *ordo amoris*—including mine—in a non-coercive manner, transforming it into a hierarchy that can in turn lead to a full and virtuous life.

Chapter 2

Diversity Statement

God created humanity to bear His divine image, but sin has corrupted our capacity to do so. The divine plan has been to redeem that image from the corruption of sin, and so bring glory to God. This plan does not apply only to an individual's relationship with God, but also to restored communities who both glorify God and love one another. God is inherently concerned with ensuring that each person receives the dignity and rights merited by their design as those who bear His image. In other words: God is a God of justice.

Ever since the Fall,[5] humanity has tragically been divided against itself, with manifestations of division and hostility along racial, sexual, and socioeconomic lines, among others. It is a crucial part of the restoration of humanity that these divisions be disbanded. In his letter to the Ephesians, the Apostle Paul expounds on the profound mystery of the gospel, that through the cross Jesus creates a single new humanity where once there was division and exclusion. In this restored humanity, the "dividing wall of hostility" has been destroyed; those who once were excluded from the promises of God have been "brought near by the blood of Christ."[6] Note that this new humanity is not the conquest of one culture over another, but is a completely new humanity. The barrier built up by sin has been obliterated by Jesus' sacrifice on the cross. Previously divided peoples are brought together as co-creators of culture under God's throne, through union with Christ.

Throughout the Bible, we see God's special attention to the restoration of the divine image in those whom society has historically mistreated. God is described in Psalm 86, for instance, as "a father to the fatherless, a defender of widows," and as one who "sets the lonely in families." In Ezekiel 34, the Lord speaks harshly to the "shepherds" of Israel, who are meant to model this care for the people of God most concretely. God rebukes them, saying:

> You eat the curds, clothe yourselves with the wool and slaughter the choice animals,

[5] Genesis 3
[6] Ephesians 2:14-22

> but you do not take care of the flock. You have not strengthened the weak or healed the sick or bound up the injured. You have not brought back the strays or searched for the lost. You have ruled them harshly and brutally. (Ezekiel 34:3-4)

Ezekiel goes on to reveal that God Himself will shepherd His people, explaining that God "...will search for the lost and bring back the strays. [He] will bind up the injured and strengthen the weak, but the sleek and the strong [He] will destroy. [He] will shepherd the flock with justice" (34:16). God is not content to let oppression and injustice be perpetuated, especially by those who are called to be shepherds of His people.

I seek to actively join in the redemptive work of God's Kingdom through teaching and mentoring undergraduate students. This is in many ways a "shepherding" role, and I therefore cannot be passive in my response to injustice, whether they are personal, historical, or systemic in form. This passage in Ezekiel in particular compels me to recognize those places where I have been "clothed with wool" while others have been treated "harshly and brutally." That is, Ezekiel invites me to "check my privilege," and so directly informs how I engage with diversity in the field of mathematics and in my classroom in particular. My Christian faith therefore provides the backbone to my commitment to inclusion and diversity in the field of mathematics, and especially in the classroom.

Even without religious convictions, however, diversity in the field of mathematics is critical. The 19th century mathematician and logician Augustus De Morgan claims "the moving power of mathematical invention is not reasoning, but imagination." We conclude that the study of mathematics itself necessarily benefits when diversity of thought, culture, and experience are brought to bear. It is no secret that throughout Western history, mathematics has remained a science shaped largely by the perspectives of white men; De Morgan's maxim suggests that the discipline of mathematics itself has suffered as a result.

As mathematics is primarily a language born out of intellectual leisure, those in positions of power and privilege are more likely to be fluent in the mathematical language than those who are socially and systemically oppressed. As with most languages, math is often learned effectively through immersion. Students from historically marginalized groups, such as women and people of color, or who are socioeconomically disadvantaged, may listen, think, and speak in ways that do not conform to the historical "dialect" of the discipline. This may lead them to wrongly believe that they are not capable of contributing to the field, when in fact mathematical development naturally requires such variety of perspectives in order to flourish. To borrow a linguistic analogy again, no one dialect of speech is superior to another, but rather they complement each other and in fact may even help clarify one another by their differences. In other words, different dialects enhance a language both in practical and in aesthetic ways. My desire to dismantle the false, self-perpetuating narrative around mathematical capacity drives me to enact inclusive and equitable practices in my courses. For instance, since successful mathematics requires creativity and diversity of thought, I

integrate Team-Based Learning (TBL)[7] in my class in order to create space where every student has the chance to speak with confidence and genuine curiosity. Rather than assigning groups randomly, I curate teams according to past dynamics, paying special attention to how women and students of color are engaging with their peers and even assigning roles to students to help balance conversation. There was once a group of four students composed of three women and one man, where the male student tended to direct the conversation. I decided one class period to implement roles in each team, and for that group in particular I carefully assigned the male student a role where the other teammates would be first to speak. I found that following this class period, even without ongoing role assignments, the female students in that group were more confident to present their ideas.

I am committed to bringing math into the vernacular of every student, starting from a young age. In my senior year as an undergraduate student, I had an opportunity to volunteer with a local after-school tutor program for elementary students primarily from disadvantaged backgrounds. This opened my eyes to some of the ways in which socioeconomic status affects student access to educational opportunities. Simply sitting with a student while they do their homework can have a tremendous impact on their motivation and their confidence. During COVID, I had a similar opportunity to volunteer with a local organization as a remote teaching assistant. I was partnered with a school with a significant population of socially disadvantaged students, and which has one of the lowest "total expenditures per pupil" within the district. I worked in Zoom breakout rooms with 5th and 6th grade students to review class material with worksheets which the teacher had prepared in advance for us to walk through. Even though I no longer participate in this program (since classes have returned to their in-person setting), I bring this experience into my UCSB classes whenever I teach math. For instance, I make an effort to get lunch or coffee with every student at least once per term. This allows me to recognize their strengths both inside and outside the classroom. For example, I have been able to find out through these conversations which students are most comfortable working with one another, which allows me to form teams that naturally work well together and where students will encourage each other to greater depth of understanding and engagement. God's image is on full display when students are empowered to employ their creative and analytic capacities, and it is an immense privilege for me to come alongside them in this work in the context of mathematics.

God's image is not constrained to neurotypical students, and I have recently discovered the need for course structures which recognize neurodiversity in the classroom. After multiple classes where I was met unexpectedly with a population of neurodivergent students, I realized my own failure to include these students in the class activities by the very design of my course. TBL is generally regarded as an effective pedagogical tool, and I tend to freely employ TBL in my classes. I have noticed that there are limitations, however, to the effectiveness of TBL for some students

[7] See Appendix A for an in-depth look at TBL in the math classroom.

such as those with social anxiety. I believe instructors should be able to accommodate a variety of learning mechanisms in order to foster a rich population of mathematicians, and to bring these students into a place where their affinities and passions can be formed into a vocation whereby they serve God and participate in the restoration of His world. I have been in conversation with Peter Rojas, a retired Professor of Mathematics at Santa Barbara City College, to learn how to do just that. Peter and his colleagues have spent a significant amount of time developing curricula and class environments where neurodivergent students have their strengths recognized, nurtured, and actualized. For example, before the start of the term Peter provides students with a questionnaire where they have the chance to indicate some of their preferred learning methods and self-perceived strengths. Following his example, I will use this questionnaire to make small adjustments to the rhythms of my class, so as to create opportunities where students can naturally employ these strengths. I hope moreover to disseminate some of the techniques which I am learning by creating and running seminars or workshops specifically for cultivating math classes with these students in mind.

By keeping math relegated to a specific demographic throughout Western history, the discipline has been stultified, and the image of God has been suppressed. As an instructor and a mentor, I am (in a some small way) a shepherd of God's people. An active dedication to diversity and inclusion allows for greater flourishing in students as those who engage in God's redemptive work of restoring and cultivating His good creation, and my commitment to justice, diversity, and inclusion is therefore integral to my vocation as an instructor of mathematics.

Chapter 3

Teaching Narrative

3.1 Self-Reflection

My teaching experience begins at a relatively young age. Throughout high school, I discovered my own capacity for teaching, and especially teaching mathematics, when a handful of my classmates and I started to teach ourselves the class material from the textbook. We ended up forming a group of four students who worked ahead of the rest of the class, and by my junior year I had finished the calculus sequence. During this time, I also tutored another student one-on-one who was having a harder time with the standard class pace. I found that because I had already learned the material she was then learning, I could effectively teach it to her, and that by teaching it to her I was establishing my own knowledge more deeply. In fact, I ended up designing some of her curriculum, her homework, and even her exams throughout high school. In a similar turn of events, in my junior year our chemistry teacher ended up leaving the school halfway through the spring semester, and a fellow classmate and I became the surrogate teachers since no suitable replacement could be found. We even wrote the final exam for the entire class that semester!

Although that was a huge responsibility to be put on the shoulders of high school students, I also think this experience spurred me on to greater enthusiasm for each subject, and that I learned the material better than I might have otherwise. In fact, when I started college, I planned to study both math and chemistry, and there is a suspicious correlation between the subjects I taught to my classmates and those I chose to pursue. This experience produced in me a love for teaching that I might not have developed otherwise. I became a course grader for math classes fairly early on as an undergraduate, and even started to hold extra "office hours" on my own time for some of them. From there it was a short step to graduate school where I would start to TA for math classes at UCSB.

At some point, I had decided to enter grad school with the intention of becoming a professor, specifically at a liberal arts college. Since stepping into the TA position, I have been given the

opportunity to teach the Discrete Math class at Westmont College a total of three semesters (Fall 2021, 2022, and 2023) in a class with about 20 students, as well as at UCSB for a quarter (Spring 2023) in a class just shy of 100 students. This love for teaching has been constantly reinforced, and my involvement in the CCUT program has equipped me to teach with practical pedagogical tools which serve not just for creating a more healthy classroom, but for developing students holistically. I prioritize the growth of students not only in their scholarship, but in how they engage with the world as a whole, priming them to live virtuous lives for the benefit of society. I aim to give them practical tools for engaging with those whose lives are different from their own, growing them in confidence to ask and answer questions, and developing them in their ability to communicate clear, concise, and convincing arguments. While this is primarily done through a mathematical lens, the CCUT program has helped me understand how to equip pedagogical tools and techniques whose benefits go far beyond the world of mathematics. Throughout my time as a TA and an instructor at UCSB (and beyond), my own ability to find the right pedagogical tools which support my material and my classroom, with the goal of building up especially those who are often overlooked or put down, has continued to grow.

Because I had already been through TA training at UCSB in 2019, I had expanded my teaching tool repertoire significantly before starting at Westmont. I organized my class using in-class activities, interspersing them with lecture to help guide the conversations and facilitate team-work within each group. Because of the restrictions imposed by COVID, everyone was required to wear masks while inside. In order to make groups more enjoyable, without staying put in an already stuffy room, I had groups work outside. This meant that group work was largely uninterrupted, and students were free to struggle without significant oversight from me during their work, a benefit which I haven't recognized until recently. This meant students had more freedom and were able to sit with a problem longer, while I walked around from group to group. Because I wasn't immediately available to help every group, this inadvertently supported the learning outcomes for the course (see Sample Syllabus) by providing "open-ended or partially-defined contexts" in which students develop the capacity to "construct solutions to novel mathematical problems" and "demonstrate perseverance." Moreover, students who were more quiet in the "large group" class setting were willing to ask questions and engage both with myself and their peers within these groups, which allowed students multiple opportunities to "clearly and accurately present mathematical constructions, computations, and arguments" (see Sample Syllabus).

Throughout this year, I grew in my confidence and capacity for teaching a course on my own. One of the formative moments of this year came when a student fainted, mid-class, hitting their head on cement pavement. I'm thankful to have been a lifeguard for a number of years before this, and was able to put that training to use. I cleared the scene, directed a student standing nearby to call campus safety, and monitored the airway, breathing, and circulation of the student who had

fainted. Thankfully the student recovered from their fainting just as campus safety arrived and transported them to the student health office where they recovered quickly, suffering only some minor bruises. This event rapidly put into perspective that my role as an educator demands that I respond not only to my students' academic well-being, but their emotional and physical well-being too. Though I am not primarily responsible for those facets of their life, they are facets which I have the opportunity to engage with. The simple awareness of this fact has given me, I believe, some much-needed perspective on my role as an educator.

In evaluations for this year, comments were almost entirely positive in nature; students commented that I was "kind", and "enthusiastic", and I "seemed to see students as people first." One student even praised me for baking cookies before each exam and presenting them with the recipe at the end of the term! Another commented that they "would probably not have known this was [my] first time teaching unless [I] had told [them]". In fact, looking through this first round of comments, and even the quantitative data available in this evaluation, I seem to be scoring at or above the level expected by the institution. These evaluations were especially meaningful to me since one of my main teaching values is rooted in the importance of fostering relationships among students.

Hooray! A job well done! Positive reinforcement!

Of course, this is not the end of the story. It might be noted that while these comments are generally positive, they do not actually have any bearing on the course learning outcomes described in the course syllabus, and perhaps this is a valuable indication of my own self-reflection that followed this year. For instance, there are hardly any comments which indicate whether students perceived themselves as capable of "explain[ing] connections between personal mathematical development and professional calling" or "demonstrating perseverance in the face of open-ended or partially-defined contexts" (see Sample Syllabus). Rather than reflecting on whether students achieved these goals, I was reflecting on their perception of me as an instructor. Pride indeed comes before the fall, and when I stepped back onto Westmont's campus in the Fall of 2022, I encountered a drastic blow to my pride in the form of a brand new set of students.

Before looking at this second set of evaluations, there are a number of things to consider when looking back on this first round from the Fall of 2021. First of all, this was the first semester fully back in person after the start of the COVID pandemic, where students were allowed to meet indoors with masks. I wouldn't be surprised if a large amount of the positive experience that students expressed in this class (even though it was at 8am) was in part due to this return to a semblance of normalcy. Besides this (and only in hindsight do I see this) there was a significant number of students in this class who were older and more experienced, again in some part due to the disruptions caused by COVID. This means that they had already been exposed to the rigors of college academics, and were quick to tackle the abstract challenges that Discrete Math brings, and

to bring other students alongside them in a way that future classes might not be able to.

I should also note that not *every* comment was strictly positive; a few of the evaluations pointed out that there were times I would be unsure of myself, or second-guess the route I was choosing to trace out on the chalkboard. This would become a theme in some of the evaluations in years to come.

In the Fall of 2022 I received what I can now proudly state is a "scathing review" of my class. Here, a student commented that "Hansen is...very flustered and all over the place when teaching. Its (sic) hard for me to learn material when he just reads out of the book and contradicts himself, writes things wrong on the board and then corrects himself, and overall is hard to follow." Paired with this, another student said "the course was a little confusing and sped up in the beginning but as the course went along it started to make more sense. Maybe explaining the base concrete ideas at the course's beginning more clearly would help."

There is some irony to this situation, since I had just finished attending the Lead TA Institute (LTAI) as a part of the CCUT program. While I was mentoring incoming graduate students in the UCSB Department of Mathematics to be outstanding TAs and instructors, I was failing to live up to this task myself. I was passing along the tools I learned in my LTAI training to these incoming TAs, and though I was implementing them in my classroom myself, they weren't "working" for one reason or another.

It wasn't until later during this Fall 2022 course that I realized what was going on. It's true that I was using the pedagogy practices I had attained through my training in the LTAI, but I had made a tremendous mistake in that I didn't see the class in front of me for who they were, and what they needed. I think there are a few reasons I had a hard time adjusting to the students in this class in a way that I hadn't had the previous year. For one, I was busier in my TA duties at UCSB, and perhaps less focused on my Westmont class than I had been able to be in the previous year. Not only was I serving as a TA at UCSB this fall, but those TA duties had moved back from being remote to being in-person, and then returned to remote instruction halfway through the term. My previous year teaching, I had been a TA for an upper division course at UCSB which required almost no in-person instruction, whereas this term I was balancing instruction at Westmont with the chaos of a back-and-forth in-person/remote TAship which required much more of my structured and active attention. Not only that, but my work as a Lead TA training up the incoming first year TAs at UCSB meant that I had increased responsibilities all around. My own research had also started to ramp up this year, and I found myself torn in a number of different directions that I hadn't in the previous year. Because of the split between these different locations and these different duties, I found myself less able to see the class in front of me, and to separate out what their needs might have been. I wanted to "coast" through the fall, and didn't realize until too late that this wouldn't be possible.

During an unofficial mid-course survey for the Fall of 2022 class, I asked students at what rate they felt the class was progressing through the material, and over 50% of the respondents indicated the pace was at or above a "7", where a "10" indicates we were moving too quickly. I have a specific memory of parsing through this information with the department chair at the time, since the Fall 2022 class had actually covered less material in the same amount of time as the Fall 2021 class, and yet the Fall 2021 class only about 33% of the respondents indicated a "7" or above. It was at this point that I realized that the class in front of me was a different class, coming in with completely different histories. These students had different relational dynamics, different interests, and different levels of mathematical experience from the previous year. This was reflected in my course evaluation as a whole, where the percentage of students who felt they "substantially" gained a basic understanding of the material dropped from 95% in 2021 down to just over 55% in 2022. Similarly, the percentage of students who expressed that I "frequently" explain material clearly and concisely (two criteria I myself use when grading their homework) dropped from 95% down to 55% Dually, the percentage of students who deemed that I only "hardly" or "occasionally" asked students to share ideas and experiences with others whose backgrounds and viewpoints were different from their own increased from 20% up to over 60%.

This final statistic landed a disheartening blow. One of the course learning outcomes is that students "clearly and accurately present mathematical constructions, computations, and arguments" (see Sample Syllabus). One metric of this is whether I have created an environment where every student feels not just comfortable, but confident in expressing their mathematical perspectives and asking others to do the same. In the previous year, students were quick to point out where I had made a mistake, quick to ask clarifying questions, and quick to propose ideas and solutions. When I asked this class whether there were any questions, however, I would often meet silence which I interpreted to mean there were none, and so we moved forward with class. I know looking back on this term that I often arrived to class tired and exhausted, and even if I was able to ramp up the enthusiasm for the students, I didn't see them with the same energy that I had the year before. My own preparation and energy for class were significantly diminished compared to the previous year. After this, I decided to implement some more scaffolding into the classroom examples, as a specific tool learned through the LTAI training. I redesigned a few assignments (particularly the typeset assignments) in order to facilitate understanding that was slowly revealed and built up, rather than presented all at once. I noticed during this time that more students were willing to attend office hours and ask questions, and that students engaged with the typeset assignment more fully during this time, even forming groups on their own initiative. By implementing scaffolding into these assignments, students were more equipped to "write and evaluate mathematical arguments according to the standards of the discipline" (see Sample Syllabus).

It was necessary to have this last class shock my ego as it did, because in the Spring of 2023 I

would be confronted with a different sort of class entirely. In particular, I would be teaching the "Foundations of Computer Science" course for UCSB. This would be a class nearing 100 students, a drastic change from the size at Westmont. While students at Westmont had been meeting in-person through most of the pandemic (with some necessary adjustments of course), the students at UCSB had been in a dance back and forth between in-person and remote and hybrid instruction even up as late as the Fall 2022 quarter. The quarter of Spring 2023 was the first quarter with absolutely no remote adjustments since going remote nearly three years before.

I had learned from my most recent Westmont class that I can't press "copy-paste" on lectures and expect the same results. In this situation, I was moving from a 25-student course over 16 weeks into a 100-student course over 10 weeks. To adjust for these differences, I made some structural changes to the course. First, most of the material became based on lecture rather than in-class activities. In order to compensate for this, however, each class started with a question on the board for students to discuss with their neighbors as they settled into the room; I would use this question as a launching point for the rest of the class period. I also utilized a "think-pair-share" model quite regularly, an activity which students eagerly participated in. Students responded positively to both the "preview" questions and the "think-pair-share" questions; even those sitting in the far back of the room would turn to their neighbors and give some attempt.

Not only would I need to restructure lecture, but the course itself needed to accommodate the shortened term. I eventually decided to turn the two midterm exams into four low-stakes online "quizzes" spaced regularly throughout the term. This allowed students to have a break from turning in homework on that day, to catch up on any of the material they needed, and to test their understanding. It had the added benefit that students never needed any extra "review" periods, since they perceived the stakes of the quizzes as lower than a midterm exam might be. In course evaluations, students reflected positively on this structure, and I believe that the move away from midterm-testing did not negatively affect the effort that students put into the class, nor the resulting knowledge that they took away. This directly benefits the course learning outcome (see Sample Syllabus) that states students should be able to "demonstrate mastery of fundamental concepts in discrete mathematics." In fact, on the final exam one student tore off a corner of the exam and handed it to me; it was a note which I have pinned in my office saying "This is I think the hardest class I've taken ever. I aced the final." By recognizing the differences in the class I was teaching at UCSB, I was able to successfully adapt the course curriculum and material to effectively meet the students in a capacity which both challenged them in their understanding of the mathematical world, while also encouraging them to press on through these difficult challenges.

One unfortunate fact about this class course evaluation system is that there are only two "quantitative" and two "qualitative" questions asked to each student. Although I am pleased that qualitatively almost 75% of respondents indicated both that I as an instructor and the class as a whole

were "very good", the "qualitative" feedback proved very insightful for this class. For instance, a significant number of students commented that even though there was a lot of homework, and that the homework was tough, there was also enough variety to stay interested, enough difficulty to really "hammer home" the concepts, and that the class period prepared them well to engage with each problem. One student phrased it by saying that "the homework felt comprehensive without being overwhelming" which indicates to me that I struck a fair balance of being demanding, personable, and inspiring (see Chapter 1).

In the exact same survey, however, a number of students said exactly the opposite. A good portion were upset that the homework was graded "harshly", and that there was often too much to complete. Another theme that emerged was that many of the students would have liked some online supplement (e.g., powerpoint, video recording, etc.) to the material. For instance, one student commented that I ought to make such materials available to the students "instead of putting the onus solely on the students." I can empathize with comments like this, which express the desire for more direct support, and I weigh this seriously against my goal of growing students as responsible adults. It is certainly helpful to keep a running record of what was covered in lecture, especially because the syllabus doesn't always convey this information fully. For this reason, after each class, I have always posted an online announcement with reminders about what we talked about in lecture. If something comes straight from the textbook, I don't elaborate much in the post, but otherwise I try to give a bit more detail so that students can check against their own notes and reconstruct what we discussed.

In the Fall of 2023, I returned to teach a final section of Discrete Math at Westmont. This year, I returned wiser than my 2022 experience, but foolish enough to still make some significant mistakes. I ended up increasing the amount of homework, and reordered some of the concepts that we discussed. Though my intentions were pure with this, students became more confused about the subjects I had rearranged. Moreover, I was more careful this year to review each section before we encountered it in the textbook, and specifically before each class period I gave myself an outline to more carefully arrange what topics would be covered, and when. If the class was lost or confused on a topic one day, I could easily insert it into the next class period without feeling like I was wasting time. There was one particular class period when I made a mistake on the board that cost me half a lecture; despite this, students were able to trust that I could recognize the mistake and walk through my own error and correct it together with them. Although this made for an especially confusing class period that day, it demonstrated (what I hope was) a proper attitude to failure and setbacks, and modeled to my students that it is okay to make mistakes. We could move on with the material after that, reviewing it the day after as well, and I was able to readjust the remaining class days as necessary. This flexibility that I hadn't permitted myself in 2022 allowed me to adapt to the class in front of me. After learning the hard lesson the year before, and getting to practice

teaching a brand new class at UCSB earlier that year, I was able to tackle the fall semester at Westmont both with knowledge and a bit more wisdom.

I believe that the students were able to grow because of my change of mindset as well. Quantitative feedback for this year rose back to mimic those of my very first 2021 class. This year, every student in the course filled out the evaluation, and every respondent said that they gained "substantial" understanding of the basic materials. Similarly, only one student out of the 14 enrolled indicated that I "sometimes" explain material clearly and concisely, all others indicating that this happens "frequently" or "almost always". Moreover, only 21% of students indicated that I "hardly ever" or "occasionally" ask students to share ideas with those whose perspectives are different from their own, dropping back to a comparable level with the 2021 class. One new statistic emerged this most recent year, however, when I saw that less than 15% of the students in the 2023 class indicated they only made "slight" or "no apparent progress" in developing skills in expressing themselves orally or in writing. In both 2022 and 2021, this number was over 30%.

By focusing on the students before me, and learning from my previous mistakes, I was able to provide a more holistic education to this class than I had ever expected. I have taken this approach with me into all of my TA duties, and I believe this is part of why I may have been selected as a recipient of the UCSB 2024 Department of Mathematics Outstanding Teaching Assistant Award. As I apply to teaching positions moving forward, I hope to continue learning humbly how to best equip students from all backgrounds to live lives of wisdom.

3.2 CCUT Signature Page

UC **SANTA BARBARA**

Certificate in College and University Teaching

SIGNATURE PAGE

Please complete all of the required items on this form with required signatures and include the Signature pages in your CCUT Portfolio. Submit an electronic version of your portfolio to Dr. Lisa Berry (lisa_berry@ucsb.edu). Your portfolio should be submitted as early as possible and no later than the quarter BEFORE you expect to graduate. Summer quarter graduates must submit their portfolios by the 5th week of Spring Quarter.

Name: Kyle Hansen Email: kylehansen@ucsb.edu

Department: Mathematics Phone: 5034813764

Name of Department Faculty Graduate Advisor: Hanming Zhou

REQUIREMENT 1

• Serve at least two quarters as a Teaching Assistant or Associate at UCSB

Course #	Employment Title	Quarter/Year
3A	Teaching Assistant	Fall 2019
34A	Teaching Assistant	Winter 2020

• Complete all TA Training activities required by your department

Departmental Faculty Graduate Advisor's signature verifying completion of the above two activities:

Signature 01/06/2025 Date

• Attend the day-long campus-wide Teaching Assistant Orientation

• Receive a classroom videotaping and consultation

Dr. Lisa Berry's (co-chair of the Faculty Advisory Board) signature verifying completion of the above two activities:

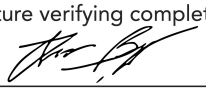
Signature Oct 8, 2024 Date

REQUIREMENT 2

• Complete a CCUT-approved course/program in pedagogy

Course/Program	Quarter/Year
Lead Teaching Assistant Institute (LTAI)	Summer 2022

Instructor's signature verifying completion of Requirement 2 (or include a copy of transcript, certificate, etc.):



Signature Oct 8, 2024 Date

UC **SANTA BARBARA**

Certificate in College and University Teaching

REQUIREMENT 3

Complete an EVIDENCE-BASED TEACHING PROJECT (must be included in portfolio Appendix, and referenced/discussed in portfolio Teaching Narrative): Identify a promising, evidence-based pedagogical approach that is intended to address a significant learning challenge (e.g., using a specific technology to foster access to equity in a course, integrating experiential learning to provide meaningful context)

CHECK ONE:

- ☒ 6-8 pages paper
- ❑ Multimedia presentation

REQUIREMENT 4

CHECK ALL

- ☒ Taught course as an instructor of record with mentoring support of a UCSB faculty member.
- ☒ Included all necessary documentation in the CCUT Portfolio:
  - ☒ A letter from your mentor describing the nature and frequency of the mentoring. Note: a Summer Teaching Institute for Associates (STIA) certificate may be offered in lieu of a mentor's letter.
  - ☒ Analysis of ESCI or other course ratings
  - ☒ Discussion of open-ended student feedback

REQUIREMENT 5

I have submitted all of the materials required for completion of the CCUT Teaching Portfolio (Teaching Philosophy Statement, Diversity Statement, Teaching Narrative, and Evidence-based Project) and attest to their accuracy.

Student's Signature — Date: 01/06/2025

Release of CCUT Portfolio Contents

"I ☒DO ❑DO NOT release my CCUT portfolio for use as an example for other students if the Faculty Advisory Board so chooses." (List any sections you wish to have omitted in a separate page.)

"I ☒DO ❑DO NOT release my CCUT portfolio for use on the CCUT or ID website if the Faculty Advisory Board so chooses." (List any sections you wish to have omitted in a separate page.)

"I ❑DO ☒DO NOT want my name attached to my portfolio if it is used as an example in the above forms."

Student's Signature — Date: 01/06/2025

Appendix

Appendix A

Team-Based Learning in Mathematics

Every teacher has some metric for their definition of success. For some, this can be measured by the number of "A+" grades, or the percentage of positive comments in a course evaluation, or even whether or not they were able to attain a good "chili pepper" rating on Rate My Professor (a metric which, thankfully, seems to no longer exist). Regardless, the specific metric a professor applies to their classroom must necessarily influence the pedagogical practices they employ. A professor whose metric of success is the amount of time they were able to spend on research, for instance, might primarily lecture from a recycled presentation they created before they had attained tenure.

In my classroom, and especially in lower division classes, I try to prioritize holistic learning over the increase of specific mathematical knowledge or skills. A few of these skills which mathematics is particularly suited to develop include the ability humbly examine your own (perhaps faulty) assumptions, to point out with compassion the errors of your peers, and to confidently and collaboratively persevere in building an understanding of the world that rests on a more firm foundation than when you started. This means that whether a class is a "success" or a "failure" cannot easily be tracked by numerical metrics, though there are a few questions on course evaluations which can demonstrate some successful growth in these areas, such as whether students feel comfortable in the classroom, and especially if they feel comfortable asking questions. A successful student is one who can confidently hear, answer, and ask questions in clear, concise, and convincing mathematical language.

In many ways, mathematics can be treated as a language with its own vocabulary, rules of grammar, and stylistic *faux pas*. There is a common practice among language teachers to employ a pedagogical method of *immersion*, where students are expected to engage entirely in the language they are learning, as long as they are in the classroom. Some textbooks (see [7]) even take this approach, and use only the language to be learned. New material is *scaffolded* onto existing grammatical structures, sometimes with the aid of a physically engaging object, or a compelling story,

or even through natural conversation. A truly immersive classroom will not let students sit idly by, and often will require that students either converse with the instructor, or with their peers under the ear of a fluent speaker.

Just as language classes may already have some students who are fluent in that language, many math classes may have "native" speakers. For instance, the child of a mathematics professor may already be accustomed to the language of existence and uniqueness, or of logical justifications and progressions of thought which the child of a grocery store clerk may not hear around the dinner table. Some students may have even had classes on logic in high school while others have never heard of a truth table before. In this way, some students may already be equipped to speak the mathematical language fluently, while others are just beginning to learn the vocabulary. To give all students the chance to improve their fluency, they must all have opportunities to converse both with fluent mathematicians and others who are new to the language.

Team-Based Learning (TBL) is a common tool in the classroom which provides every student with the chance to practice their mathematical conversation skills. In this pedagogical approach, teams of 4-6 students are formed in which students perform activities in class, often through a "flipped classroom" model, or other inquiry-based (IBL) practices. This pedagogical tool has four main pillars as outlined by [6] (and explained in [8]): that

1. groups are properly formed and managed
2. students held accountable both for group and individual work
3. group assignments promote both individual education and team development
4. students receive performance feedback both frequently and quickly

As long as teams are carefully formed, this approach allows a diverse mix of students to engage with one another through natural conversation about mathematical topics. With teams formed, students at all stages of mathematical linguistic capacity are given the opportunity to converse with a fluent speaker. This means that every student has the chance to make errors in low-stakes conversations among their peers, and as examined in [9] a result of TBL is that "students engage in peer interaction, which helps them to develop the interpersonal skills that are highly valued in the workplace."

I myself have implemented TBL methods in my Discrete Math class at Westmont College. This course typically contains 15-25, mostly first- or second-year students with the occasional junior or senior. During the first day of class, I have put up on the screen a list of groups of students, of 4-5 students each. Because I often do not know the students personally ahead of time, I structure the groups to provide a diverse balance both in race and in gender, while striving to create groups where no one individual will feel out of place. Paying attention to this demographic mix especially

at the start of the term provides students with peers they can relate to as much as possible, while also introducing them to new friends and colleagues with backgrounds different from their own.

During a standard class period, I begin by reviewing where the class left off the previous period, and introducing where we will be heading in that day. After I introduce some of the basic ideas and work through an example on the board, groups will work together on worksheets and in-class activities which guide the rest of the period. As students work in their teams, I walk around the classroom listening in to conversations and preparing to answer questions that may come up.

By eavesdropping, I can often get a sense early on in the course who is already conversational in the mathematical language, and can prepare to restructure teams in the following weeks to ensure a more balanced classroom. A handful of times throughout the term, teams are reformed to accomplish this, and to ensure students hear from a wide variety of their peers.

Although one might worry that changing up the teams disrupts the flow of class, I have found that it actually fosters more community, and gives students practice in talking to new peers for the first time. One student commented in their course evaluation that they particularly enjoyed that teams rotate throughout the semester. More than that, however, I have found that students are more often willing to ask questions in these teams. After introducing a particularly difficult concept, I may ask the class what questions they have, only to be met with silence. Once this silence persists long enough, I instruct the teams to come up with one question as a group. One student commented in their course evaluation that "sometimes we didn't have a question but were still confused so it was helpful when Kyle made us all ask one question as a group." I find that students who are otherwise hesitant to ask their own question in the context of the larger class are willing to present it as their team's question, highlighting how this use of teams contributes to my overall goal as an instructor.

Once group work has become an established rhythm in the class and groups are comfortable working with one another, one team will be selected each day to present their answers on the board for the rest of the class to see. Although only one student needs to present their answer, that team is responsible for walking through their solutions with the rest of the class. This gives students a chance to practice speaking the precise mathematical language in a larger setting, and to practice hearing and answering questions of their peers on the fly.

I have designed a TBL activity to teach about equivalence relations which has proved especially useful and engaging. There is a card game named "Set" which has a collection of shapes with different colors and in different quantities on a number of cards. I give each team a replica of the card desk, and ask them to organize them into three groups for me. I give them no other instructions than these, and teams become invested in determining what the "right" groups are. By including a hands-on project for every student to be a part of, they take ownership for the groups they

create. I then use the groups that they have created to introduce the terminology of equivalence relations, equivalence classes, and representatives of those classes. Throughout this time, teams engage with each other and interact in lively discussion about the groups that they formed, and after this project I tend to see some of the most engagement throughout the entire semester up to that point. I've learned through this that giving teams specific tasks to complete which are *not* specifically worksheet problems can be an extraordinary tool for producing more involvement and garnering more "natural" questions and engagement.

At the end of the term, the TBL structure culminates in a team project where each team will research a subject of particular interest to them, and present their subject to the rest of the class. If "all education is self-education" as Louis L'Amour claims, then this provides students the chance to put their education throughout the term into full use. Students have found this to be a meaningful capstone to the course. Up to this point in the term, they have had practice in team assignments with an instructor guiding what they study, and how they assess their understanding. Now, they get to take responsibility for their own learning as a team, and for presenting their work to the rest of the class at the end of the project.

Because of the team-structure used throughout the course, this moves away from being a "Group Project," and truly becomes a team effort. Because teams have formed and reformed throughout the term, trust is established between students by the end of the course and as [4] explains, this leads students in these final teams to challenge one another, and to maintain a high level of individual effort while working effectively together as a team to accomplish complex tasks.

All in all, I have seen that this team-based approach leads to more confident students, and students who are eager to engage with material that is difficult to learn. One student even mentioned in particular that this is a class they could look forward to, "even at 8am," while another stated that they learned "so much from this class; not just the subject but also how to organize [themselves] better. [They] learned holistically." Comments like this indicate that a class can grow students in more than just their mathematical understanding, and team-based learning is one valuable tool by which that happens.

There is a temptation to believe that this tool is suitable only for small classes. However, in [8] it is demonstrated that even in classes of around 150, TBL can be implemented with "many positive benefits to students, including exceptionally high class attendance, higher midterm and final exam scores than in non-TBL sections, and larger gains on the Calculus Concept Inventory than in non-TBL sections." These case studies demonstrate that TBL is a useful technique for getting students engaged with the material, not just in small classes, but in large calculus sections as well! One of the significant challenges that comes with TBL in this larger setting, as pointed out in this study, is that the classroom itself must allow for teams to work together; a standard lecture hall may not be a suitable environment to implement TBL. Moreover, in order to facilitate the sort

of "eavesdropping" I was able to employ in my own class, this larger class TBL structure required a number of extra TAs to attend lecture, so that it could more easily mimic the setting of a smaller class.

Despite this success story, one significant pitfall to TBL is that students with certain accessibility requirements can be particularly marginalized by this class structure. As [2] points out, the current literature fails to "address in sufficient detail...its appropriateness for [higher education] students with learning needs, disabilities or mental health issues such as anxiety".

I have personally witnessed this even in the small classroom setting. In two of my first three years of teaching Discrete Mathematics, I have had students with acute social anxiety enrolled in my class. In each case, I was not made aware of this until after the term began, and so did not correctly prepare the course structure with these student in mind. Although these accessibility needs eventually became apparent, it was often not until after a few weeks into the term when TBL and group activities were established as a part of the daily rhythm of class.

I was careful to work with school counselors and to make adjustments to the course structure to accommodate these students, but I am sad to report that in each case the student ended up withdrawing from the course. This is an obvious drawback to employing a TBL structure without considering the particular students in the class, as some students may be *a priori* excluded from participating fully.

Although I do not have specific solutions to this challenge yet, I am in the process of meeting with a faculty emeritus at a local community college who has spent some amount of time researching accessibility in the mathematics classroom in particular. It is my hope to learn from him of resources and techniques for developing a classroom where *all* students have the opportunity to learn and grow in their confidence, both mathematically and otherwise, and to create a more informed TBL classroom in the future. During a preliminary meeting, this instructor presented me with a number of resources which will be implemented in future courses. One of the first of these tools is a simple sheet which helps students identify any modes which make learning more accessible or less accessible for them.

A brief foray into the topics discussed by [1] has already allowed me to reframe these situations, encouraging me to learn the strengths of the individual students, and structure courses where those abilities are empowered for the benefit not just of one student, but of the whole class. For instance, some students excel at creating narrative whereas others can synthesize data presented to them at rapid rates. Rather than asking every student in a team to be prepared to engage in one specific way (such as presenting material at a chalkboard), it would be more effective to have a variety of modes by which each team member may engage in the material.

One way I have attempted to implement this in my classroom is through a variety of "roles"

which students get to choose from. Each role should have a clear job within the team, and should give each student a different mode of participation which employs certain strengths. This allows each student to engage with the material in a way that most effectively suits them, while still challenging them to participate in the broader team (see [3]). In Table A.1 and Table A.2 I provide a sample of role assignments I have used in past courses.

Role	**Description**
Leader	Guide the discussion. You should be the first to present ideas in any new topic.
Skeptic	Challenge and assess the Leader's ideas. The first thing on your mind should always be "Why...?" or "What do you mean by...?"
Scribe	Record group observations and questions. Ensure that everyone has arrived at a consensus, and that there are no outstanding issues. Present findings to other groups if appropriate.

Table A.1: A classic selection of roles as prescribed by [5]

The roles in Table A.1 provide a backbone on which to improvise and curate different roles for groups moving forward. I personally enjoy a challenge of creating alliterative role names so that students can easily remember the names. A sample of these custom roles may be found in Table A.2.

Role	**Description**
Inquire	Clarify ideas by asking questions. Ask your peers to unpack their definitions, and to explain how those terms are relevant to the discussion.
Inspire	Cheer one another on. Find value in the ideas your team presents, and guide others down that path you see as valuable. Encourage and support others in your group, and ask others for their insights and ideas.
Improvise	Present your ideas without thinking before-hand. You will likely be the first in your group to talk, and that's good—even if you don't quite know what you're saying!

Table A.2: Roles I created in order to facilitate question-asking within each group

Some of these roles even naturally require less active verbal processing, so that students who are strong listeners get to engage in a meaningful and crucial way which puts their strengths to use without forcing them into a position where they cannot operate with confidence. If things go well, these approaches may even build students in their confidence to try new roles, pushing their own talents and affinities into uncomfortable territories, and growing them not just in their understanding of the material at hand, but growing them holistically as well.

In spite of some of the natural challenges it encounters, TBL is an effective method for motivating students towards a common goal. It provides students with low-stakes environments in which to test their ideas, to ask questions, and to pose solutions. Moreover, by being a part of a team, students take ownership for their education in a way that I tend not to see in a traditional lecture setting. They truly embrace Louis L'Amour's philosophy, whether they know it or not. Students often grow personally, relationally, and holistically; for these reasons I will continue to refine my own use of TBL in the classroom, and hope that others do as well, for the benefit of all students.

Appendix B

Course Evaluations Analysis

B.1 Evaluation Synthesis and Reflection

Here, I summarize the student evaluations from my course in Discrete Mathematics (Westmont, 2021-2023) and the Foundations of Computer Science (UCSB, 2023) where I was instructor of record. For the purpose of identifying long-term trends, I have included quantitative insights from my teaching evaluations as a TA at UCSB, for a range of lower- and upper-division courses between 2019-2023.[8] Student Comments contains select quotes which support my insights, with references to the corresponding course evaluations. Quantitative Data supplies some context to the quantitative TA insights.

Areas of Strength

Students comment that I am a kind, enthusiastic, and engaging instructor who balances rigor with a student-centered environment for learning, resulting in high motivation. Students appreciate the multiple modes of learning I employ in class, and find the variety, frequency, and scope of assignments to be important for keeping them on track and deepening their understanding of the material. Lecture and group work allow for a balanced class structure, and my integration of "preview questions" creates a meaningful flow to the course. Students see me as widely available,[9] and appreciate office hours and exam review sessions that I hold. They claim that I create classes where students are extremely comfortable asking questions and where holistic development occurs.

Within the quantitative data from my evaluations as a TA (rather than an instructor) at UCSB, there is a consistent trend towards "excellence" in every question asked. As I lead a course more and more, my clarity of explanations improves, as does my preparation, and hence so does my "overall" ability to help students. This is most noticeable in the upper division courses, but can

[8] Justification for the selection of this range of dates can be found in Quantitative Data.

[9] ...at least, when they know I exist at all. See the section on Areas of Growth for contrast.

also be seen in lower division courses such as MA-8. My enthusiasm and clarity especially improve as I repeatedly teach a course. In recent years I have also developed better tactics for creating environments where students are comfortable asking questions, such as instructing groups rather than individuals to contribute questions. Evidence for these claims can be found in Quantitative Data below.

Areas of Growth

Students have commented that I can become unclear and second-guess myself, especially when teaching extemporaneously. I have two plans to address this. I have already started an outline of my lecture notes for easy reference and review prior to each class period, which I will use to prevent indecision about choosing conventions which might conflict with the textbook. If indecision is likely to result from extemporaneous thinking and teaching, I plan to inform students of this fact beforehand, so that even when I backtrack they will know this is a mode of thinking rather than a collection of fully formed thoughts. I expect that this will allow students to experience what it looks like to "construct solutions to novel mathematical problems, demonstrating perseverance in the face of open-ended or partially-defined contexts," one of the course learning outcomes (see Sample Syllabus), and so to grow in their capacity for this themselves.

Throughout COVID a number of students commented on my TA evaluations that they did not even know there was a TA for the course. To address this, I now post regularly on the official course pages before each exam reminding them of my availability. In the courses where I am instructor, I post followup outlines to the day's class and remind students of significant upcoming events.

Sometimes I jump too quickly into deeper material without enough of an "on-ramp," and provide overwhelming amounts of homework. Scaffolding, one of the techniques I learned through the LTAI training, gives one way I can combat this. (See Student Comments for a specific implementation of scaffolding I plan to incorporate.) In recent years I have adjusted assignments to have different "types" of problems, which indicate to students which problems to focus their efforts on, and I can provide more challenging problems as extra practice. I have found that students are often overwhelmed by the amount of homework in this class, which leads them to having less time and energy for persistence in the face of open-ended questions. One of the course learning outcomes is that students develop such perseverance, and I have seen that by giving each question a different label, students are more willing to sit and struggle with the reduced number of "core" questions. Moreover, I will actively solicit more group questions during lecture, since this has been an effective way to discover what specific examples are unclear or confusing. This not only allows me to be more clear in my explanation, but gives students the chance to evaluate my mathematical arguments as a group. Such evaluation is precisely one of the goals of the course (see Sample Syllabus). By constantly making subtle changes to my course each time I teach, I hope to settle into a course

which is stable, rigorous, and rewarding for everyone, and where the course objectives can be readily attained.

Student Comments

The heading preceding each selection of quotes provides the course evaluation from which the quotes are derived. Quotes evidencing strengths are marked with a "+" sign, while quotes evidencing weaknesses are marked with a "−" sign. Under each collection of quotes, I have given a brief summary of how these comments challenge or encourage my current techniques.

Westmont MA/CS-015, Fall 2021

+ "He has taught the material with energy and enthusiasm and always made sure to communicate effectively and thoroughly...He often broke us up into groups to work on activities, which I found to be a great way to dig into the material and break up the lecture."
+ "...he made a substantial amount of progress in every way of teaching...he was always getting better, whether it was explaining concepts, answering questions, or listening to our group conversations and implementing those questions into lecture."
− "Though very well prepared, he sometimes second guesses himself during a lecture, which will revolve *(sic)* itself through repetition and practice."

Analysis: TBL can be an effective tool for giving students mastery of fundamental concepts of the course, and I plan to continue using TBL in my classes.

Westmont MA/CS-015, Fall 2022

+ "I learned so much from this class; not just the subject but also how to organize myself better. I learned holistically."
+ "The type of teacher you want and look forward to seeing even at 8am."
− "Its *(sic)* hard for me to learn material when he just reads out of the book and contradicts himself, writes things wrong on the board and then corrects himself."

Analysis: I see that students do grow holistically in my class, which I see in their confidence and capacity to communicate mathematics clearly to one another through TBL. However, I myself do not always clearly and accurately present mathematical constructions, computations, and arguments, which is exactly contrary to the course learning outcomes (see Sample Syllabus). My reliance on the textbook, and my aim to be consistent with notation, may be a distraction from (rather than a benefit to) the core material. I have already addressed some of this by preparing a separate document of notation and conventions that help me stay consistent.

UCSB CMPSC-040, Spring 2023

+ "Makes me rethink a lot of assumptions I've had my entire life with math. Professor...makes students want to engage with the material."
+ "I liked how neatly structured the course was for the majority of the quarter. Weekly quizzes and homework helped me stay on track."
+ "It was also helpful how we revisited and tied in the concepts from last lecture and the current lecture at the beginning of class so there was a sense of flow to the course and we could be reminded of what we did last time."
− "The workload is way too heavy considering students also have other classes for which they must complete homework."
− "Professor needs to stop being indecisive during lecture. He skips around a lot and makes it difficult to follow along. When he is not doing this, his teaching makes sense, but when the teacher keeps changing his mind about what examples he is doing and the order [in] which he teaches his content it makes it hard to learn."

Analysis: During this term, I tried to begin lecture with a small recap of where we ended previously helped students see connections between fundamental concepts we covered. This term also had quizzes every-other-week due to the accelerated 10 week course constraints. It seems this choice and structure of consistent, constant, low-stakes assessments allowed students to keep up with new material while being reminded of previous content. However, students in this class were overwhelmed by the volume of assignments, and it is possible that this negatively impacted students' capacity to persevere in the fact of open-ended or partially-defined contexts. It may be valuable to have a few days where homework is intentionally designed as a very small number of open-ended problems. This way, students may get both a break from the constant onslaught of homework, while also getting to meet the course objective of developing perseverance in such contexts.

Westmont MA/CS-015, Fall 2023

+ "It really taught me how to think creatively...and I liked how it changed my perspectives on the concepts that I already knew."
+ "The homework, group work, lectures, and office hour instruction were varied and helped me approach the content from many different angles."
+ "Kyle...is passionate about the subject matter. He is kind and gives everyone in the class a chance to succeed."
− "It felt like when we started them I had proofs being thrown at me and I wasn't sure even on the structure of the proofs."

– "Go through easier examples at first and then explain how it connects to more challenging examples/problems."

Analysis: Students who struggle with the basic/fundamental concepts at the very start of the course will almost certainly struggle with fundamental concepts later on, and since proofs form the basis of writing and evaluating mathematical arguments, I plan to provide more scaffolding around proof-writing as I move forward. For instance, I plan to incorporate a new activity where the sentences of a proof have been scrambled, and students are responsible for unscrambling the proof. At the start of the term, the proof structures will be very simple. As new proof techniques are introduced, the proofs will themselves naturally become more complex. I hope this develops more clear understanding of what the standards of the discipline are, and how to write arguments in a way that matches that standard.

Quantitative Data

Here I provide a synthesis of some of my quantitative scores from the TA ESCI evaluations (*not* my instructor evaluations) administered by UCSB between 2019-2023. I have included six charts below, one for each question asked in the ESCI forms. These plot my **average score** in each criteria for each term. The methods for collecting evaluations for TAs changed in the Fall of 2023 at UCSB, and unfortunately the metrics are not consistent with evaluations pre-2023. In fact, they are not even internally consistent.[10] I have included only the 2019-2023 data below for consistency and clarity of any "long-term" trends which may be visible.

Interpreting the Charts A score close to "1" indicates an "excellent" job, while a score close to "5" indicates a "very poor" job. The charts have been rescaled to have a "poorest rating" of 2.5 ("slightly better than average") for ease of reading; all scores are still to be interpreted out of the original 5-point scale. In order, the questions asked are

1. How enthusiastic was the TA about teaching? (**my average: 1.5**)
2. Rate the clarity of the TA's explanations. (**my average: 1.6**)
3. How available was the TA to help students? (**my average: 1.4**)
4. Rate the TA's preparation for conducting section. (**my average: 1.6**)
5. Rate your TA's overall performance in helping you master the material. (**my average: 1.6**)
6. The TA created a classroom environment in which students felt comfortable asking questions. (**my average: 1.5**)

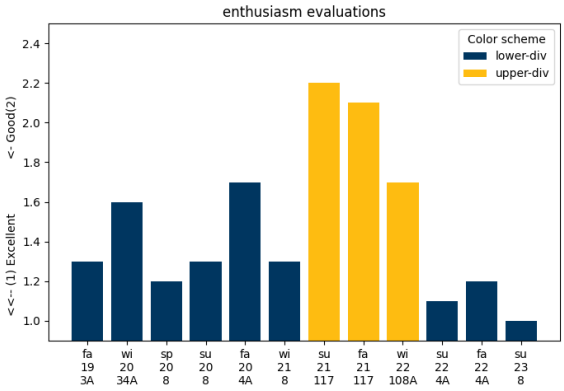
[10] For instance, under the revised system 2023-present, a "1" may sometimes indicate an "excellent" performance in one evaluation, while indicating a "poor" performance elsewhere.

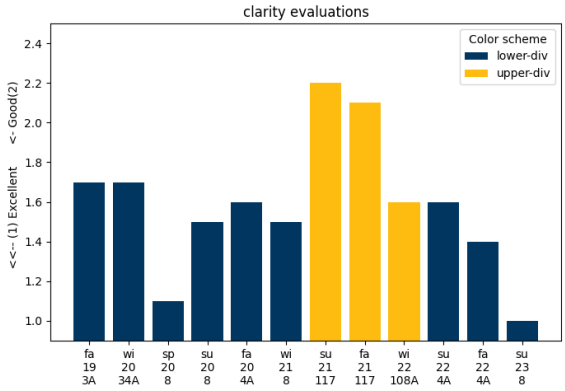
Nota Bene 1: Quantitative data from Spring 2020 through Fall 2021 may be significantly skewed. Besides the obvious impacts of COVID, respondents sometimes commented during this time that they did not even know there was a TA available. See the section on Areas of Growth for more on this.

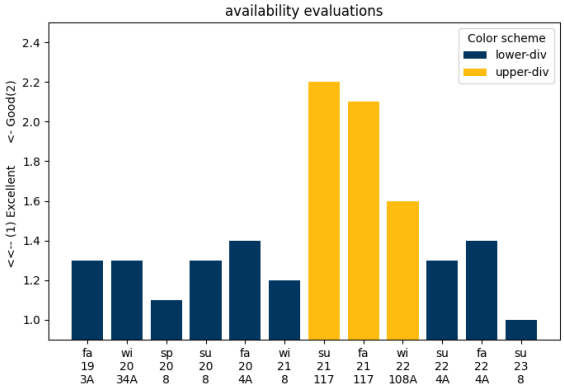
Nota Bene 2: There is a noticable spike (indication of "poorer" performance) during my first term as an upper division TA in Summer 2021. In addition to the previous analysis on my weaknesses addressed above, this spike may be due in part to the fact that the evaluation metrics do not change, even though the role of the TA changes significantly from lower- to upper-division classes. In particular, the primary role of the TA changes from leading discussion sections to grading proof-based assignments. Unfortunately, the questions asked on these evaluations do not reflect this change in role, and still ask (for example) about the TA's preparation for conducting section. Because the onus is on students to seek out the TA independent of discussion section in upper-division courses, many of the questions may not even be relevant to many of the students.

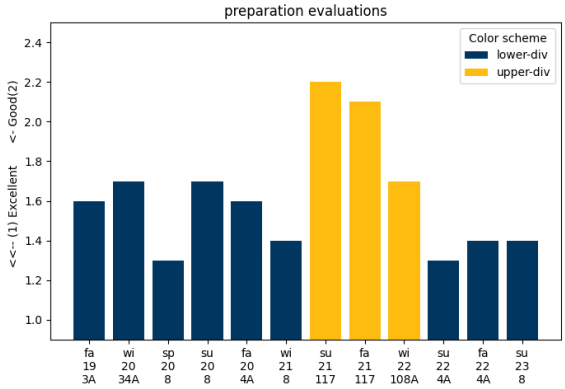
Analysis: One of the most noticeable trends that one can see in the charts below is that the more frequently I teach a subject, the more clear my explanations become, and the more capable I am to create an environment where students are comfortable asking questions. Because I aim for students to grow in their own communication capacities, this is especially crucial for me to take note of. One can also see that a massive "spike" (a "bad" indicator) occurs in my role as an upper division TA. There is a clear downward ("good") trend in these courses which I believe comes with my own willingness to engage more fully with the students whom I am grading, since I started giving them not feedback on their assignments, but started inviting them to attend office hours and math lab more frequently. Since I cannot employ the active pedagogy tools to encourage participation (as I'm mostly serving as a grader rather than an instructing TA in those years), these interactions are all the more important. As a grader, however, I still play a vital role in developing students' ability to read and write proofs in a clear, concise, convincing manner. I implement thorough feedback, together with suggestions, which allow students to both hear what professional standards sound like, while maintaining the context of their individual voice. In other words, I ensure that my suggestions are limited in scope to a single phrase (or sentence) so that the structure and voice of a proof still belong solely to the original student. Note as a curiosity that my overall scores started to improve in 2022. This may be a direct consequence of my involvement in the Lead TA Institute (LTAI) where I developed pedagogy practices which I continue to use to this day.

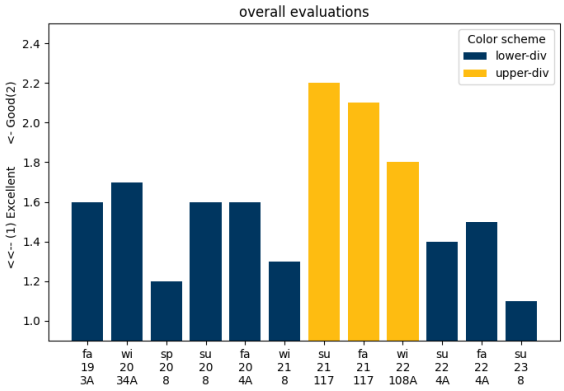
Graphs of Kyle's Average TA Evaluation Scores, 2019-2023

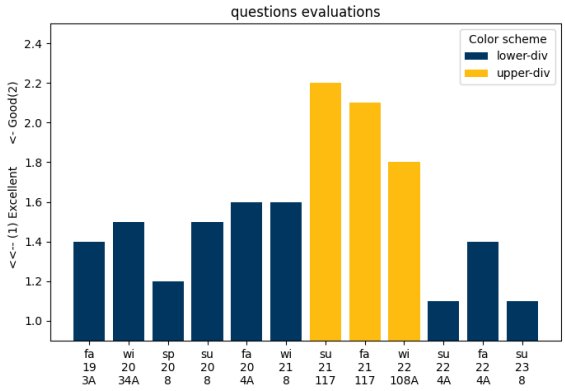












B.2 Sample Instructor Evaluations, Westmont College, Fall 2023

8/14/24, 11:41 AM - Anthology

CS 015 (1): Discrete Mathematics, MA 015 (1): Discrete Mathematics

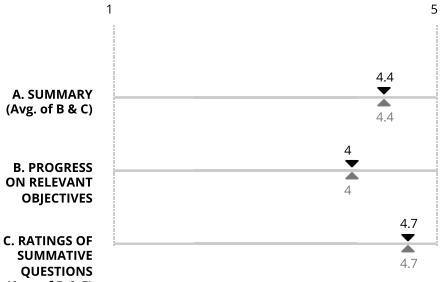
Fall Semester 2023 | Kyle Hansen | Course CIP Code: 11.0101

14 | Students Enrolled
14 | Students Responded
100% | Response Rate

Summative

▼ | Adjusted
▲ | Raw
| 3 Point Plus/Minus

Your Average Scores
5 Point Scale



Your Overall Mean Ratings
5 Point Scale

Ratings of Summative Questions	Raw	Adj.
D. Excellent Teacher	4.9	4.9
E. Excellent Course	4.4	4.4

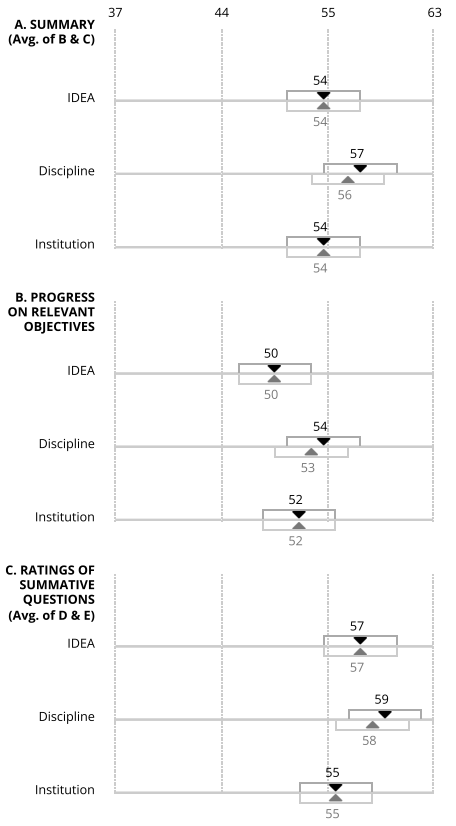
Your Overall Converted Ratings

Ratings of Summative Questions	Raw	Adj.
D. Excellent Teacher		
IDEA	59	60
Discipline	60	61
Institution	57	57
E. Excellent Course		
IDEA	55	55
Discipline	56	56
Institution	52	52

Converted Average Buckets
Based on a Bell Curve

Much Lower *(Lowest 10%)*	Lower *(Next 20%)*	Similar *(Middle 40%)*	Higher *(Next 20%)*	Much Higher *(Highest 10%)*
37 or Lower	**38 - 44**	**45 - 55**	**56 - 62**	**63 or Higher**

Your Converted Average



8/14/24, 11:41 AM - Anthology

		Your Converted Average		
Course Description	**Your Average**	**IDEA**	**Discipline**	**Institution**
Amount of coursework	3.8	60	57	60
Difficulty of subject matter	3.9	59	56	59

		Your Converted Average		
Student Description	**Your Average**	**IDEA**	**Discipline**	**Institution**
As a rule, I put forth more effort than other students on academic work.	3.8	49	50	49
I really wanted to take this course regardless of who taught it.	4.5	65	60	63
When this course began I believed I could master its content.	4	52	51	53
My background prepared me well for this course's requirements.	3.4	43	45	44

Formative

Teaching Essentials	**Your Average**	**Students Rating**	**Suggested Action**
Demonstrated the importance and significance of the subject matter	4.2	0% (1 or 2) 93% (4 or 5)	You employed the method with frequency typical of those teaching classes of similar size and level of student motivation.
Made it clear how each topic fit into the course	4.2	0% (1 or 2) 86% (4 or 5)	You employed the method with frequency typical of those teaching classes of similar size and level of student motivation.
Explained course material clearly and concisely	4.4	0% (1 or 2) 93% (4 or 5)	You employed the method more frequently than those teaching classes of similar size and level of student motivation.
Introduced stimulating ideas about the subject	4.2	0% (1 or 2) 93% (4 or 5)	You employed the method with frequency typical of those teaching classes of similar size and level of student motivation.
Inspired students to set and achieve goals which really challenged them	3.8	7% (1 or 2) 71% (4 or 5)	You employed the method less frequently than those teaching classes of similar size and level of student motivation.

Reflective and Integrative Learning	**Your Average**	**Students Rating**	**Suggested Action**
Helped students to interpret subject matter from diverse perspectives (e.g., different cultures, religions, genders, political views)	3.1	36% (1 or 2) 43% (4 or 5)	You employed the method less frequently than those teaching classes of similar size and level of student motivation.
Encouraged students to reflect on and evaluate what they have learned	4.6	0% (1 or 2) 93% (4 or 5)	You employed the method more frequently than those teaching classes of similar size and level of student motivation.
Provided meaningful feedback on students' academic performance	4.2	0% (1 or 2) 86% (4 or 5)	You employed the method more frequently than those teaching classes of similar size and level of student motivation.
Stimulated students to intellectual effort beyond that required by most courses	4.4	0% (1 or 2) 93% (4 or 5)	You employed the method more frequently than those teaching classes of similar size and level of student motivation.
Related course material to real life situations	3.6	7% (1 or 2) 57% (4 or 5)	You employed the method less frequently than those teaching classes of similar size and level of student motivation.
Created opportunities for students to apply course content outside the classroom	3.6	0% (1 or 2) 43% (4 or 5)	You employed the method less frequently than those teaching classes of similar size and level of student motivation.

Collaborative Learning	**Your Average**	**Students Rating**	**Suggested Action**
Formed teams or groups to facilitate learning	4.9	0% (1 or 2) 100% (4 or 5)	You employed the method more frequently than those teaching classes of similar size and level of student motivation.
Asked students to help each other understand ideas or concepts	4.2	7% (1 or 2) 79% (4 or 5)	You employed the method with frequency typical of those teaching classes of similar size and level of student motivation.

Active Learning	**Your Average**	**Students Rating**	**Suggested Action**
Encouraged students to use multiple resources (e.g., Internet, library holdings, outside experts) to improve understanding	3.6	21% (1 or 2) 57% (4 or 5)	You employed the method less frequently than those teaching classes of similar size and level of student motivation.
Involved students in hands-on projects such as research, case studies, or real life activities	3.7	7% (1 or 2) 57% (4 or 5)	You employed the method less frequently than those teaching classes of similar size and level of student motivation.
Gave projects, tests, or assignments that required original or creative thinking	3.9	7% (1 or 2) 64% (4 or 5)	You employed the method less frequently than those teaching classes of similar size and level of student motivation.

Quantitative

Describe the frequency of your instructor's teaching procedures.	**Hardly Ever**	**Occasionally**	**Sometimes**	**Frequently**	**Almost Always**	**N**	**DNA**	**SD**	**M**
The Instructor:									
Found ways to help students answer their own questions	0% (0)	0% (0)	0% (0)	50% (7)	50% (7)	14	0	0.5	4.5
Helped students to interpret subject matter from diverse perspectives (e.g., different cultures, religions, genders, political views)	7.14% (1)	28.57% (4)	21.43% (3)	28.57% (4)	14.29% (2)	14	0	1.19	3.14
Encouraged students to reflect on and evaluate what they have learned	0% (0)	0% (0)	7.14% (1)	28.57% (4)	64.29% (9)	14	0	0.62	4.57
Demonstrated the importance and significance of the subject matter	0% (0)	0% (0)	7.14% (1)	64.29% (9)	28.57% (4)	14	0	0.56	4.21
Formed teams or groups to facilitate learning	0% (0)	0% (0)	0% (0)	7.14% (1)	92.86% (13)	14	0	0.26	4.93
Made it clear how each topic fit into the course	0% (0)	0% (0)	14.29% (2)	50% (7)	35.71% (5)	14	0	0.67	4.21
Provided meaningful feedback on students' academic performance	0% (0)	0% (0)	14.29% (2)	50% (7)	35.71% (5)	14	0	0.67	4.21
Stimulated students to intellectual effort beyond that required by most courses	0% (0)	0% (0)	7.14% (1)	50% (7)	42.86% (6)	14	0	0.61	4.36
Encouraged students to use multiple resources (e.g., Internet, library holdings, outside experts) to improve understanding	7.14% (1)	14.29% (2)	21.43% (3)	28.57% (4)	28.57% (4)	14	0	1.24	3.57
Explained course material clearly and concisely	0% (0)	0% (0)	7.14% (1)	42.86% (6)	50% (7)	14	0	0.62	4.43

Describe the frequency of your instructor's teaching procedures.	**Hardly Ever**	**Occasionally**	**Sometimes**	**Frequently**	**Almost Always**	**N**	**DNA**	**SD**	**M**
The Instructor:									
Related course material to real life situations	0% (0)	7.14% (1)	35.71% (5)	50% (7)	7.14% (1)	14	0	0.73	3.57
Created opportunities for students to apply course content outside the classroom	0% (0)	0% (0)	57.14% (8)	28.57% (4)	14.29% (2)	14	0	0.73	3.57
Introduced stimulating ideas about the subject	0% (0)	0% (0)	7.14% (1)	64.29% (9)	28.57% (4)	14	0	0.56	4.21
Involved students in hands-on projects such as research, case studies, or real life activities	0% (0)	7.14% (1)	35.71% (5)	35.71% (5)	21.43% (3)	14	0	0.88	3.71
Inspired students to set and achieve goals which really challenged them	0% (0)	7.14% (1)	21.43% (3)	57.14% (8)	14.29% (2)	14	0	0.77	3.79
Asked students to share ideas and experiences with others whose backgrounds and viewpoints differ from their own	0% (0)	21.43% (3)	35.71% (5)	14.29% (2)	28.57% (4)	14	0	1.12	3.5
Asked students to help each other understand ideas or concepts	0% (0)	7.14% (1)	14.29% (2)	28.57% (4)	50% (7)	14	0	0.94	4.21
Gave projects, tests, or assignments that required original or creative thinking	0% (0)	7.14% (1)	28.57% (4)	28.57% (4)	35.71% (5)	14	0	0.96	3.93
Encouraged student-faculty interaction outside of class (e.g., office visits, phone calls, email)	0% (0)	0% (0)	7.14% (1)	57.14% (8)	35.71% (5)	14	0	0.59	4.29

Describe your progress on:	No Apparent Progress	Slight Progress	Moderate Progress	Substantial Progress	Exceptional Progress	N	DNA	SD	M
Gaining a basic understanding of the subject (e.g., factual knowledge, methods, principles, generalizations, theories)	0% (0)	0% (0)	0% (0)	71.43% (10)	28.57% (4)	14	0	0.45	4.29
Developing knowledge and understanding of diverse perspectives, global awareness, or other cultures	14.29% (2)	42.86% (6)	35.71% (5)	7.14% (1)	0% (0)	14	0	0.81	2.36
Learning to *apply* course material (to improve thinking, problem solving, and decisions)	0% (0)	0% (0)	14.29% (2)	57.14% (8)	28.57% (4)	14	0	0.64	4.14
Developing specific skills, competencies, and points of view needed by professionals in the field most closely related to this course	0% (0)	0% (0)	7.14% (1)	64.29% (9)	28.57% (4)	14	0	0.56	4.21
Acquiring skills in working with others as a member of a team	0% (0)	0% (0)	42.86% (6)	35.71% (5)	21.43% (3)	14	0	0.77	3.79
Developing creative capacities (inventing; designing; writing; performing in art, music, drama, etc.)	14.29% (2)	42.86% (6)	21.43% (3)	7.14% (1)	14.29% (2)	14	0	1.23	2.64
Gaining a broader understanding and appreciation of intellectual/cultural activity (music, science, literature, etc.)	14.29% (2)	28.57% (4)	14.29% (2)	21.43% (3)	21.43% (3)	14	0	1.39	3.07
Developing skill in expressing myself orally or in writing	7.14% (1)	7.14% (1)	35.71% (5)	42.86% (6)	7.14% (1)	14	0	0.97	3.36
Learning how to find, evaluate, and use resources to explore a topic in depth	14.29% (2)	28.57% (4)	21.43% (3)	21.43% (3)	14.29% (2)	14	0	1.28	2.93
Developing ethical reasoning and/or ethical decision making	21.43% (3)	42.86% (6)	7.14% (1)	21.43% (3)	7.14% (1)	14	0	1.24	2.5
Learning to *analyze* and *critically evaluate* ideas, arguments, and points of view	7.14% (1)	14.29% (2)	14.29% (2)	35.71% (5)	28.57% (4)	14	0	1.23	3.64
Learning to apply knowledge and skills to benefit others or serve the public good	7.14% (1)	28.57% (4)	42.86% (6)	7.14% (1)	14.29% (2)	14	0	1.1	2.93
Learning appropriate methods for collecting, analyzing, and interpreting numerical information	0% (0)	0% (0)	21.43% (3)	21.43% (3)	57.14% (8)	14	0	0.81	4.36

The Course: *On the next two items, compare this course with others you have taken at this institution.*	Much Less than Most Courses	Less than Most Courses	About Average	More than Most Courses	Much More than Most Courses	N	DNA	SD	M
Amount of coursework	0% (0)	0% (0)	35.71% (5)	50% (7)	14.29% (2)	14	0	0.67	3.79
Difficulty of subject matter	0% (0)	7.14% (1)	28.57% (4)	35.71% (5)	28.57% (4)	14	0	0.91	3.86

For the following items, choose the option that best corresponds to your judgment.	Definitely False	More False than True	In Between	More True than False	Definitely True	N	DNA	SD	M
As a rule, I put forth more effort than other students on academic work.	0% (0)	14.29% (2)	21.43% (3)	35.71% (5)	28.57% (4)	14	0	1.01	3.79
I really wanted to take this course regardless of who taught it.	0% (0)	0% (0)	14.29% (2)	21.43% (3)	64.29% (9)	14	0	0.73	4.5
When this course began I believed I could master its content.	0% (0)	7.14% (1)	14.29% (2)	50% (7)	28.57% (4)	14	0	0.85	4
My background prepared me well for this course's requirements.	14.29% (2)	7.14% (1)	14.29% (2)	50% (7)	14.29% (2)	14	0	1.24	3.43
Overall, I rate this instructor an excellent teacher.	0% (0)	0% (0)	0% (0)	14.29% (2)	85.71% (12)	14	0	0.35	4.86
Overall, I rate this course as excellent.	0% (0)	0% (0)	7.14% (1)	42.86% (6)	50% (7)	14	0	0.62	4.43

Qualitative

Comments -

- What is one specific way the course structure (regardless of Kyle's instruction) should stay the same? - I believe that the activity work in the table groups is very helpful and should stay the same for future classes. What is one specific way the course structure (regardless of Kyle's instruction) can be improved? - I can't think of any ways that it can be improved. What is one specific way Kyle's instruction (regardless of course structure) should stay the same? - He asks people to ask questions and he thoroughly explains things in helpful ways What is one specific way Kyle's instruction (regardless of course structure) can be improved? - There should be more time to do problems like the ones we see for homework in class, so that you are not lost when you open the homework. Also more step by step instructions on how to solve problems for the people that it is less intuitive for. This year, Kyle gave different "types" of problems on homework (bold, italic, starred, and "regular") to help discern where to focus your homework efforts: What is one specific way these "types" were helpful? - they helped me deduce which questions were most important. This year, Kyle provided "additional exercises" to supplement the textbook reading and exercises. What is one specific way these exercises were helpful? - it was helpful to see different types of problems and applications to the topics.
- I really enjoyed the textbook and group activities implemented and think those are tool which should definitely stay. I liked the preview activities but wish we talked about them more in class. I appreciated how Kyle brought enthusiasm to each topic. I think he did a good job of blending them together and creating a foundation for "why?" I also liked his coloring on the chalkboard and the constant rotation of groups. I think there were certain problems/activities which we weren't able to finish / prove correctly the first time which could lead to confusion. Also, sometimes we didn't have a question but were still confused so it was helpful when Kyle made us all ask one question as a group. I did not really follow the guidelines as I have built my own study habits already. I really liked that I knew which problems to focus on or double check, this helped improve my grade and focus my time. I also enjoyed the challenge / feeling of accomplishment in doing the starred problems. I think the types are great and shouldn't be changed. The additional exercises were able to introduce new and important language which the textbook doesn't cover such as our "one and only one" and provided a better foundation in the functions section by making us use identity functions and mappings. I also really liked it because there was no temptation to flip to the back of the book so every answer had to be more thought out individually. I am not sure what could be changed with these. I did appreciate hints on a few of the problems. daq :)
- I had a fantastic experience in discrete math this semester with Professor Hansen. I loved how interactive he was and how much he cared about our learning and understanding of the subjects.
- Thanks for making this class a cool, mind-changing, and logical class. It really taught me how to think creatively about my moves in discrete math, and I liked how it changed my perspectives on the concepts that I already knew.
- What is one specific way the course structure (regardless of Kyle's instruction) can be improved? Start with more clear explanations of proofs. For someone who has never seen proofs before they were exceptionally confusing. It felt like when we started them I had proofs being thrown at me and I wasn't sure even on the structure of the proofs. Overtime I got them and getting more examples in class helped me understand what proofs look like. What is one specific way Kyle's instruction (regardless of course structure) should stay the same? Keep the split between multiple modes of learning. The homework, group work, lectures, and office hour instruction were varied and helped me approach the content from many different angles. This year, Kyle provided a "sample schedule" to help students gauge where they should be spending their time in this class. If you tried to follow these guidelines, what was most helpful and what was least helpful about the schedule? I didn't follow them consistently but when I did they were a helpful way to gauge the amount of time needed. If you did not try to follow them, why not? - For when I was not following them I was simply just trying to follow my own schedule. This year, Kyle gave different "types" of problems on homework (bold, italic, starred, and "regular") to help discern where to focus your homework efforts: What is one specific way these "types" were helpful? Sometimes if I was pressed for time, knowing what to focus on and what I can get through a bit quicker was nice. What is one specific way these "types" could be improved? I mainly just looked at them as either bold or not. If it was bold I needed to try to make sure I got the right answer. If it was not bold, I would still do the problem for personal understanding but wasn't as worried about getting it right. This year, Kyle provided "additional exercises" to supplement the textbook reading and exercises. What is one specific way these exercises were helpful? They typically were a bit different from the normal exercise and provided yet another angle to look at the content from which was appreciated. What is one specific way these exercises could be improved? Maybe having answers to the questions. Sometimes I would have problem and was completely unsure if what I did was correct or not and wouldn't have time to meet for office/tutor hours to check. Overall I really liked this course. Kyle is a great professor.
- I loved this class! This class should be required in my personal opinion. The skills I gained in this class are and continue to be invaluable. Kyle Hansen is an excellent professor who is passionate about the subject matter. He is kind and gives everyone in the class a chance to succeed. I'm sad that this class is over 10/10!
- great teacher that wanted the best for his students
- i really enjoyed taking this class and having you as a prof!
- These relate directly to the questions asked, and follow the same order. 1. The spacing of the three tests, two midterms and final were excellent. We learned enough to take the first midterm and still have a lot that it covered. The second midterm is necessary to cement the ideas from the second part of class, all the proofs by induction. Testing has been proven to be one of the most effective ways of learning, and I think this class had a great testing structure. The typesets also were great complements to the tests, being helpful study aids while letting us learn latex. I liked the group project instead of a typeset for the last final since that's just a busy time of the year. 2. There were a couple topics that might have needed a bit more support. The proofs using strong induction, at least a couple of the homework problems, were difficult since I hadn't seen them before. I also feel that many people didn't get the rules for the big theta classes, at least not straight away, like taking the biggest term. 3. I liked the amount of problems done on the board, and the overall switching between lessons and bookwork so that we didn't have to watch someone write the whole time, but also got to work some problems by ourselves. The instruction should stay with the boards, and not switch to a powerpoint lecture style. 4. There are only two times I remember being lost, both me, the professor, and the class. The problem with finding the most visited point on the graph using probability. And a proof of big omega classes both had us all stumped. While those were some of the most memorable times for me, because I am extremely interested in problem solving, some of my other classmates seemed to become a bit lost. The professor may choose to omit the problem with the visited point since it's generally confusing and isn't used many other times. The professor should, not necessary, stick to worked examples he knows, but this may be a good idea. Some of the problems just take some time to think, and mistakes are made when there isn't a lot of time. I would suggest sticking to problems that are planned when the problems are hard. Also, this may be avoided if instead of jumping into a hard problem at the end of class, the professor waits till next class to explain it. These are just a few ideas, and this didn't really happen that often, but these are some ways the teaching might become better. 5. If this isn't referring to the weekly (maybe more often) emails of what we learned, I have no idea what it's referring to. And if it is the emails, I didn't know they were supposed to help us divide our time into what's important. I didn't follow the emails, but I don't really know what this question if referring to. 6. For the most part, the additional exercises were helpful. There were a couple questions that were in the additional exercises that weren't a part of the book which were intriguing, like the question that had us counting infinities. There were also some that were very long, and tedious processes, which I didn't like. But some of math is like that. For the most part, the exercises were complementary. I don't think more should be added. Some of the homework was decently long because after doing a lot of bookwork there were multipart additional exercises. If the professor decides to add a new additional exercise it should replace one of the others.
- 1. The order in which the chapters are explained. 2. More background or information on topics. 3. The way you go through the course material makes it great to pay attention to! 4. Maybe go through easier examples at first and then explain how it connects to more challenging examples/ problems. 5. I did not try to follow the guidelines because I found that I needed to spread out my time throughout the day and week differently. 6. These types were helpful because I knew which questions I for sure needed to understand the best. 7. The problems that were graded on if they were correct were usually a lot more challenging and I had a lot more questions on them. 8. Introduced new problems than the ones in the books 9. I sometimes found it hard to find examples in the book that could help me figure out how to solve the other exercises, so maybe give hints or where to look in the book for help.
- I didn't follow the sample schedule this year, because I felt sufficiently competent in my learning and didn't see the need for time spent beyond homework. Some additional excersises are extremely helpful, but for others that present a lot of new information, it can be difficult to take both the new information and the concepts of the overall homework together.

B.3 Sample ESCI Instructor Evaluations, UCSB, Spring 2023

ESCI ONLINE SURVEY STATISTICS 6/23/23

Note that the Campus and Departmental Norms for this Survey are based ONLY on other ESCI Online Courses.
Due to the different method of data collection, these Norms do not include ESCI Surveys collected by the paper response forms.

End of Spring Quarter 2023 -- ESCI Online

Department and Campus Norms taken over time span: Fall Quarter 2018 - Spring Quarter 2023

Abbrv: **CMPSC** Instructor: **HANSEN K D** Rank: **Teaching Associate** Course: **CMPSC 40 0100** Type: **Lecture**
Department: **COMPUTER SCIENCE** Course Enrollment: **95**

Guidelines for "Interpreting ESCI Data" and a description of the "Report Output" can be found at http://oic.id.ucsb.edu/esci.
NOTICE: Please examine these evaluations upon receipt and immediately report any suspected errors to: ESCI Office, Instructional Development, 1130 Kerr Hall (x4278) or (id-esci@ucsb.edu)

These two questions were determined by the Academic Senate Committee on Academic Personnel (CAP) and Committee on Effective Teaching and Instructional Support (CETIS) to be appropriate for all student end-of-course surveys.

(1) **A.** In rating a course, you should consider the instructor's teaching apart from the course materials or content.

Please rate the overall quality of the instructor's teaching.

(a) Excellent (b) Very Good (c) Good (d) Fair (e) Poor

Response weighting:	1 (a)	2 (b)	3 (c)	4 (d)	5 (e)	Blank Response	Total Students	Total Courses	Mean	Median
This COURSE current quarter	**52%**	**23%**	**18%**	**5%**	**2%**	**0**	**65**	**1**	**1.8**	**1.0**
Student-weighted Norms (UG students)										
Dept CMPSC TCHG ASSOCs current q	34%	27%	25%	8%	6%	0	142	2	2.3	2.0
Dept CMPSC TCHG ASSOCs over time	41%	24%	17%	11%	7%	0	742	17	2.2	2.0
Campus TCHG ASSOCs over time	55%	24%	13%	5%	2%	22	20304	728	1.7	1.0
Course-weighted Norms (UG courses)										
Dept CMPSC TCHG ASSOCs current q	35%	26%	25%	8%	6%			2	2.2	2.0
Dept CMPSC TCHG ASSOCs over time	40%	22%	17%	13%	8%			17	2.3	2.0
Campus TCHG ASSOCs over time	62%	21%	11%	4%	2%			728	1.6	1.0

(2) **B.** Please rate the overall quality of the course, including its material or content, independent of the instructor's teaching.

(a) Excellent (b) Very Good (c) Good (d) Fair (e) Poor

Response weighting:	1 (a)	2 (b)	3 (c)	4 (d)	5 (e)	Blank Response	Total Students	Total Courses	Mean	Median
This COURSE current quarter	**43%**	**29%**	**25%**	**2%**	**2%**	**0**	**65**	**1**	**1.9**	**2.0**
Student-weighted Norms (UG students)										
Dept CMPSC TCHG ASSOCs current q	33%	26%	27%	8%	6%	0	142	2	2.3	2.0
Dept CMPSC TCHG ASSOCs over time	38%	30%	19%	8%	5%	1	742	17	2.1	2.0
Campus TCHG ASSOCs over time	53%	26%	14%	5%	2%	41	20304	728	1.8	1.0
Course-weighted Norms (UG courses)										
Dept CMPSC TCHG ASSOCs current q	34%	26%	27%	8%	5%			2	2.2	2.0
Dept CMPSC TCHG ASSOCs over time	38%	28%	18%	10%	6%			17	2.2	2.0
Campus TCHG ASSOCs over time	59%	23%	12%	4%	2%			728	1.7	1.0

HANSEN K D
CMPSC 40 0100 (T R 1400-1515 NH 1006) Survey Number: **414360**

ESCI ONLINE SURVEY STATISTICS 6/23/23

Note that the Campus and Departmental Norms for this Survey are based ONLY on other ESCI Online Courses.
Due to the different method of data collection, these Norms do not include ESCI Surveys collected by the paper response forms.

End of Spring Quarter 2023 -- ESCI Online

Department and Campus Norms taken over time span: Fall Quarter 2018 - Spring Quarter 2023

Abbrv: **CMPSC** Instructor: **HANSEN K D** Rank: **Teaching Associate** Course: **CMPSC 40 0100** Type: **Lecture**
Department: **COMPUTER SCIENCE** Course Enrollment: **95**

Guidelines for "Interpreting ESCI Data" and a description of the "Report Output" can be found at http://oic.id.ucsb.edu/esci.
NOTICE: Please examine these evaluations upon receipt and immediately report any suspected errors to: ESCI Office, Instructional Development, 1130 Kerr Hall (x4278) or (id-esci@ucsb.edu)

(3726) **1. Please indicate what you consider to be the most valuable aspects of the course.**

Great lectures, kind and passionate professor, reasonable homework and exam expectations, content presented well

---

I really liked how the lectures were structured with interactive questions and writing on the whiteboard in conjunction with teaching instead of slides.

I think the most important thing about this course is the fact that the homework is worth a lot of our grade, and that it isn't just graded on completion. I've only been able to get a perfect score on one of the (over 10) assignments this quarter. This isn't because Professor Hansen is unreasonable, it's because there's naturally always a lot to improve on when doing countless proofs, and he carefully reads and grades every student's work with specific feedback to improve. The homework takes a fair amount of time, but it's always just enough to really hammer home what we learned, and it always feels satisfying to do. I also appreciate the fact that there aren't any midterms. Obviously, most students would say this about a class without midterms just because people don't like midterms, but I genuinely think it works better for this class. Instead, we have a quiz every other week that is open note. I think a midterm would make a lot less sense because the class is about making sure we understand the tools we have to logically prove different problems in math, not memorizing specific proofs and facts. This is what a midterm would likely be about: memorizing as much as you can, only to get stuck when there's a proof that you just don't really understand how to do. Instead, the open-note quizzes are low stress ways to make sure we understand the tools we are using. We can use proofs we've done in class as templates. When I take the quiz, I'm not using the notes as a crutch because I never learned the information, I'm using the notes to guide me along the way to a solution to a difficult proof. Attending class and doing the homework was most definitely enough to make me understand how to prove things logically and the strategies that come with it, and the quizzes are just a check to make sure of that.

The office hour as Professor answers all questions you have.

---

everything

The course was a challenging course that required us to study and practice problems more.

He explains concepts in a way that is easy to understand.

The lectures are always very clear and easy to follow, making going to class interesting and the homework easy to do. Most of the time, the lectures would give us exactly the tools we need to do well on homework/quizzes. I liked the think-pair-share format because it prompts us to be actively engaged in the content. If we're just listening to someone talk at us the whole time, it's easy to get bored and get distracted. The homework, as long as it may be, also really helps to reinforce the concepts we learn in class (both hunter and other exercises).

The course taught us a very different set of material than what most people were used to, but handles it quite well.

ESCI ONLINE SURVEY STATISTICS 6/23/23

Note that the Campus and Departmental Norms for this Survey are based ONLY on other ESCI Online Courses.
Due to the different method of data collection, these Norms do not include ESCI Surveys collected by the paper response forms.

End of Spring Quarter 2023 -- ESCI Online

Department and Campus Norms taken over time span: Fall Quarter 2018 - Spring Quarter 2023

Abbrv: **CMPSC** Instructor: **HANSEN K D** Rank: **Teaching Associate** Course: **CMPSC 40 0100** Type: **Lecture**
Department: **COMPUTER SCIENCE** Course Enrollment: **95**

Guidelines for "Interpreting ESCI Data" and a description of the "Report Output" can be found at http://oic.id.ucsb.edu/esci.
NOTICE: Please examine these evaluations upon receipt and immediately report any suspected errors to: ESCI Office, Instructional Development, 1130 Kerr Hall (x4278) or (id-esci@ucsb.edu)

I appreciate the teaching and sections are amazing!

The way he taught the class through chalk board and explaining every thing on the board
---
Lectures were well executed. Homework was tough but I learned a lot. I liked that instructors responded quickly on piazza.

Makes me rethink a lot of assumptions I've had my entire life with math. Professor is superb at teaching, makes students want to engage with the material.

The professor is very enthusiastic and tries his best to be thorough with the content. The homework is very valuable, as it is challenging and forces you to fully grasp the concepts.

Induction, Counting Problems, Methods of Proof, Formal Logic
---
detailed lectures

The lectures are clear, interesting, and easy to follow along with.

The lectures are detailed and easy to follow

He is really engaging inside the classroom and his teaching skills are on point.

Detailed explanation of class topics.

Comprehensive hw that allowed for a pretty thorough review. Decent lectures.

I found it valuable to learn how to communicate logic in more professional notation and the dynamics of numbers in computer science.

The organization and structure of the course was very good. A thorough syllabus that I can reference in the case that I needed to look back into the textbook to cover topics that were unclear during lecture was very helpful.

The professor, Kyle Hansen, was incredibly enthusiastic about the topic and it showed in lectures. Professor Hansen provided engaging and instructive lectures that were paced well and generally easy to follow. The structure of the course was fantastic. My TA, Isaac Mackey, provided ample opportunities to succeed. He went above and beyond offering students in his section the opportunity to have homework proofread. The section he lead was incredibly informative and was great as a supplement to the sometimes dense lectures. I also found the requirement of learning LaTeX to be extremely helpful as it helped me become familiarized with the tool and approach it when it otherwise seemed intimidating. Easily one of the courses with the best teaching

ESCI ONLINE SURVEY STATISTICS 6/23/23

Note that the Campus and Departmental Norms for this Survey are based ONLY on other ESCI Online Courses.
Due to the different method of data collection, these Norms do not include ESCI Surveys collected by the paper response forms.

End of Spring Quarter 2023 -- ESCI Online

Department and Campus Norms taken over time span: Fall Quarter 2018 - Spring Quarter 2023

Abbrv: **CMPSC** Instructor: **HANSEN K D** Rank: **Teaching Associate** Course: **CMPSC 40 0100** Type: **Lecture**
Department: **COMPUTER SCIENCE** Course Enrollment: **95**

Guidelines for "Interpreting ESCI Data" and a description of the "Report Output" can be found at http://oic.id.ucsb.edu/esci.
NOTICE: Please examine these evaluations upon receipt and immediately report any suspected errors to: ESCI Office, Instructional Development, 1130 Kerr Hall (x4278) or (id-esci@ucsb.edu)

staff I have had.

I liked how neatly structured the course was for the majority of the quarter. Weekly quizzes and homework helped me stay on track.

Favorite TA i've ever had, super helpful, very critical to improve, and helped on homework.

The way Professor Hansen taught the course was very effective (i.e. writing on the chalkboard instead of going through slides on a screen). By writing out all the steps along with us and explaining the reasoning, it allowed more time for us to think about the concepts. It was also helpful how we revisited and tied in the concepts from last lecture and the current lecture at the beginning of class so there was a sense of flow to the course and we could be reminded of what we did last time. Office hours were also extremely helpful and the instructors responded on Piazza quickly if I had questions, which was very beneficial to understanding the course materials. Overall, this really helped keep me engaged throughout the entire course.

I feel like the teaching methods were good. Most new topics felt approachable, with the instructor providing pretty easy to understand examples and building up to more complex ideas. Very rarely did I ever feel lost during lectures. The homework felt comprehensive without being overwhelming, and TA feedback was helpful in understanding mistakes to avoid them in the future. The general structure of the course, having biweekly quizzes, worked well for me. Having no exams until the final made the class less stressful that it could've been, while still testing our abilities in an exam-like environment.

Sufficient and high-quality choices of homework problems both from textbooks and those professor comes up himself. In-time feedback from teaching faculties. These really helps a lot.

Learning how to prove an iterative function and recursive function to be equivalent

---

Lectures were relevant to the course material and beyond. Instructors are helpful both during and outside class. Exam preparation material is very comprehensive.

---

interesting for those interested in discrete math

Smaller quizzes reduces the stress of exams. Professor Hansen was accessible and helpful to students.

Great explanation on the content.

It goes through important topics in an organized and formalized manner.

Definitely learning to write proofs.

The hw problems test all areas that you must know for the quizzes which makes it great study material. Likewise there are many office hours to clear up questions.

ESCI ONLINE SURVEY STATISTICS 6/23/23

Note that the Campus and Departmental Norms for this Survey are based ONLY on other ESCI Online Courses.
Due to the different method of data collection, these Norms do not include ESCI Surveys collected by the paper response forms.

End of Spring Quarter 2023 -- ESCI Online

Department and Campus Norms taken over time span: Fall Quarter 2018 - Spring Quarter 2023

Abbrv: **CMPSC** Instructor: **HANSEN K D** Rank: **Teaching Associate** Course: **CMPSC 40 0100** Type: **Lecture**
Department: **COMPUTER SCIENCE** Course Enrollment: **95**

Guidelines for "Interpreting ESCI Data" and a description of the "Report Output" can be found at http://oic.id.ucsb.edu/esci.
NOTICE: Please examine these evaluations upon receipt and immediately report any suspected errors to: ESCI Office, Instructional Development, 1130 Kerr Hall (x4278) or (id-esci@ucsb.edu)

Throughout the course, we were given many useful examples and thorough explanations on how to write proofs.

The homework feels like the most vital part of the course.

This was the first course that taught me about proofs and how to write them. I've seen proofs, theorem, and related ideas in other classes, but this class went into depth and gave me a good fundamental understanding.

The Regrade Requests, Piazza, and chalkboard problems.

The lectures in this course were the most valuable out of all the courses I have taken this year. The content is explained clearly and the pace of the class is very good. I learned the most from attending lecture.

I think the lectures were good with pair share and all of the different ways to get students involved to keep them interested. The homework assignments were pretty good although there were a couple that took much longer than others. The quizzes were good difficulty and had good frequency to help ground you and show you what you know and what you need to work on. Piazza was really helpful and participation points are good because they kept me going to section which further helped my understanding. The arrangement of topics and balance between homework and quizzes was good.

The proof examples and willingness to answer questions.

The lectures.

I like the homework based grading schedule and the frequent quizzes instead of a midterm.

I like basically all of it so not sure what helpful feedback I can really give... I found the lectures very helpful but sometimes they were a little hard to follow; the homework is good because it gives me a chance to use LaTeX which I like while practicing writing proofs which is helpful.

Liked the course, curriculum made sense

ESCI ONLINE SURVEY STATISTICS 6/23/23

Note that the Campus and Departmental Norms for this Survey are based ONLY on other ESCI Online Courses.
Due to the different method of data collection, these Norms do not include ESCI Surveys collected by the paper response forms.

End of Spring Quarter 2023 -- ESCI Online

Department and Campus Norms taken over time span: Fall Quarter 2018 - Spring Quarter 2023

Abbrv: **CMPSC** Instructor: **HANSEN K D** Rank: **Teaching Associate** Course: **CMPSC 40 0100** Type: **Lecture**
Department: **COMPUTER SCIENCE** Course Enrollment: **95**

Guidelines for "Interpreting ESCI Data" and a description of the "Report Output" can be found at http://oic.id.ucsb.edu/esci.
NOTICE: Please examine these evaluations upon receipt and immediately report any suspected errors to: ESCI Office, Instructional Development, 1130 Kerr Hall (x4278) or (id-esci@ucsb.edu)

(3707) **2. How could the course be improved? (e.g. additional detail about topics, modifications to instructional materials, different teaching strategies, etc.)**

Homework grading is unnecessarily harsh, students should be given chances to redo homework problems to get points back

---

Some of the lectures were a little haphazard/didn't flow as smoothly, but I'm sure that will improve the second time around. It would have been nice to implement a system for grading homework where we could correct our work to get partial credit back because it sort of seemed like we got a grade and didn't get to reflect on it.

I think something that other people might like is to have some sort of resource to document what we learned in each class, online. Attending class is very, very important to making sure you understand the material, and I enjoy attending class anyway. It's entirely taught on the chalkboard, which I think is very helpful for paying attention because I have to so that I don't miss anything. However, I could see that it might be hard if someone must miss class for some reason, as the entire lesson is in person, and there are no online resources describing the topics we learned, or his lecture notes. I'm not sure if this has ever been a problem for anyone, but I could see that it could become one.

It will be better if the material can be covered with more relation with the homework.

---

less homework. lower percentage of score on homework, quiz, and final

---

This course could be improved by adding study guides available on Canvas and/or Piazza before each homework assignment and/or quiz.

The format/structure of proofs could be explained more clearly.

Towards the end of the course, from when we learned strong/structural induction onwards, lectures didn't feel as helpful as in the past. When we learned how to prove things using strong/structural induction, it felt like we hadn't really learned it during lecture and were just thrown off the deep end to do a bunch of proofs without fully understanding or doing both types of proofs in class beforehand. Once we started on chapter 4 and 5 content, it started feeling repetitive because I had already learned the content in prior classes. Especially once we started getting into functions/algorithms/runtime analysis, it wasn't as interesting because I had already learned the content before in prior CS classes.

I believe going forward, having the professor go over simpler strategies to help students understand how to go about their assignments and exams.

The homework is a lot. I think the two times a week structure takes a lot of time and effort and would prefer once a week even if it was more content. Additionally, the homework is graded really harshly for minor reasons which makes it hard to do well and/or be

ESCI ONLINE SURVEY STATISTICS 6/23/23

Note that the Campus and Departmental Norms for this Survey are based ONLY on other ESCI Online Courses.
Due to the different method of data collection, these Norms do not include ESCI Surveys collected by the paper response forms.

End of Spring Quarter 2023 -- ESCI Online

Department and Campus Norms taken over time span: Fall Quarter 2018 - Spring Quarter 2023

Abbrv: **CMPSC** Instructor: **HANSEN K D** Rank: **Teaching Associate** Course: **CMPSC 40 0100** Type: **Lecture**
Department: **COMPUTER SCIENCE** Course Enrollment: **95**

Guidelines for "Interpreting ESCI Data" and a description of the "Report Output" can be found at http://oic.id.ucsb.edu/esci.
NOTICE: Please examine these evaluations upon receipt and immediately report any suspected errors to: ESCI Office, Instructional Development, 1130 Kerr Hall (x4278) or (id-esci@ucsb.edu)

motivated.

Using the white board made the lecture notes chaotic sometimes.

Strong induction and structural induction could have been explained better

---

Less penalization of homework assignments.

Perhaps adding lecture slides in addition to the piazza posts about lecture review, as it would improve students ability to refer to something discussed in class.

Course topics are fine, but they don't seem to flow much from chapter to chapter. First, we did formal logic. Then, we did proofs were formal logic symbols were banned. At some point we did induction and then suddenly we're counting things. Also, too much attention to detail for my taste. I get that you have to prove things, but I felt there was only 1 right way to write a proof. I never knew if I would randomly lose points for my word choice or something like that.

---

less homework, especially formatting time

In general, I'm opposed to graded homework. That's what quizzes are for. Homework should be for practice. It would be better if quizzes were a larger portion of the grade, and homework was a smaller part and graded for completion. For feedback on incorrect homework answers, there are a few options I suggest. Gradescope feedback can stay as is, or you can drop an answer key before the homework is due, or you can keep graded homework, but with the option for revision to correct the wrong answers for a potential full score.

Points are taken away on homework's for reasons not outlined well in lecture. Homework is worth too much.

I would have loved it if he had power point slides. Thats all

---

The workload is way too heavy considering students also have other classes for which they must complete homework. Despite being a 5 unit class, there needs to be some leniency on the deadlines and possibly dropping one or two homework assignments at the end of the quarter because people have unfortunate circumstances and shouldn't be punished for that. There also needs to be more consistency in the work assigned for homework. Some homework take considerably more time than others, like hours more, and should be hence given more time to complete.

Supplemental notes provided along with lecture would really help, especially for topics like induction or more examples of comprehensive proofs for different topics. Lectures are fast paced and not always parallel or similar to the textbook so it's hard to find enough material when reviewing. Rubric for hw - it was hard to figure out what has to be included to achieve maximum points. Did consult TAs for some assignments but had schedule conflicts that meant I couldn't go to office hours every week, and wasn't always able to do comprehensive review in the limited time of OH. No chances for any makeup.

ESCI ONLINE SURVEY STATISTICS 6/23/23

Note that the Campus and Departmental Norms for this Survey are based ONLY on other ESCI Online Courses.
Due to the different method of data collection, these Norms do not include ESCI Surveys collected by the paper response forms.

End of Spring Quarter 2023 -- ESCI Online

Department and Campus Norms taken over time span: Fall Quarter 2018 - Spring Quarter 2023

Abbrv: **CMPSC** Instructor: **HANSEN K D** Rank: **Teaching Associate** Course: **CMPSC 40 0100** Type: **Lecture**
Department: **COMPUTER SCIENCE** Course Enrollment: **95**

Guidelines for "Interpreting ESCI Data" and a description of the "Report Output" can be found at http://oic.id.ucsb.edu/esci.
NOTICE: Please examine these evaluations upon receipt and immediately report any suspected errors to: ESCI Office, Instructional Development, 1130 Kerr Hall (x4278) or (id-esci@ucsb.edu)

The professor teaches in a style that is more similar to a TA in section, which means that not a lot of material is covered over a long period of time with some unnecessary details that may or may not be relevant. Although the professor has good intentions, I feel like it took away from learning the material. In addition, being thrusted into using LaTeX the first week of the quarter was a hard obstacle to overcome, so a better introduction into it would have been wise.

A faster pace through examples and practice problems would have been more helpful in my opinion. Sometimes too much time is spent on one problem during lecture but the structure of the sections were very good in supplementing that and preparing me for the homework regardless.

One change I would have liked to see added to the course would be the addition of homework corrections. I believe that if students were given the opportunity to receive some % of their grade back if they corrected their homework would have helped both deepen their understanding of the material and incentivize them to retrace old homework. As is the course is extremely fast paced with homework's and it is difficult for students to review past topics / homework due to the sheer amount of homework / topics.

I think the course could be improved if there was a little less homework required on week 10 in order to help study for the final.

Some of the example questions we did in class were repetitive of the homework, so I didn't learn as much from them.

Personally, I'd would've liked the grading of the assignments to be less harsher.

Perhaps digital supplements could have been used during lectures rather than writing and drawing everything by hand; occasionally it felt like using the chalkboard was slow when an image in a slideshow could've worked the same purpose.

Maybe can consider using powerpoint to save time from board writting during lectures.

It would be nice if we could learn a little about K-maps in this class
---
More consistency between the different instructors' grading criteria would be appreciated. Expectations on the homework assignments can be vague at times.
---
upload teaching materials/answers instead of putting the onus solely on the students.

Professor needs to stop being indecisive during lecture. He skips around a lot and makes it difficult to follow along. When he is not doing this, his teaching makes sense, but when the teacher keeps changing his mind about what examples he is doing and the order of which he teaches his content it makes it hard to learn.

Assignments were sometimes difficult, and lecture was at times confusing relative to the material. Perhaps guided practice and more challenging examples in class would have helped with understanding.

ESCI ONLINE SURVEY STATISTICS 6/23/23

Note that the Campus and Departmental Norms for this Survey are based ONLY on other ESCI Online Courses.
Due to the different method of data collection, these Norms do not include ESCI Surveys collected by the paper response forms.

End of Spring Quarter 2023 -- ESCI Online

Department and Campus Norms taken over time span: Fall Quarter 2018 - Spring Quarter 2023

Abbrv: **CMPSC** Instructor: **HANSEN K D** Rank: **Teaching Associate** Course: **CMPSC 40 0100** Type: **Lecture**
Department: **COMPUTER SCIENCE** Course Enrollment: **95**

Guidelines for "Interpreting ESCI Data" and a description of the "Report Output" can be found at http://oic.id.ucsb.edu/esci.
NOTICE: Please examine these evaluations upon receipt and immediately report any suspected errors to: ESCI Office, Instructional Development, 1130 Kerr Hall (x4278) or (id-esci@ucsb.edu)

More example of proofs in class.

Some of the grading for the homework feels unfair and lackluster, it feels like the TAs are trying to give as little points as possible. This is the only class where the TAs have made clear mistakes with grading.

I have no criticism, the class was taught extremely well.

When hw is graded, the hw answers are also released. It would make figuring out what was wrong easier.

I feel like it was close, if not perfectly taught.

Lecture notes or a document that lists all the axioms/definitions we need to know would be helpful.

It is perfect as is.

Grading for homework could be harsh at times. The content covered in the last two weeks of class was also not as valuable to me. Topics that we have most likely covered already in other CS classes like the syntax of functions or algorithms should be covered much more quickly in favor of spending time with more complicated topics.

Personally, I feel there wasn't enough time spent on strong and structural induction or at least not enough examples in class to help understand how to use them. I feel that some of the homework hunter problems were graded to harshly where the question in the book didn't ask for an explanation yet we were docked points for not explaining so maybe writing somewhere to remember to explain or be more direct about what we need to explain.

N/A

More online material provided, more content to jump back onto.

Please record the lectures, since this is a difficult topic and there's actually not that many resources online to help review for tests, etc.

I would maybe say you could have slides for lectures or something but I think the way the lectures are is fine. The only problem I had was sometimes I was a little lost with how to do certain homework problems, but the textbook and stuff like the well written proofs sheet usually explain how it should be. Overall everything was great though I liked the class and don't feel like I could have any good suggestions for how to change it.

I liked the course. The assignments and quizzes were challenging, but it made sense. The common mistakes posts on piazza for homework were really helpful, and doing it for all the homework would be nice.

E S C I O N L I N E S U R V E Y S T A T I S T I C S 6/23/23

Note that the Campus and Departmental Norms for this Survey are based ONLY on other ESCI Online Courses.
Due to the different method of data collection, these Norms do not include ESCI Surveys collected by the paper response forms.

End of Spring Quarter 2023 -- ESCI Online

Department and Campus Norms taken over time span: Fall Quarter 2018 - Spring Quarter 2023

Abbrv: **CMPSC** Instructor: **HANSEN K D** Rank: **Teaching Associate** Course: **CMPSC 40 0100** Type: **Lecture**
Department: **COMPUTER SCIENCE** Course Enrollment: **95**

Guidelines for "Interpreting ESCI Data" and a description of the "Report Output" can be found at http://oic.id.ucsb.edu/esci.
NOTICE: Please examine these evaluations upon receipt and immediately report any suspected errors to: ESCI Office, Instructional Development, 1130 Kerr Hall (x4278) or (id-esci@ucsb.edu)

Appendix C

Supplemental Materials

Contents

C.1 Video Consultation Letter

TA DEVELOPMENT PROGRAM
INSTRUCTIONAL DEVELOPMENT, UC SANTA BARBARA
1130 Kerr Hall 805.893.4289 http://oic.id.ucsb.edu/ta-development-program

TO: Kyle Hansen
FR: Brody Thompson, Consultant
RE: Video Consultation on 10-30-19

It was very nice meeting you and being able to observe your teaching, thank you for coming in for a consultation. In this letter I will address the following areas:

1. positive feedback on your teaching
2. your biggest concerns
3. a summary of our discussion

You create good rapport with your students, which fosters a critical learning environment. Students participate in structured group work and you provide worksheets and simple instructions to facilitate these active learning strategies. Not only is there a healthy flow of information in your sections but you use time wisely, effectively, and efficiently, often writing things up on the board while students are working in groups. These are all positive characteristics of your teaching because they actively engage students in the learning process, which research shows creates greater learning gains.

Your biggest concerns are phrasing questions in an inviting way and eliminating habitual phrases of speech that can be alienating to students (e.g. “right?” etc.). Keep in mind that these are lifelong concerns of all educators and can always be improved. Be that as it may, we discussed several ways to address these concerns.

We discussed how rephrasing questions can invite students into the conversion who might not be otherwise. For example, instead of asking “yes/no” questions that focus on a single answer, we can ask our students “open ended” questions that invite answers that focus on their experiences (e.g. “what did you find most confusing”, “how did you approach this problem”, etc.). Another aspect we discussed was planning questions into your lesson plan (i.e. thinking through questions that assess whether your students are achieving the learning objectives you set for them). We discussed that by planning probing questions, we can limit our habitual phrases of questioning, your other big concern. Lastly, focus on addressing your habitual phrases of speech outside of the classroom, this way you will not be overloaded during your teaching.

In sum, you bring enthusiasm for the subject and teaching into your sections and create a lively space for students to engage with each other in groups that are guided by worksheets and structured with simple instructions (e.g. scribe, guide, skeptic). These are all strong pedagogical traits that help create stronger learning outcomes by actively engaging your students. Your main concerns are that you want to create more effective questioning techniques and eliminate alienating phrases of speech. We discussed ways of rephrasing and planning questions to address these concerns.

Attached is one resource to get you started on researched based ways of addressing your concerns.

I hope you find these strategies effective. Thank you for an enjoyable discussion about your teaching, and good luck with your future endeavors.

Warmly,

Brody Thompson

P.S. To download your video simply go to gauchocast.ucsb.edu, and login using your UCSBnetID. Then search for your name. Open your video and look for the download (arrow) icon in the upper right corner. Click on the icon, and your video will download.

If you would like to arrange for additional video tapings to improve your instructional skills, conference presentations or job talks, please email us at id-tavideo@ucsb.edu. You may also arrange for a consultation without a recording to discuss teaching and learning issues.

C.2 Mentor Letter

UNIVERSITY OF CALIFORNIA, SANTA BARBARA

BERKELEY • DAVIS • IRVINE • LOS ANGELES • MERCED • RIVERSIDE • SAN DIEGO • SAN FRANCISCO

SANTA BARBARA • SANTA CRUZ

DEPARTMENT OF MATHEMATICS
South Hall 6510
garfield@math.ucsb.edu

SANTA BARBARA, CALIFORNIA 93106-3840

Department of Mathematics
University of California
Santa Barbara, CA 93106
January 17, 2025

Dear Colleagues,

I have been asked by Kyle Hansen to provide a letter of support for his CCUT portfolio, as one of his UCSB faculty mentors who was in regular contact with him as he taught as instructor of record.

Kyle has been a faithful TA for the department of mathematics at UCSB since 2019. Although Kyle has not been an instructor of record for our department, he has instructed Discrete Mathematics (MA/CS-015) at Westmont College for three separate terms (Fall 2021, 2022, and 2023), as well as the corresponding class Foundations of Computer Science (CMPSC-40) for the Department of Computer Science at UCSB (Spring 2023). During the second term teaching Discrete Mathematics in Fall 2022, I had the opportunity to meet nearly weekly with Kyle, where we were engaged in discussions about pedagogy techniques, teaching experiences, and plans for future instruction.

Kyle simultaneously worked under my instruction as a Lead TA during this term, where he helped train the incoming cohort in their TA duties. He would often draw on his recent teaching experiences to highlight and supplement various topics, providing anecdotal evidence to support what was covered in the training. His success in teaching the Foundations of Computer Science course the following Spring, with nearly four times the number of students as the corresponding class at Westmont, demonstrates his capacity to adapt to the class in front of him and to manage the undergraduate and graduate teaching assistants assigned to him.

Kyle's reception of the departmental Outstanding Teaching Assistant Award in 2024 is a reflection of his commitment, dedication, and excellence in instruction. I fully support Kyle's reception of the Certificate in College and University Teaching.

Respectfully yours,

P-M G

Peter M. Garfield
Associate Teaching Professor

C.3 Sample Syllabus

MA/CS-015: Discrete Mathematics
Fall 2023

Class Information

Time: Tu/Th 8:00-9:50am
Classroom: Voskuyl Library 106

Instructor Information

Name: Prof. Hansen
Office: Winter Hall 307
Email: kylhansen@westmont.edu
Office Hours: Tu/Th 10am-12pm

Tutor Information

Tutor: Isaac Song
Time: TBA
Location: TBA

Course Description

"**MA/CS 015 Discrete Mathematics (4)** Prerequisite: Admissions Math Requirement. If calculus is analog, then discrete mathematics is digital; it is the study of things that you count, rather than things that you measure. Topics include logic (organizing thought), set theory (organizing objects), graph theory (representing relationships), combinatorics (clever ways of counting), and algorithms (analyzing processes). Students will learn how mathematicians prove theorems and how computer scientists solve problems."

Textbook, Materials, & Software

Textbook: *Essentials of Discrete Mathematics* by David Hunter (**Fourth Edition**).
Note: It is essential to get the correct edition of the textbook for this class.

Materials: You will be required to keep a (sprial-bound, or composition) "Lab Book" to record Preview Assignments and In-Class Activities throughout the term. More details will be provided in a separate handout.

Software: You will be asked to typeset some assignments using a markup language known as LaTeX (pronounced "lay-tekh") throughout the term. We will devote some in-class time to setting up and learning basics of LaTeX.

Grading

I will assign grades based on a 90/80/70/60 scale. In borderline cases, I reserve the right to take into account consistency of attendance and participation. The course grade is determined by the following components:

Participation:	10%	
Homework:	25%	
Midterm Exams:	40%	(2 @ 20% each)
Final Exam:	25%	

PARTICIPATION

This class will require your active involvement in discovering and constructing the main concepts of discrete mathematics. Your participation will be assessed through Lab Book write-ups for Preview Assignments, and engagement in Group Activities. More details on what a Lab Book should look like will be found in a separate handout.

Prior to each class meeting, *Preview Assignments* located in the textbook will ask you to do some thinking about new ideas on your own, before we investigate them together. As long as you make a solid effort on every problem, you should receive (nearly) full credit for these assignments.

Classes will typically begin with a mini-lecture, followed by collaborative *Group Activities* that guide you through the new topics for the day. You will write up answers (and record any corrections) to the assigned activities in your Lab Book. Part of your participation grade will be based on your active engagement within your groups.

HOMEWORK

Written Assignments (15%)

Other homework assignments will be collected daily, due at the start of each class period. Selected problems will be graded for correctness, while others will be graded on completeness. I will accept late assignments (but with a grading penalty of 5%) up until the time I leave my office on Tuesdays and Thursdays (around 12 pm, with some wiggle room). Unless there are extreme circumstances, homework will not be accepted afterwards. See Tentative Course Schedule for some homework assigned from the textbook. **This list of assignments is unofficial, and is highly subject to change. Some "Other Assignments" not found in the textbook will be assigned as well. Official assignments/deadlines will be accessible through pdfs on Canvas.**

Typeset Assignments (6% — 2 @ 3% each)

Some problems are listed to be turned in on exam days—these problems are to be *typeset* using LaTeX, and turned in on the day of the exam. They will be graded not only on correctness, but also on the style in which they are typed up. Further details will be provided as the term progresses.

Group Presentation (4%)

The final chapter of the textbook contains applications of what we will have learned throughout the semester, or some other topic subject to instructor approval. Groups will give a brief (20-minutes max each) presentation on one of the topics to the rest of the class during the final week of lectures, along with a written (typeset) report. Group selection and further details will be provided around the date of the second Midterm Exam.

EXAMS

There will be two (2) written exams in class during the semester worth 20% each, and one (1) cumulative written final exam worth 25% of the final grade, for a total of three (3) exams worth 65% of your grade. The dates and scope of these exams will be announced well in advance, though tentative dates can be found on final page of the syllabus. The final exam will be on **Friday** 12/15 from 8:00-10:00am. The final exam will not be rescheduled to accommodate travel arrangements.

In general, we will try to conform to the following plan for the scope of exams, although this plan is subject to revision at the instructor's discretion.

- *Exam #1*: Formal Logic, Mathematical Proof, Graphs, Sets, Relations
- *Exam #2*: Functions, Recursion, Induction, Combinatorics and Probability.
- *Final Exam*: Big–Θ Estimation, Algorithm Complexity, Program Verification (+ all previous material)

Attendance Policies

If you miss a significant number of classes, you will almost definitely do poorly in this class. I consider it excessive to miss more than three classes during the course of the semester. If you miss more than six classes without a valid excuse, I reserve the right to terminate you from the course with a grade of 'F'. Significant tardies count as absences. Work missed (including tests) without a valid excuse will receive a zero. Please be familiar with Westmont's attendance policies at https://www.westmont.edu/attendance-policies. If you miss an in-class Activity because of an excused absence, you can record solutions to the numbered problems for the day that you missed in your Lab Book.

Academic Integrity

Learning communities function best when students have academic integrity. Cheating is primarily an offense against your classmates because it undermines our learning community. Therefore, dishonesty of any kind may result in loss of credit for the work involved and the filing of a report with the Provost's Office. Major or repeated infractions may result in dismissal from the course with a grade of 'F'. Be familiar with the College's plagiarism policy, found at https://www.westmont.edu/office-provost/academic-program/academic-integrity-policy.

Course Learning Outcomes

The department of mathematics and the department of computer science at Westmont College have formulated the following Program Learning Outcomes ("PLO"s) for all of their classes: (1) Core Knowledge, (2) Communication, (3) Creativity, and (4) Christian Connection. For descriptions of each of these items in each of their respective fields, please visit

https://www.westmont.edu/departmental-program-reviews/program-review-mathematics
https://www.westmont.edu/departmental-program-reviews/program-review-computer-science

In addition, the faculty of Westmont College have established common learning outcomes for all courses at the institution ("ILO"s): (1) Christian Understanding, Practices, and Affections, (2) Global Awareness, (3) Diversity, (4) Critical Thinking, (5) Quantitative Literacy, (6) Competence in Written Communication, (7) Competence in Oral Communication, and (8) Information Literacy.

The above outcomes are reflected in the particular learning outcomes for this course. After taking this course, you should be able to:

- Demonstrate mastery of fundamental concepts in discrete mathematics. (PLO 1, ILOs 4,5)
- Write and evaluate mathematical arguments according to the standards of the discipline. (PLO 2, ILOs 4,6)
- Clearly and accurately present mathematical constructions, computations, and arguments. (PLO 2, ILO 7)
- Construct solutions to novel mathematical problems, demonstrating perseverance in the face of open-ended or partially-defined contexts. (PLO 3, ILO 4)
- Explain connections between personal mathematical development and professional calling. (PLO 4, ILO 1)

These outcomes will be assessed by preview activities, group work, activity write-ups, practice problems, and tests, as described above.

General Education

Reasoning Abstractly GE: One of the main themes of this course is abstract reasoning. We will study logical arguments using the formal methods of propositional and predicate logic, and we will also explore direct proofs, proofs by contradiction and contraposition, and proofs by induction. We will learn how to evaluate valid arguments by studying abstractions of structures that occur in computer science and other areas of study. The problems we do in this class are not just about getting the correct answer—the point of working problems is to understand the reasoning that leads to the solution.

Quantitative and Analytical Reasoning GE: This course is not just about abstraction; many of the methods we will study provide quantitative and analytical models for decision making in computer science, physics, biology, and the social sciences. When we study combinatorics, we will learn advanced counting techniques, and we will see how to analyze problems and make decisions using discrete probability. The study of graph theory leads to a range of applications in industrial optimization, data analysis, coding theory, and a variety of other contexts. Many of these applications involve manipulating structures using algorithms; the analysis of algorithms is another main theme of the course.

Accommodations for Students with Disabilities

Students who have been diagnosed with a disability (learning, physical or psychological) are strongly encouraged to contact the Disability Services office as early as possible to discuss appropriate accommodations for this course. Formal accommodations will only be granted for students whose disabilities have been verified by the Disability Services office. These accommodations may be necessary to ensure your equal access to this course. Please contact the Office of Disability Services directly (310A or 311 Voskuyl Library, ODS@westmont.edu) or visit the website for more information: https://www.westmont.edu/disability-services.

Tentative Course Schedule

Bold problems are good review problems, and will almost be certainly graded for correctness.
Italic problems will almost certainly be graded for thoughtful completion.
Starred* problems will be optional.
Unmarked problems may be graded either for correctness or thoughtful completion.
Besides the "Hunter Problems", other exercises will be assigned through pdfs on Canvas.

	Date	Textbook Section and Preview Work	Hunter Problems Due	Other Notes
1	8/29	Introductions & §1.1		
	8/31	§1.1 & 1.2	Introductions Sheet	
2	9/5	§1.3	§1.1: **3**, 7, 8, 9, 12, **14**, **18** §1.2: 1, 27	
	9/7	§1.4 & 1.5	§1.2: 2, **8**, **11**, **16**, 23	Last day to drop a class without record 3:30 pm
3	9/12	§1.5 & 2.1	§1.3: **6**, 12, 15, **16**, 21, **22** §1.4: 3, 4, 5	
	9/14	§2.2	§1.4: **6**, *13*, 15, 24, 25* §1.5: 2, **4**, **8**, 17	**Ungraded Diagnostic Quiz #1 Due Friday 9/15**
4	9/19	§2.4	§1.5: 13, **14**, **16**, 19, 22* §2.1: **6**, 8, **9**	Yes, we are covering §2.4 before §2.3
	9/21	Catchup & LaTeX	§2.1: 15, **24** §2.2: 7, 9, *10*, 15, **26**, *28*	Please bring a computer to class on this day
5	9/26	§2.3	§2.2: *2*, **3**, 20, 21, 22 §2.4: *7*, **10**, **14**, *20*	
	9/28	§3.1 & Review	§2.4: 8, **9**, 13, 29 §2.3: 2, **15**, 17, 19, 20	
6	10/3	§3.1 & 3.2	§2.3: **8**, *13*, **14**, 18, **24**, 25, *33*, *34*, *35* §2.4: 31* *All prior work returned to you*	
	10/5	Exam #1	Typeset # 1 *Turn in Lab Book at start of class*	*Exam emphasis:* *§1.1-1.5 and §2.1, 2.2, & 2.4*
7	10/10			Fall Break
	10/12	§3.2 & 3.3	§3.1: 1, **4**, **8**, 9, **10**, 14*, 16, 17, *25*, 27	
8	10/17	§3.4	§3.2: 3, **4**, **8**, *9*, 10*, **17**, 18, 19	
	10/19	§3.5	§3.3: 5, **6**, *10*, **12**, 14, *19*, **20**, *24*, *26*	

	Date	Textbook Section and Preview Work	Hunter Problems Due	Other Notes
9	10/24	§4.1	§3.4: **4**, *5*, 8, **9**, 10, *11*, 12, **22**	
	10/26	§4.2	§3.5: 1, **2**, **4**, **10**, 20, 21, 23, 24	**Ungraded Diagnostic Quiz #2 Due Friday 10/27**
10	10/31	§4.3	§4.1: 4, 5, **6**, 9, **12**, 14, 16, **19**, 20, 24, 26, 27	
	11/2	§4.4	§4.2: 3, **4**, **11**, 14, **16**, 21, 22	
11	11/7	§4.5 & Group Selection	§4.3: 2, **4**, *6*, 11, **12**, 13, *17*, 18, **22**, 23	
	11/9	§4.6 & Review	§4.4: **2**, 3, 5, 11, **12**, 15, **22**, 25	
12	11/14	§4.6	*All prior work returned to you*	
	11/16	Exam #2	Typeset # 2 *Turn in Lab Book at start of class*	*Exam emphasis:* *§2.3, §3.1-3.5, and §4.1-4.4* Last day to withdraw or change to P/NC grading (11/18)
13	11/21	§5.1	§4.5: **4**, 5, 6, 7, **14**, 15, 18, **24**	
	11/23			Thanksgiving Holiday
14	11/28	§5.2 & 5.3	§4.6: 3, 4, **5**, **10**, 15, **27**, 28, 33*	
	11/30	Group Work Day	§5.1: **2**, 3, 5, **8**, **10**, 14, 18, 25	
15	12/5	Group Presentations	§5.2: 1, **2**, 7, **14**, 17, 20, **24** §5.3: 7(a), **11**	Presentations on Ch. 6
	12/7	Final Review	*Turn in Lab Book at start of class* *All prior work returned to you*	Last Day of Class
16	12/15	Final Exam		**It's (on) Friday (Friday!)**

C.4 Sample Lesson Plan

The following is a guided lesson/worksheet I provided to my students when I was absent due to the death of a family-member. This activity balances the active/passive and independent/dependent work that I strive to attain when present as instructor as well.

MA/CS-015: Discrete Mathematics
Fall 2023

§4.2: Permutations and Combinations

Due 11/26 @ 11:59pm

8:00 Pray with your group

8:05

Example 1. Suppose you want to create a 3-letter string out of the 26 letters in the English alphabet $A, B, C, \ldots, X, Y, Z$.

1. How many options do you have for the first letter of the string?
2. How many options do you have for the second letter of the string? Does this number change based on which letter you chose to be the first letter?
3. How many options do you have for the third letter of the string? Does this number change based on which letter you chose to be the first and second letters?
4. Using the multiplication principle, how many total strings of this form are possible?

8:09 *Write down one question your group has.*

8:10

Example 2. Suppose you have 26 fridge magnets, one for each letter of the English alphabet $A, B, C, \ldots, X, Y, Z$. Suppose you want to create a 3-letter string by rearranging these letters on the fridge.

1. How many options do you have for the first letter of the string?
2. How many options do you have for the second letter of the string? Does this number change based on which letter you chose to be the first letter?
3. How many options do you have for the third letter of the string? Does this number change based on which letter you chose to be the first and second letters?
4. Using the multiplication principle, how many total strings of this form are possible?

8:16 *Write down one question your group has.*

8:17 The **Arrangement Principle** states that if you want to create an *ordered list* of r *distinct* elements from a collection of n *distinct* elements, there are $P(n,r)$ ways to do so, where

$$P(n,r) = \frac{n!}{(n-r)!}.$$

We read this quantity as "n permute r". (Recall that $k! := 1 \cdot 2 \cdot \cdots \cdot k$, and $0! := 1$.)

Example 3.

1. Look back at Example 1 and Example 2. Which of these examples can be solved by the Arrangement Principle?
2. Look back at Example 1 and Example 2. Which of these examples **can not** be solved by the Arrangement Principle? Why not?

8:24 *Write down one question your group has.*

9:25

Example 4. Suppose an urn contains 10 orbs. Each orb contains one of the following letters, and no orb contains more than one letter:

$$\texttt{D}, \texttt{A}, \texttt{Q}, \texttt{S}, \texttt{N}, \texttt{O}, \texttt{T}, \texttt{I}, \texttt{G}, \texttt{H}$$

You reach into the urn and, one-by-one, write down the letter on a piece of paper, keeping track of the order in which the orbs were drawn.

1. Suppose you replace each orb into the urn immediately after reading/recording it. How many strings of length 3 might you end up with? Justify your answer using a specific counting principle, and simplify your answer in such a way that it is clear what principle you used.
2. Suppose each orb is also a delicious candy and you eat it immediately after reading/recording it. How many strings of length 3 might you end up with? Justify your answer using a specific counting principle, and simplify your answer in such a way that it is clear what principle you used.
3. Suppose that in the question immediately above this, you *know* that you drew the letters $\texttt{D}$, $\texttt{A}$, $\texttt{Q}$, but you completely forgot to write them down because you ate the chocolates too quickly. How many possible strings *might* you have recorded? Write down all the possible arrangements to confirm that you counted them all correctly.

9:35

Example 5. Consider the setup of Example 4, Question 2. Suppose that X_1 and X_2 are two arrangements of 3 distinct letters, as in part 2 of the problem. We will say that $X_1 \sim X_2$ if X_1 and X_2 have all the same letters if we ignore their order. (*Discuss:* Convince yourselves that $\sim$ is an equivalence relation!

1. Is `DAQ` $\sim$ `DAN`? Why or why not?
2. Is `DAQ` $\sim$ `QAD`? Why or why not?
3. Suppose that $X_1 =$ `DAQ`. What is the equivalence class of X_1 under $\sim$? In other words, what are all of the 3-letter strings that have the same 3 letters as X_1, but in potentially different orders? (*Hint:* You solved this in a previous problem!)
4. *Discuss:* What does the unordered set of letters $\{\texttt{D}, \texttt{A}, \texttt{Q}\}$ have to do with your answer to the previous question?
5. Suppose that X_1 is *any* string of length 3 as described in Example 4. How many elements are in the equivalence class of X_1 under $\sim$? (*Hint: Does it matter what the three letters are?* ***Double hint: it does not.***)

9:49 *Write down one question your group has.*

9:50 Take a break.

9:55 When we forget about the order of a list of r distinct elements, there are a total of $r!$ *ordered* lists that all have the same *unordered set* of those elements. For example, in Example 5, you should have discovered that $6 = 3!$ different arrangements of the letters `DAQ` all have the same *unordered* set of letters. In other words, if we have forgotten the order of a list of r letters, there are $r!$ ways to rearrange them. This suggests that there are $r!$ as many *ordered lists* of these distinct elements as there are *unordered sets* of those distinct elements.

You saw this in Example 4. When you forgot the ordered of the letters you drew, there were $6 = 3!$ ways in which the *unordered set of letters you remembered* might have actually been arranged. More generally, there are $r!$ ways to order an unordered collection of r distinct elements. Combining this with the Arrangement Principle, we discover a new principle:

9:04 *Write down one question your group has.*

9:05 The **Selection Principle** states that if you want to create an *unordered set* of r *distinct* elements from a collection of n distinct elements, there are $C(n,r)$ ways to do so, where

$$C(n,r) = \frac{P(n,r)}{r!} = \frac{n!}{(n-r)!r!}.$$

We read this quantity as "n choose r".

9:08 *Discuss:* How in the world can we guarantee that $\frac{n!}{(n-r)!r!}$ is always going to be a natural number? Why is this never going to be a "fraction" like $\frac{1}{2}$ or $\frac{17}{3}$?

9:10

Example 6. Consider the setup to Example 4, but where instead of drawing orbs one-by-one, you reach in and grab 3 orbs at once.

1. How many different 3-orb-handfuls might you draw? Justify your answer using a specific counting principle, and simplify your answer in such a way that it is clear what principle you used.

9:15 Often, the challenge isn't the "arithmetic" here, but rather interpreting a problem in such a way that the Arrangement/Selection Principles can be applied (perhaps even in combination with the Addition/Multiplication Principles).

Example 7. Suppose that there is a parking lot with 10 spaces, and you are a parking attendant in charge of parking cars. Every day, 3 red cars and 7 blue cars park in the lot. You try to park them in such a way that there is never the same arrangement of red/blue cars as there has been before.

1. Suppose that you always park the blue cars first. You do so by *choosing* 3 *slots from the* 10 and then parking the cars there. How many ways are there to choose 3 such slots for the blue cars? (Remember, we don't care that the blue cars might actually be "different cars", we just care about which slots are occupied by some blue car.)
2. In this scenario, how many ways are there to place the red cars once the blue ones are already in place? (Again, we don't care that the red cars might actually be "different cars", we just care about which slots are occupied by some red car.)
3. Under this method of choosing 3 slots to be occupied by blue cars, and then filling in the rest with red, how many possible "arrangements" are there? (And discuss: why is the word "arrangements" in scare-quotes?)
4. Suppose we reverse the situation, and we place the 7 red cars in first. How many possible "arrangements" are there?
5. Do your answers to the previous two questions agree? *Should* they? (*Hint:* They should.)

9:29 *Write down one question your group has.*

9:30 Read through Example 4.21 of the textbook together.

9:35 Work on Activity 4.2.1 as a group.

9:49 *Write down one question your group has.*

9:50 Submit your group answers to this Active Work Day by email.

MUCH LATER Glance through the topics in Chapter 6 of the textbook.

MUCH LATER + 10 minutes: Fill out the "Group Presentation Chapter Selection" Quiz on Canvas.

MUCH LATER + 15 minutes: Fill out the "Will You Be Here on November 21?" Quiz on Canvas.

MUCH LATER + 16 minutes: idk, have an ice cream from the DC or something?

C.5 Sample Assignment

The following is a sample "LaTeX" assignment, which I assign preceding exams as a way to review old material while gaining familiarity with a tool used by professional mathematicians and scientists for typing up one's work. These assignments may be viewed as a "collaborative, open notes, open book, take-home" portion of my exams.

Typeset Assignment 2

YOUR NAME HERE

THE DATE GOES HERE

Problem (Exercise 1)**.** Prove that the last digit of 2^{4n-1} is 8 for all $n \in \mathbb{N}$. (A sequence of hints will be released in the days leading up to the due date.)

THE DATE GOES HERE YOUR NAME HERE

Problem (Exercise 2)**.** Suppose $f : X \to Y$ and $g : Y \to Z$ are both injective. Prove that $g \circ f$ is injective.

Solution. Your solution goes here. □

THE DATE GOES HERE YOUR NAME HERE

Problem (Exercise 3)**.** In this exercise, we will use matrices to construct a familiar recursive sequence. This exercise requires you to know how to multiply matrices of size 2×2. For a refresher, you might check here or here. For a less helpful link, click here.

(a) Let $M = \begin{bmatrix} 0 & 1 \\ 1 & 1 \end{bmatrix}$. Compute the first few terms in the sequence M, M^2, M^3, M^4,.... etc. (Recall for computational convenience that $M^2 = M \times M$, that $M^3 = M^2 \times M$, and that in general, $M^n = M^{n-1} \times M$ for $n > 1$.)

(b) What do you notice about the above sequence? Make a conjecture about what the matrix M^n will be.

(c) Prove using induction that your conjecture is correct. (Hint: it will be *very* helpful for the sake of recursion to view the matrix M^n as $M^{n-1} \times M$.)

Solution. Your solution goes here. □

THE DATE GOES HERE YOUR NAME HERE

Problem (Exercise 4)**.** Let $n \in \mathbb{Z}$ with $n \geq 0$. Let X be a set with n elements, and let $\mathcal{P}(X)$ be the power set of X. Let S be the set of all binary strings of length n.

a) Find and describe a bijection
$$f : \mathcal{P}(X) \to S$$
where S is the set of all n-digit binary strings. (You do not need to prove that the f you provide is a bijection.)

b) Use this bijection to compute $|\mathcal{P}(X)|$.

c) Let $r \in \mathbb{Z}$ with $0 \leq r \leq n$. Define $\mathcal{P}_r(X)$ to be the set of all subsets of X of size r. That is, define
$$\mathcal{P}_r(X) := \{A \subseteq X \mid |A| = r\}.$$
Compute $|\mathcal{P}_r(X)|$. (*Hint: the previous parts of this problem might help you find a relevant set S_r and a relevant bijection $f_r : \mathcal{P}_r(X) \to S_r$.*)

Solution.

(a) Your solution to (a) goes here.

(b) Your solution to (b) goes here.

(c) Your solution to (c) goes here.

□

THE DATE GOES HERE YOUR NAME HERE

Problem (Exercise 5, optional)**.** In this problem, we will explore why 0 should be considered a natural number, despite some conventions that declare otherwise.

(a) Explain why we need a base case in a recursive definition.

(b) Is $\emptyset$ a set? (*Hint*: Yes it is.)

(c) Define the *natural numbers* $\mathbb{N}$ recursively as follows:
B $\emptyset \in \mathbb{N}$.
R If $n \in \mathbb{N}$, then so is $n \cup \{n\}$.

Write out the first few terms of the above definition, and determine how many elements are in each set. (Don't forget the base case!) Make a conjecture.

(d) Should 0 be considered a natural number, despite some conventions that say otherwise? Explain. (*Hint*: Yes, it is. See parts (a), (b), and (c).)

Solution.

(a) Your solution to (a) goes here.

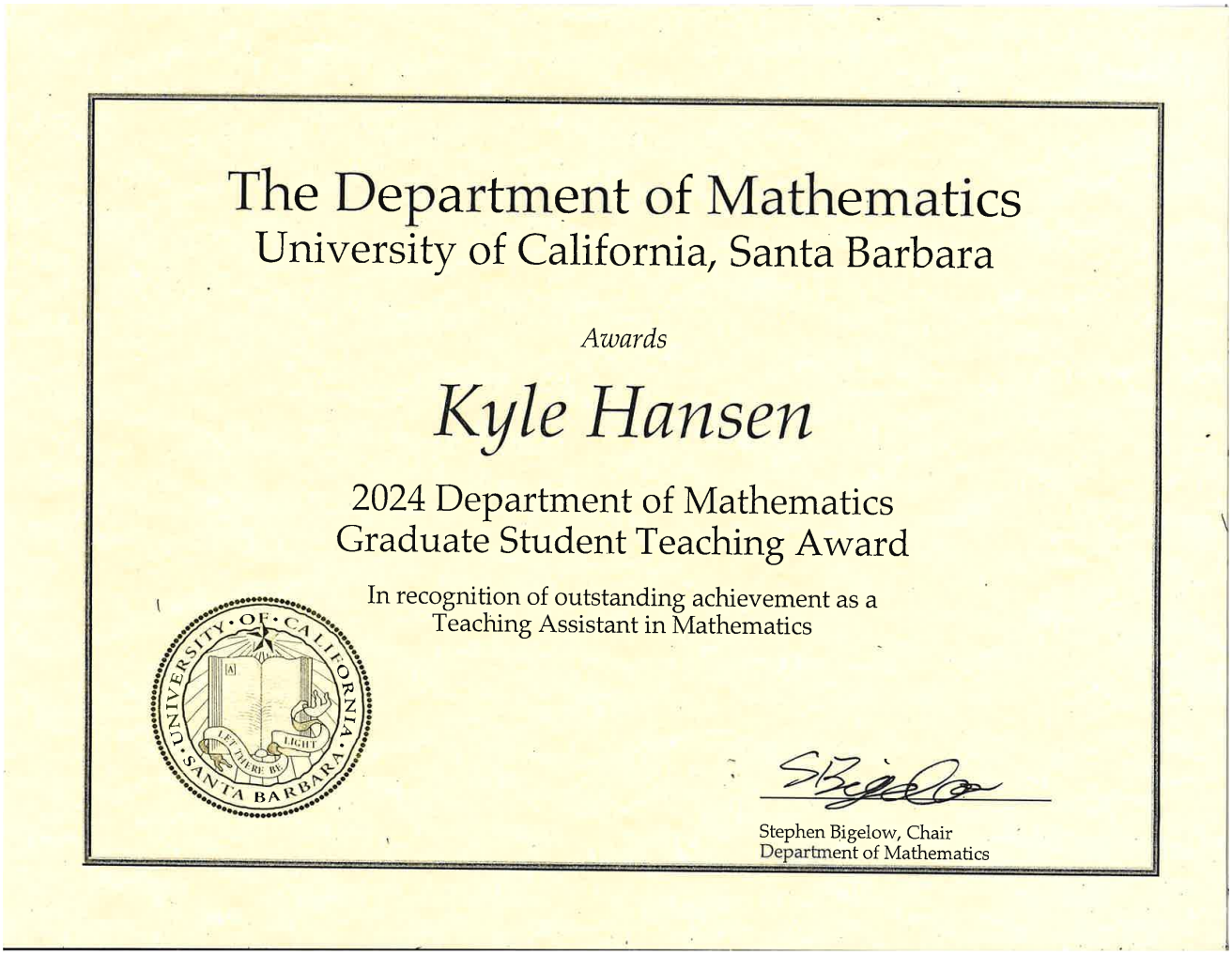
(b) Your solution to (b) goes here. (*Hint*: The answer is "yes".)

(c) Your solution to (c) goes here.

(d) Your solution to (d) goes here. (*Hint*: It is. Why?)

□

C.6 Departmental Outstanding TA Award



The Department of Mathematics
University of California, Santa Barbara

Awards

Kyle Hansen

2024 Department of Mathematics
Graduate Student Teaching Award

In recognition of outstanding achievement as a
Teaching Assistant in Mathematics

Stephen Bigelow, Chair
Department of Mathematics

References

[1] Thomas Armstrong. *Neurodiversity in the classroom: Strength-based strategies to help students with special needs succeed in school and life*. ASCD, 2012.

[2] Wendy Ashall. A toe in the water, or beware the under-toad: assessing the benefits and pitfalls of TBL-light. *University of Sussex*, 6 2019.

[3] Alison Burke. Group work: How to use groups effectively. *Journal of Effective Teaching*, 11(2):87–95, 2011.

[4] L Dee Fink. Beyond small groups: Harnessing the extraordinary power of learning teams. In *Team-based learning*, pages 3–26. Routledge, 2004.

[5] Diana Fuss and William Gleason. *The Pocket Instructor: Literature: 101 Exercises for the College Classroom*. Princeton University Press, 2016.

[6] Larry K Michaelsen, Arletta Bauman Knight, and L Dee Fink. *Team-based learning: A transformative use of small groups in college teaching*. Taylor & Francis, 2023.

[7] Hans Orberg. *Lingua Latina: per se illustrata*. Lingua Latina Series. Hackett Publishing Company, Incorporated, 2005.

[8] Travis Peters, Elgin Johnston, Heather Bolles, Craig Ogilvie, Alexis Knaub, and Thomas Holme. Benefits to students of team-based learning in large enrollment calculus. *Primus*, 30(2):211–229, 2020.

[9] Michael Slaubaugh Sheena Choi and Xiaoguang Tian. Integrating learning interpersonal skills through team-based learning (tbl) in a management course. *Journal of Education for Business*, 96(8):498–509, 2021.