Canadian Perspectives on Academic Integrity (2021)
Peer reviewed *https://doi.org/10.11575/cpai.v4i1.71341*

Towards a Supportive Math Pedagogy: Power Dynamics and Academic Integrity

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Abstract

Mathematics is a discipline with implicit power dynamics that affects who is seen as a viable educator and learner. In this paper we explore the power dynamics of the teaching and learning of mathematics at the university level, highlighting the inequitable and exclusionary aspects of math pedagogy that can lead to academic misconduct. We argue that a supportive pedagogy that meets learners at their social location will model academic integrity and create an educational environment that is inclusive of diverse learners. The potential effect of a supportive pedagogy that keeps universal design in mind, means a reconceptualization of both learning outcomes as well as surveilled high-stakes assessments for traditionally exclusionary fields such as mathematics.

Keywords: *academic integrity, assessment design, Canada, inequity, mathematics, power, online proctoring, pedagogy, postsecondary*

Towards a Supportive Math Pedagogy: Power Dynamics and Academic Integrity

Nowhere has the discussion around academic integrity and the need for a new pedagogical paradigm during COVID been more heated and fraught than in disciplines where the main form of teaching was content delivery and where assessment was done primarily through recall. Thus, departments with Science Technology Engineering and Math (STEM) and management programs have been at the forefront of debates at universities around the use of monitoring software.

In mathematics in particular, there is an innate power dynamic in its traditions and structure, from assessment design and standardized high-stakes testing and assessment, to content delivery and curriculum development. Similar to the power innate in academic discourse and academic literacy, numeracy is not neutral. These curricular designs are manifestations of what Su calls the “coercive power” (2020, p. 31) of mathematics, which keeps would-be participants from entering and enjoying mathematics. This "culture of exclusion" in mathematics, as termed by Louie, also places a high status on mathematics and those who are successful at it, and those who do not "get" the math right away are seen as slow or needing remediation (2017).

There are academic integrity implications to this cultural landscape. McCabe et al. (1999) document both contextual and individual factors that influence cheating among university and college students, including the normalization of cheating behaviour among peers and the perception of needing to cheat in order to level the playing field. They also mention that rates of cheating by women in engineering majors (a traditionally male-dominated field) are higher compared to women in non-engineering majors, since there is more pressure to "compete by the 'men's rules' to be successful" (McCabe et al., 2001, p. 228).

There has not been much research on academic integrity in mathematics. Most studies on academic misconduct in STEM courses investigate science and engineering courses, and comparatively fewer consider mathematics and technology (Gilmore et al., 2016). This might be "because the nature of mathematics is not well understood" by academic integrity practitioners (Seaton, 2019, p. 1064). Seaton (2020) also offers both tradition and pragmatism as reasons why mathematics has not been greatly explored. The use of high-stakes proctored testing leads to a self-perpetuating cycle of even greater reliance on proctoring, which is assumed to work, so that "no customized integrity literature has seemed warranted in mathematics" (Seaton, 2020, p. 177). In Canada, it is a similar situation: Eaton et al.'s comprehensive annotated bibliography on academic integrity in Canada (2019) does not mention mathematics, nor does Eaton and Edino's review of academic integrity literature in Canada (2018).

Thus, there is a gap that needs to be addressed in relation to academic integrity and mathematics education. Due to the nature of mathematics teaching and learning, this gap also necessarily needs to address the power relations that are innate in math and explore, as Gutiérrez asks: "[i]n what way(s) are mathematics education researchers and educators complicit in the institutional practices that perpetuate inequities and unnecessarily constrict the identities that learners and teachers are able to enact around mathematics?" (2013, p. 61). Power dynamics are at play at many levels in mathematics education, from the role of the "ideal" instructor through to the role of the "ideal" learner. This is part of what Burton (2009) calls "mathematical culture" which is "the socio-political attitudes, values and behaviours that dictate how mathematicians, and their students, experience mathematics in the settings of conferences, classrooms, tutorials, etc" (p.159). These framings exclude those learners who are from diverse student populations in terms of race, gender, and sexual orientation. As queer academics in the university system, we understand and negotiate these power structures daily. Yusun is an assistant professor of mathematics, and Gangé is an educational developer, and our collective work in academe centres on recognizing the role of power and actively taking steps to make pedagogy more inclusive. As we suggest in this paper, recognizing power dynamics and decreasing the barriers to learning that power upholds, are the very same ways in which academic integrity is best promoted and supported in mathematics education at the post-secondary level.

Active Learning as Gateway Pedagogy

Instructors and university programs that have had a strong active learning component and practice seem to have fared the transition to remote teaching better than most. However, there are also still very robust discussions about the use of active learning as an effective pedagogical strategy in higher education, despite the strong body of literature that speaks to its use (Freeman et al., 2014; Prince, 2004).

An active learning approach can be utilized as a gateway pedagogy for online or remote teaching and learning and a way to reframe how we think about assessments. The centering of the student experience and engagement is, as we will argue, the key to creating a supportive math pedagogy that keeps power dynamics and academic integrity in mind. Active learning strategies support formative activities and community building that in turn prepare students for summative assessments, testing or exam situations. As Trinidad et al. (2020) suggest, "[g]iven the growing use and adoption of student-centered pedagogies in higher education classes, there is likewise a need to know which practices specifically are good for students" (p.162) and in turn which ones will help support students pedagogically and emotionally for assessment situations.

Students have different ways of engaging with these active learning practices, "[e]ngagement can often be defined in terms of behavioral, emotional, and cognitive ways of students actively participating in the task at hand" (Trinidad et al., 2020, p.162) and these "ways in" or access to the learning of the course are embodied in a very real way. Thus, having an awareness of what teaching practices will be both engaging, but also ultimately the most effective for students as they prepare for testing and exams, is one way to address the power inequities in the course and design around a supportive framework.

Trinidad et al. (2020) discovered that "students found four practices to be both engaging and effective: (1) recitations, (2) lectures where the teacher engages with the class, (3) use of real-life applications and examples, and (4) use of exercises and drills in the classroom" (p.164). All these practices employ types of active learning strategies that go beyond the kind of banking model of teaching and learning referenced by Freire (1969) and hooks (1994). Further, "[a]lthough students enjoy classes that require pure memorization because of its ease, they do not think they get much out of them" (Trinidad et al., 2020, p.166), which demonstrates that some traditional methods of rote memorization found in STEM field subjects, like mathematics, do not appeal to students nor are they seen as effective methods to engage with material that would be found on tests or exams.

Not every institution or department is open to different ways of teaching that involve authentic examples and applications, or a lecture with an engagement component. It is only by modelling practices and sharing outcomes with colleagues that we can clearly demonstrate the benefit of active learning and inclusive assessment practices. However, there are instances where disciplinary stereotypes become the root of why a transition to a different way of thinking about teaching and learning is more difficult.

Stereotypes: The Tensions Between Math Praxis and Pedagogy

The field of mathematics has clear exclusionary stereotypes associated with it: that only certain people can do and be successful at math (Burton, 2009). The belief that only "nerds" are good at science and that math isn't "cool" is perpetuated by TV shows and mass media; see for instance shows like *The Big Bang Theory* (McIntosh, 2014). The genius myth is also permanently embedded in culture, that people who become successful at math are such because of an innate brilliance or talent (Chestnut et al., 2018).

Moreover, Gutiérrez (2013) argues that since mathematics is perceived to be universally objective and rational, then mathematicians are also considered "imbued with a sense of higher esteem" (p. 47). This pedestalling of math and mathematicians, combined with the genius myth, makes it more likely that someone who does not demonstrate math competencies in school will either assume they are not smart enough, or made to take different types of math that are marketed as "easier." These instances of exclusion are reinforcements of power inequities. The stereotypes that are mentioned above in relation to who a math researcher and practitioner is and how math research is performed, in turn frame math pedagogy with a power dynamic that is exclusionary.

This framing of mathematics is gendered and race-based. For example, Nosek et al. found that "stronger math + male associations were related to stronger math orientations for men but to weaker math orientations for women" (2002, p. 54). In another study by Copur-Gencturk et al. (2020) teachers were asked to evaluate student solutions that were assigned race- and gender-specific names; students with White-associated names were rated higher in mathematical ability than Black- and Hispanic-associated names, even if the solutions were identical.

Exclusive stereotypes reinforce the systemic gatekeeping that pushes students away from mathematics: see for instance the practice of tracking or streaming high school students into different sequences of math, English, or science based on perceived academic ability and preferences. This has been argued as tending to place lower-income students and those from visible minorities into trajectories that restrict postsecondary options (Krahn & Taylor, 2007). We note that Ontario high school programs will be phasing out this practice starting in September of 2021 (Rushowy, 2020). A longitudinal study by Canning et al. (2019) highlights faculty beliefs about their students' mindsets as the strongest predictor of student motivation and success, over other factors such as their gender, race, age, or teaching experience. Students who receive messaging (e.g., by being streamed) about the fixed mindset belief that intelligence is an unchanging entity also display lower motivation and respond to failure less positively than those who associate more with a growth mindset, that intelligent is malleable and can increase (Blackwell et al., 2007; Boaler 2016).

Students who enroll in mathematics courses are also varied: they could be mathematics majors with a genuine interest in the subject, or students who are taking the course only to fulfill business, biology, or engineering program requirements. Students for whom first-year algebra or calculus is a terminal math course may lack motivation to learn the subject, or may be more likely to internalize the exclusionary nature of the field, especially in relation to their conceptualizations of themselves vis-à-vis the identities they are expected to embody in the classroom (Cobb and Hodge, 2002). It is not uncommon for a first-year mathematics course to gatekeep students from their desired programs, thinning the pool because of program capacity requirements; as Douglas and Attewell (2017) state, this role of mathematics as gatekeeper arises "precisely because of its apparent objectivity as a yardstick, along with long-standing western cultural beliefs about its relationship to innate talent as well as its perceived independence from family circumstances" (p. 665). These biases, both explicit and implicit, shape academic culture and demonstrate themselves in curricula and pedagogy. Power dynamics are intrinsic in decisions such as what courses are required for which programs, how students are assessed, and what accommodations are made available for students with varying backgrounds who come to university. This may run counter to the American Mathematical Society ethical guidelines that underscore "[m]athematical ability must be respected wherever it is found, without regard to race, gender, ethnicity, age, sexual orientation, religious belief, political belief, or disability" (American Mathematical Society, 2019).

Power dynamics also exist in relation to the positionality of the instructor and their understanding and practice of academic integrity. This is even more the case for which instructor chooses to critically reflect on academic integrity outcomes. For example, there are other levels of power and pressure for faculty members who identify as non-white, identify as trans, or identify not as male (or any intersection of these) in relation to the perception of their pedagogical rigour as instructors if academic misconduct occurs in the courses they teach. As Sara Ahmed has demonstrated in her foundational work on inclusion in academic spaces, *On Being Included: Racism and Diversity in Institutional Life* (2012), these types of scenarios are rarely spoken of in academic literature, for "[w]e need a space that is not designated as institutional space to be able to talk about problems with and in institutions" (p.10). Published articles and research that speak to gendered and racialized perceptions of pedagogy and rigour are an extension of institutional spaces. For those instructors who are precariously employed or are early career, this fear of being perceived as lacking rigour or lacking a pedagogical framework that supports academic integrity is even more acute (Crossman, 2019). In what follows we reflect on the role of power in the university mathematics classroom and around assessment practices, and then identify approaches to make math a more inclusive space, and not a space of fear and surveillance.

Power Dynamics in Mathematics

Pedagogy, as Freire (1969) has demonstrated in his work *Pedagogy of the Oppressed,* is innate with power structures, power dynamics and the reinforcement of barriers. This power dynamic is not something that is specific to mathematics or even STEM, however, there are certain types of barriers that are experienced in the teaching and learning and assessment of mathematics that may not necessarily intersect in other fields. One of these barriers comes from the stereotypes connected to math teaching and the ideal or successful math practitioner. Power dynamics are part of the overarching "systemic problem" that Bretag (2019) and others have identified in relation to academic integrity and contract cheating.

Reasons for Rogeting and Poor Paraphrasing

The feeling of being "othered" can be highlighted and intensified through certain kinds of pedagogical philosophies and training. If course delivery and assessment instructions are not accessible to students who are English language learners or English as an additional language users, this is an access barrier that reinforces the linguistic and disciplinary power that the instructor (or institution) has over the learner (Sanders et al., 2020). No longer is this a space where ideas are shared, but a space where a certain type of terminology must be used to be a valid interlocutor in this learning dynamic. Bourdieu's work on cultural capital (1986) can help explain this belief towards certain types of acceptable academic discourse and demonstrates how this academic cultural discourse can be exclusionary (Thacker, 2020).

What is needed within the realm of mathematics teaching is a way to connect to the student's social location (their lived positionality) instead of making academic institutions the necessary default social location. As Leonard et al. (2010) state, "culturally relevant and social justice instruction can offer opportunities for students to learn mathematics in ways that are deeply meaningful and influential to the development of a positive mathematics identity" (p. 261). As well, a social-justice pedagogy, especially in the context of math teaching, can support the following as outlined by Gonzalez (2009) and cited by Leonard et al. (2010): "(a) access to high-quality mathematics instruction for all students; (b) curriculum focused on the experiences of marginalized students; (c) use of mathematics as a critical tool to understand social life, one's position in society, and issues of power, agency, and oppression; and (d) use of mathematics to transform society into a more just system" (p.262). Having the experiences of marginalized students at the forefront of math pedagogy has greater implications for access and ultimately for academic integrity. By reinforcing math as a critical tool, a tool of power, a tool of agency, and yes, often a tool of oppression, students can understand the systemic role of mathematics and mathematics teaching and learning, and in turn find ways to disrupt it instead of cheat it.

As Hennessey et al. (2012) frame, "[d]iscussion should start with an honest appraisal of what is known and believed about the subject. This eliminates the need to infer or guess student knowledge and get straight to the instructional strategies" (p.194). This framing of discussion around beliefs and the individual students' feelings or cultural understandings about math allows for a new way of starting their university math experience without reinforcing power dynamics, and rejects the assumption that there is a monolithic way of engaging, conceptualizing, or assessing mathematics. For example, a course welcome survey could include a few questions about the students' experiences in their past mathematics classes, and about their attitudes and perceptions of mathematics. Course material and pedagogy can then be tailored to the class. Certainly, this is much more feasible in a small class—in multi-section coordinated courses with hundreds of students in each section, students tend to be more isolated and anonymous (this is exacerbated in the remote learning environment), and it is more difficult to foster interactions with the instructor, or among students (Kerr, 2011).

Classroom management also needs to address modeling, and how instructors should model an engagement with power that they would like to see from the learners. This is complex and multifaceted and as Boylan and Woolsey state, "[a] pedagogy of compassion entails informing teacher education for social justice with the same principles and ethics of care and informed empathy that we would want teachers to enact in their classrooms" (2015, p.70). The same pedagogical ethics that the instructor enacts become foundational to the ethics that learners would approach the concepts and assessments in the course.

When group work is part of the pedagogy, there are also power dynamics at play within the group itself and ethical considerations to be addressed in a microcosmic way. In mathematics classes students may be asked to complete an activity in groups in a smaller tutorial section, or engage with their neighbours in a class that utilizes active learning or peer instruction. Many pedagogical studies of group dynamics and outcomes in courses, show "that certain students are systematically more likely to underperform in classes where dominators persist in group work" (Theobald et al., 2017, p.11). This suggests that it is important for the instructor to be aware of these dominant group members and how these dominant group members may be adversely affecting the learning experience for those who do not feel comfortable interjecting in group work due to cultural or social backgrounds. This discomfort may be more acute in an online environment, since students may be more anxious to turn their video and audio on due to their living situations and technology. Further, "there is evidence that self-selected groups are best for students from marginalized and minority groups" (Theobald et al., 2017, p.12) and thus, this could be a strategy used to help support marginalized learners. Further, this group selection can also be coupled with discussions and framing that supports awareness of microaggressions, discrimination, and biases that happen in classes between students. When self-selection is not an option or choice provided, when universal design is not part of the pedagogical framework, students could use that power imbalance and lack of comfort as a reason to disengage because integrity and ethics is not being modelled in the pedagogy they are experiencing.

Assessment Design and Delivery

Assessment design also has power dynamics innate in its structure; a dynamic that is often overlooked by instructors and can be perpetuated by departments if there is no real reflection on the way questions and prompts are phrased or if the outcomes of assessments and testing necessarily disadvantage certain gender-identified learners, Black, Indigenous, and students of colour, and queer learners. One example is having prompts that only use Anglo-Americanized names like John, Suzie, Bob. Another example are prompts that reinforce heteronormative conceptualizations of a family or a certain class perspective that learners may not be able to relate to (e.g., your mother and father want to hire a landscaper to redesign your 2-acre backyard; or 4 married couples are at a party, how many ways can they pair off so that husbands do not dance with their wives?). Having this disconnect between question and learner is one of the gaps that demonstrates a lack of ethical pedagogical modelling. It is in these gaps that a tendency to cheat becomes real. As Alt (2014) states, students "who evaluated their teachers' behavior toward them personally as just, held more positive evaluation of the learning environment, and were less inclined toward academic cheating neutralization." (p.124); the phrasing and exemplars used in math problems are an extension of that perception of a just world.

There also needs to be clearer framing of the difference between types of questions, from recall to evaluation categories, that will allow students to reclaim the learning and empower themselves on their educational paths. Students do not necessarily know the difference between an analysis or an application question; all questions may seem like recall and pattern recognition questions to them, so it is important to model problem-solving skills that will support mathematical thinking, and provide clear goals and expectations. If this modelling is absent or inaccessible, students are more likely to give up if they encounter a different type of problem that was not practiced in lecture, opening the door to academic integrity infringements.

Some students are very used to standardized testing situations in content-led STEM disciplines. One only needs to look at the Education Quality and Accountability Office (EQAO) in grades 3, 6, 9 in Ontario to see the pressure and power innate in mathematical testing (and in this case also literacy scores). It is of no surprise that the Ontario government is trying to use a standardized testing educational technology company to administer these benchmark tests in the upcoming school year (Government of Ontario, 2020) because this is an example of a high-stakes situation that leads to surveillance, and the perceived notion that surveillance will provide quantifiable metrics to reassure parents.

Proctored tests reinforce power dynamics. Final exams in mathematics courses are held in huge gyms and meeting halls, where students are surveilled by a team of invigilators. Term tests and midterms are administered in a similar manner, sprinkled throughout the semester. These summative assessment pieces are high-stakes, comprising upwards of 80% of the students' final marks, with the final examination typically taking up a significant portion (40% or higher). With the shift to remote learning there were attempts to apply the test design to the online space, via online proctoring services. And as many reports emerged of students experiencing traumatic experiences with online proctoring (see The Learning Network, 2020, for some examples of students' reflections on their experiences), educators were propelled to take a more critical look into the way we assess students.

Proctoring, Math, and Power

Seaton speaks of "the silence that has surrounded academic integrity in mathematics education" (2020, p.176), and offers proctored in-person exams as a reason why there is a significant gap in the literature. Instructors who administer proctored tests do not need to think too much about the veracity of student grades. This reliance on high-stakes proctoring feeds the argument that the weights of assignments and other non-test assessments must be limited in computing student grades, since cheating must occur at a higher frequency in these assessments, in turn increasing the reliance on proctoring even further (Seaton, 2020).

Many mathematics courses, especially first-year courses, have learning outcomes that are procedural: find the slope of the line, compute the derivative, evaluate the integral. Thus, in the spring, as the global pandemic moved courses online, some math courses started to consider online proctoring as a "solution" to the academic integrity challenges that arose. Services like ProctorU, Proctorio, Examity, and Respondus LockDown Browser monitor student browsers and invite themselves into the students' home environments to record them taking the exam in real-time. Student behaviours are flagged for suspicious activity and these red flags are sent to the instructor in a detailed report afterwards. There are different service models as well, and each institution would have specific contracts with the service providers that vary in terms of transparency to instructors and students. As Brenna Clarke Gray states in a recent episode of her podcast, *You Got This!* there is a gap between what we do or do not know about a contract:

> Because where does that contract live? Like who, who does get to see it on some level, surely there's an argument that it's a public document, right? Like it's public money at a public institution. And yet of course there are all kinds of you know, corporate reasons why those documents may not be made completely public (2021).

For example, there could be live proctoring, or recording and review of video data—data that some companies have questionable content-saving agreements for, allowing them to keep users' videos for years after these students graduate (Harwell, 2020). Institutions have created elaborate work flows for setting up these proctoring "solutions" which often give the provider and not the institution nor the instructor ultimate control, in an ultimate demonstration of power dynamics and control. The responsibilities given to each stakeholder in this online proctoring situation also demonstrate the inequities of the situation.

These online proctoring solutions only have the illusion of being flawless, and relying on machines to make decisions about humans is necessarily reductive: it sees the student as moving pixels on a screen, sequences of bits that the algorithm uses to deduce whether the student might be engaging in academic dishonesty or not, and ignores everything about their context and social location. Thus, there is a real need to have humans be part of the review and the training models that prioritize pedagogy over technology in curriculum decision making. Review and training with a pedagogical priority would demonstrate that the solutions do not seem to have teaching and learning benefits; they do not provide formative feedback, only a binary cheating/no cheating flag. They are also marketed as part of the large technological branding, as a "solution," often without a specific awareness of educational context and learner context that is exclusionary and ableist.

Students are compared to a baseline data set, a collection of faces and bodies taking tests, that assist the algorithm in making these decisions. Swauger (2020) writes, "[a]lgorithmic test proctoring encodes ideal student bodies and behaviors and penalizes deviations from that ideal by marking them as suspicious, which threatens students with academic misconduct investigations and exclusion from the educational community" (The Eugenic Gaze section, para. 1). This is yet another example of coercive and exclusionary power: when underrepresented groups are more likely to be flagged for cheating because the algorithm does not view them as an "ideal test-taker" (a problematic paradigm in itself), this is a systemic barrier and a signal of distrust that will keep these students from participating in and enjoying mathematics. For example, there is already evidence of artificial intelligence algorithms being racially-biased which Safiya Noble in *Algorithms of Oppression: How Search Engines Reinforce Racism* (2018) and Ruha Benjamin in *Race After Technology: Abolitionist Tools for the New Jim Code* (2019) both expand on. Both of these texts as well as the recent documentary, *Coded Bias* (2020) speak to how systems are coded with a built-in prejudice against non-white users. Noble and Benjamin speak to how the origins of this bias are from those who build the code or are part of the testing processes. This is applicable to online proctoring systems which are coded and tested in similar ways. As well, a Twitter thread by Colin Madland (2020) even demonstrated how video conferencing tools like Zoom, and social media platforms like Twitter erase Black bodies.

In the power dynamics inherent in mathematics, in the idealization of "who can do mathematics" and in the structural barriers that exclude, there are parallels to the inequities that online proctoring brings about. Surveillance pedagogy sends a message opposite to the need for openness and a dialogue around learning. There is a distrust of students right from the beginning where the syllabus needs to include online proctoring notices if it is to be used, before the instructor has even met a single student. Recent work by Gurung and Galardi (2021) demonstrates how a first-encounter document like the syllabus sets the tone of the course for the students, and frames mental health and the sense of care, safety, and trust in the classroom. And while one might assume that the number of students who cheat in the final exam may be lower than what it might have been without online proctoring, studies have yet to determine this

(Holden et al., 2020). In addition, students who hold predetermined assumptions about their own capabilities in mathematics, who come into a course where they are explicitly not trusted and are required to sit through the invasiveness of online proctoring, might emerge from the course no more eager nor encouraged to do mathematics, and potentially traumatized with their experience of the discipline.

Instead, we advocate for the fostering of an academic culture in the university community where academic integrity is something students should participate and engage with because they believe in its value, instead of being forced into it by technological tools that are discriminatory and ableist.

Another benefit for using online proctoring is the "theatre" or the performative aspect of its use: students who never cheat will feel better knowing that this will make other students less likely to cheat as well, resulting in a perception of fairness. This theatre of it might also encourage those instructors who are precariously employed or early career, to support these assessment strategies; early career academics need to align to the systems within which they were hired. As mentioned previously, this is even more true of BIPOC instructors. However, as we have seen in online proctoring, there is no fairness within these systems, only inequities and misplaced power.

We contend, as we will discuss in the next section, that a supportive and inclusive pedagogy, one that treats students as individuals who can be successful at mathematics while coming from all social locations (and in their own definitions of success), is the most effective way to address the structural imbalances of power in mathematics as well as support academic integrity in the math and in the broader community. It is through a pedagogy first and not a technology first approach.

Dismantling Power and Inequity Through Pedagogy

Instead of this movement towards technology as guardian, we need to begin from a place of trust. Bertram Gallant argues for a teaching and learning strategy to address academic integrity, one that asks "how do we ensure students are learning?" instead of "how do we stop students from cheating?" (2008, p. 87). Broad interventions that have been suggested to support embedding academic integrity, and ethical citation practices and values, include having conversations about academic integrity in one's course; fostering an inclusive classroom environment where students feel like they belong and are part of a community; emphasizing feedback over performance; and building a community of learning that takes students' social location into account (Bertram Gallant, 2008; McCabe et al., 2001). As Lang (2013) states, "the environments which reduce the incentive and opportunity to cheat are the very ones that...will lead to greater and deeper learning by your students" (p. 39).

To act with academic integrity, students must first develop a relationship with mathematics and their learning. Grades will always be important to students, since it is how they are evaluated in their programs and awarded degrees. As such, the very act of grading embeds a movement toward academic dishonesty. So, there is a need to address having these two very different but always coexisting sources of motivation. It has been shown that being motivated by externalities like grades and a peer culture where cheating is the norm pushes students to cheat. This is even more pronounced in higher-stakes environments (McCabe et al., 1999; Munoz & Mackay, 2019).

When a course has a learning outcome of "students should be able to compute the derivative of a rational function" while at the same time students have access to calculators online to do the work for them, how do we actually test what they know? The more pertinent questions are: how can we motivate students to want to learn to do this? Why is this still a learning outcome that needs to be tested? Finally, why are we defaulting to the standard idea of a "test" when there are many other ways for students to represent their learning?

We are not implying that summative assessments must be eliminated altogether; final grades still need to be assigned at the end of the term. But as Gernsbacher et al. (2020) state in their recent work, time-limited tests are less valid and reliable. A time-limited test is simply a snapshot of a student's work at that specific moment, not unlike a literal photo being taken. If we were having one's picture taken for a professional website and the photographer only takes three shots, it's likely none of them would be good enough, unless one is lucky (and not quite bad at posing for pictures). If the photographer takes a hundred pictures, among those shots the chances of finding something satisfactory is much higher.

Sometimes students do not feel well on test day; some students are more prone to anxiety than others. One practice that attempts to address this challenge is that of mastery-based grading, which allows students to demonstrate understanding of course outcomes multiple times in a semester, and assigns grades based on whether they have successfully done so at some point during the term. Being able to revise and resubmit reduces student pressure and fosters student ownership of their learning, and can potentially create more equitable environments (Lewis, 2020; Prasad, 2020).

Alternative assessments also allow students to represent their learning in varied ways, as well as foster deeper connections with the material. In author one's discrete mathematics class, students work on a revise-and-resubmit math portfolio throughout the term in addition to the more standard low-stakes quizzes, a midterm, and final exam. For this portfolio, they write-up draft solutions and proofs to a given list of problems, with an emphasis on their writing and communication. Graders then give personalized feedback on their proofs, which students use to revise and prepare for resubmission. Some questions ask them to reflect as well (for examples of this see Su, 2017). The goal is for students to create meaningful connections with the material and reflect on their metacognition through scaffolded draft submissions and targeted feedback.

Interventions that foster equity, diversity, and inclusion in the classroom also support academic integrity and signal that the student's lived experience and connection to the topic matter, which is what assessments such as this portfolio promote. Efforts to make the mathematics classroom equitable and inclusive will support academic integrity by creating a deeper student connection with the material as well as increasing motivation. When academic integrity is upheld in the classroom community—when the values of honesty, trust, fairness, respect, responsibility, and courage are promoted (International Center for Academic Integrity, 2021)—this will also lead to more open and genuine participation in mathematics for all. This reduces barriers to participation and supports a framework for thinking about mathematics as something that is beautiful, useful, and part of our everyday lives instead of simply a box on a checklist representing the path to a degree. Students who genuinely want to learn and do mathematics will act with integrity because it is their learning at stake.

Gutiérrez (2013) talks about the post-structuralist view that we are all products of our experiences as we navigate the world. Our relationships with institutions, other individuals, and society at large, all define what is normal for each of us, as it is for our students. And so, they enter the classroom with a different definition of success, and a different understanding of mathematics, leading to the tension of trying to reconcile or assimilate their view with what is traditionally reinforced as the predominant perspective, and this predominant perspective is often framed by those who have the most power in the discipline. Instead, why don't we start by asking our students the questions:

What is mathematics for *you*?

How will *you* be able to tell that *you* are successful in mathematics?

What does "success" in mathematics mean for *you* personally?

As Evans-Tokaryk (2014) highlights in relation to academic integrity, it is only when we acknowledge the different understandings that students are coming in with, and how globalization has influenced higher education, that we can find the real authentic connection points for students.

Even the conversation about gender and minority gaps is driven by standardized measures of successes and achievement in mathematics. The mathematical discourse centres around how minority groups fall behind and girls score less than boys. These are deficiency-driven models that speak to what students lack by comparing them to others who may not have had the same background and experiences (Gutiérrez, 2008). Nowhere in this discourse is a reflection on the pedagogy that informed these gaps or the power dynamics that are innate in these pedagogical decisions. Moreover, this discourse largely ignores individual creativity and the manner in which students construct their own relationships with mathematics. Su (2020) puts it beautifully in the title of his book: *Mathematics [is] for Human Flourishing*.

Repositioning mathematics as something authentic and meaningful to the learners is part of a larger Universal Design for Learning (UDL) framework. This ability to reflect, connect, and apply, leads to higher-order thinking and moves beyond the lower-level recall or computational questions that seem to make surveillance and proctoring a necessity. A move to authentic connection makes all assessments more about learner stakes as opposed to high stakes and low stakes. Regardless of what the assessment is worth, whether it be questions where learners work together collaboratively, or a testing situation, the stakes that matter should be the pedagogical stakes and not the numerical ones. These types of assessment situations pull on constructivist frameworks where the learner's connection to the topic and social location are just as valuable to the process as the course goals and outcomes. By approaching assessments and pedagogy with the learner positionality in mind, especially in a polarizing discipline like mathematics, barriers to the topic are decreased, and power dynamics are addressed at the forefront before approaching the concept. Context is key, and this will in turn reduce the chances for question prompts that are exclusionary and speak to concepts that are far removed from where the learners are at.

What these strategies suggest is ultimately the need to build a comprehensively inclusive and accessible community of learners and peers. Having such an inclusive community models the ethical pedagogy that supports academic integrity, reduces the need for bypassing learning through cheating, and reduces the need to gatekeep knowledge within the discipline as something that only belongs to one type of instructor or one type of learner. In such a space (be it on campus or virtually), math belongs to everyone

Conclusion

In the power dynamics innate in mathematics and its practice we have seen a tendency to exclude, and this is perpetuated in popular media and society. The genius myth pervades the field and implicit beliefs in these fixed characterizations of who can do mathematics push students away from math. This creates inequitable groups of math instructors and math learners.

Mathematics university educators in Canada are anxious: this is a time when the status quo has been disrupted several times over. Some have reacted to the pandemic and a change in course delivery models by increasing the reliance on surveillance pedagogy. However, online proctoring brings with it a slew of privacy issues as well as the dehumanization of participants and users.

By the use of online proctoring solutions to deter cheating instead of looking deeply and critically into course and assessment outcomes first, there is a movement away from access and accessibility. There is a movement away from equitable engagement with concepts, and instead a movement towards a homogeneity of learning experiences that necessarily excludes Black learners, Indigenous learners, disabled learners, queer learners, and any learner who has not been deemed normative by the software or the institution of higher learning. This technological surveillance signals distrust to students. This will not make students any more eager to do mathematics, or at least, may create more resistance to participation and enjoyment.

Supporting academic integrity in mathematics courses is equivalent to creating equitable, inclusive, and diverse classrooms for our students. While this is not a novel idea (Bertram Gallant, 2008; Lang, 2013), the potential effect of having a supportive pedagogy of care is even more pronounced in mathematics because of its traditionally exclusionary nature and levels of power dynamics innate from the instructor to the learner. A mathematics educational space where a multitude of opinions are welcome, student differences are acknowledged and celebrated, and each individual is invited to reflect on their personal math histories, and not have to erase their lived experiences—this is a classroom where a culture of academic integrity can also be built and developed.

There are long-standing practices in mathematics that are slow to change, although the growth in recent years of active learning as a student-centered pedagogy gives one hope that even more evidence-based studies will be done on academic integrity which may lead to change in standard practices around assessment and grading. As Seaton states, the reliance on proctored exams in mathematics leads to complacency, and we would benefit from more research in this area (2020). Our article is a call, to echo Seaton, for the need for more evidence-based analysis of mathematics and assessments in relation to academic integrity, and the need for more analysis on how power and systemic inequity plays a foundational role in how mathematics is conceptualized, taught, and applied.

Certainly, the dearth of evidence around academic integrity in mathematics education should not keep us from trying to change the culture and learning environments we are in and is certainly inspiring for the possibility for future research. Focusing on what we as educators can do "can also create a sense of empowerment in individual faculty members" (Lang, 2013, p. 38). We are at a turning point where critical reflection on our pedagogical choices could have a significant long-term effect on mathematics education in the future. And we have the ability to create inclusive and accessible environments where learners feel supported with the goal of promoting a culture of academic integrity, but also as a way to reduce barriers to mathematics and support demographically inclusive learners, even in the post-pandemic era.

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