Mathematics and Ethics: From Interrelational Epistomology to Social and Ecological Sustainability

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Abstract

Elsewhere, I spoke about interrelational epistemology (Abtahi, 2022). I conceptualised this epistemology as a way of becoming to know which consider the learner not as an individual but as a self who is in relations to others, humans, non-humans, different systems of knowledges and more. I called such view of an individual a *self-in-relations*. This epistemology does not consider knowing as possession of one's intellectual ability. Instead, knowing is about understanding one's position in the webs of interconnected relations, with which one is in constant interactions. This view of knowing feeds from and feeds back to multidimensions of one's experiences. In this essay, I create a more concrete and practical base to better introduce interrelational epistemology not only in the broad theoretical aspect, but also in the pragmatic practices of teaching and learning mathematics.

Keywords: Ethics, Social and Ecological Sustainability, Interrelational Epistomology

Why do I do this?

I belong to a branch of mathematics education research, Critical Mathematics Education (CME), which is critical about the role of mathematics and its teaching and learning in understanding and interpreting the social, ecological, and political events of the world (see for example Hunter, Civil, Herbel-Eisenmann, Planas & Wagner, 2018; White, Crespo & Civil, 2016; Coles, Barwell, Cotton, Winter & Brown, 2013). Similar to many others within CME, I envision mathematics education as being constantly vigilant about how we could be (and remain) in solidary with the things we are in relation with: each other and our planet. I introduced interrelational epistemology to conceptualise how mathematics – as a system of knowledges that we are in relation with – could play a role in social and ecological sustainability. In this paper, I first explain how I see interrelational epistemology as a root of becoming to know. Then to make the theoretical base more concrete, I utilise the Four Pillars of Education to Sustain the Commons as constructed by UNESCO. Along the way, I explicitly highlight my view of ethics and responsibility.

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Interrelational Epistemology

Previously, I have explained how I see self-in-relation. Rumi says each self, like a drafting compass, has two legs, one leg rooted in history, experience and reflections and the other leg moving to make relations with other things: humans, non-humans, and knowledges (Abtahi, 2022). With the rooted leg rooted and the moving leg in movement, one can draw coherent relationships, similar to how a drafting compass can draw circles. In this understanding of self-in-relation, knowledges (of mathematics, for example) become inherently part of to how one acts and interacts to build sustained (ethical and dignified) relationships. In this sense, mathematical knowledges are not abstract "things" to their end. Instead, they become means with which one engages and build relations with all that we are in webs of social and ecological interdependence. If I perceive my students as a selves-in-relations, the interrelational epistemology help me conceptualise the ways to become to know. Interrelational epistemology does not see knowledge as of intellectual ability of an individual. Instead, this epistemology tries to perceive knowledge as understanding and reflecting on one's position in the web of relationships between the moving and the rooted leg. In this epistemology, the aim is to capture the idea that knowledges are not fragmented. Knowledges are mutually dependent and are interrelated to ever-evolving life and social and cultural experiences (Abtahi, 2022).

Let's think about the mathematical concept of "1m – one meter". 1m could just mean a number (1) closely accompanied by a letter (m). It could mean the size of a metre wooden ruler stick, standing beside the whiteboard. It could mean *danger* if it is how far away a lion is from you. It could mean *tiny* if it is the height of a room. It could mean *unusable* for a size of a hammer, and it could equally mean *nothing* to a person who uses inch, as a unit of measurement. In all these examples, the mathematical concept of 1m is in relation to the interpretations and experiences of the person (dangerous, tiny, unusual, or meaningless), and in relation to other things that this person is in relation to. This is exactly what I mean by (mathematical) knowledges that are mutually

dependent and interrelated to life and experience. Within interrelational epistemology, becoming to know (acquiring knowledge) does not just enable individuals, but rather is formed to connect individuals to all the things that individuals live with and are in relation to.

An extremely crucial point I like to highlight here is that interrelational epistemology does not only seek to understand how one becomes to know a specific knowledge (such as fractions or algebra). Instead, it seeks to understand the position of relationality to which the acquired knowledge puts the individual. Within this epistemological view, the knowing (the knowledge of fractions, for example) not only makes the individual knowers powerful, but also provides a basis for an understanding of relationships and interdependencies. This means the question of an educator moves from 'how do we better teach fractions so that the students learn fractions even better?' and becomes 'by knowing fractions, what webs of others and things does the child become-in-relation with?' The latter question invites us to reflect not only on knowing (or not knowing) fractions as a knowledge, but also on the ethics and responsibilities that follows when we acquire that knowledge. To be mindful of how fractions (or any other mathematical knowledge for that matter) lead us to reflect on the ways in which we affect and are affected by the world around us, as beings-in-relations to, for example, animals, plants, waters, mountains, knowledges, worldviews and other humans. As I said, this understanding of knowledge (as one's position in the network of relations with other things) immediately brings forth two crucial elements of being in-relationships: a. ethical awareness; and b. responsibility.

Ethics and Responsibility

The issues of ethics and responsibility within mathematics and mathematics education have been navigated, from different angles, for decades. Ethics has been conceptualised as ethics of mathematics itself, as a subject of social construct (Ernest, 2021), as a fundamental value of being in relationships (Boylan, 2016), and as having empathy (Abtahi, 2021). For example, Ernest (2021) notes the social constraints that have been imposed within the historical practices that shaped

mathematics. Hence, he argues, human interests and values underpin the formulation of mathematics, making the subject the outcome of an ethical process. Boylan's (2016) view of ethics goes beyond the personal or those we are directly connected to. Considering ethical actions as ambiguous and ambivalent, he proposed ethical judgement to attend to relationship rather than to ethical rules. In this view of ethics, he considers relations with others, the societal and cultural, the ecological and the self. Finally, in teaching mathematical concepts to a group of Canadian indigenous teachers, Abtahi (2022) relates ethical awareness to increased sensitivity, responsiveness and capabilities in other-oriented and imaginative attempts to experience events as another human has experienced them. She argues that "unless we can imagine the world from the point of view of others—people and things whose experiences, contexts and ways of living are very different from our own—we are likely to act (albeit unintentionally) in ways that are detrimental to these others' individual and/or communal well-being" (2022, p. 154). Sprouting from ethical awareness are the responsibilities one has for others. Atweh and Brady (2009), consider ethics as face-to-face encounter and interaction between people, which leads to one's ethical responsibility to and for the other. They believe the relationship to others should be the original ethical form in which societal and institutional responsibilities are set. Roth (2007) goes one step further: referring to Levinas, he explains that the original ethical relationship consists of a limitless responsibility toward each other that is beyond all formal responsibility dictated in the law and stated in ethical principles. Abtahi (2022) argues that empathy as an other-oriented act is a necessary condition for ethical awareness and ethical action. Hence ethics extends beyond identifying the nature of right or wrong and good or bad, to encompass such matters as "responsibility" and "accountability" - not one's responsibilities as a good citizen of a government-ed society, but rather one's responsibilities as a person who cares about selves and selves-in-relations. I build on the view that sees a circular relationship between ethics and responsibility. What I add to existing views of ethics and responsibility is neither about the ethics of mathematics itself nor about the ethics and responsibility

of being face-to-face with an Other. Instead, I am conceptualising the ethics and responsibility that come with the "knowing of something": ethical awareness that is necessary, once one becomes to know their position in the web of interrelations that one lives with and is dependent on, and the responsibilities that follow.

Ethics here is directly related to knowing. Once I become to know something, what do I become ethically aware of? What then is my responsibilities? It is exactly in relation to this understanding of ethics of self-in-relation that I ask how mathematical knowings makes us ethically aware and leads us to understand our responsibilities towards trees, bees, ants, peoples, lions, and oxygens that we are in relation to and interdependent with? For me, this ethical awareness and the consequent responsibilities are the basis for understanding social and ecological justice. Mathematics teaching and learning towards a more sustainable ecological and social place means teaching and learning mathematics that connects to the webs of relations we are part of, which raises ethical awareness and highlights the responsibilities we hold towards things we cannot live without.

My argument is that at the roots of interrelational epistemology are selves-in-relations. The ways of becoming to know (in understanding the knower as a self-in-relations), the knowledges (as knowing one's position in a web of interrelations and interdependencies), the ethics (as having empathy) and responsibilities (towards all we are in relation to and interdependent with) are all woven together to portray an understanding of what it means to become to know mathematics in relation to more socially and ecologically sustainable webs of relationships. Now, I provide a more practical perspective, as to how the teaching and learning of such mathematics might look. To do so, I utilise UNESCO's Four Pillars of Education to Sustain the Commons (2021).

Education to Sustain the Commons

In 2021, UNESCO introduced the Four Pillars of Education to Sustain the Commons. The commons are described as what is shared; commoning is what is done together; the common good

is what is built and cared for by individuals together. With this concept of the commons in mind, the four pillars for learning are described as: 1. learning to study, inquire and co-construct together; 2. learning to collectively mobilise; 3. learning to live in a common world; 4. learning to attend and care.

> *1. Learning to study, inquire and co-construct together.* To highlight the social dimensions of learning, this pillar orients towards *learning together*. Pillar 1 also acknowledges the diverse and networked dimensions of knowledge. UNESCO claims that the "learning to know" pillar points educators towards constructivist pedagogical approaches and towards viewing their students as learning communities.
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> *2. Learning to collectively mobilise.* The second pillar is related to skills that enable collective action. Focusing on collaboration capability, this pillar aims to empower learners to take action together, focusing on "deliberation, cross-cultural communication and coalition building".
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> *3. Learning to live in a common world.* UNESCO explains that "tolerating and respecting the rights of others and the ways of being of others is a first step. But the challenge for humans living on Planet Earth in 2021 is to make healthy, sustainable ways of co-living: with one another and with the planet". The third pillar in Education to Sustain the Commons orients towards *learning to live in a common world* by engaging the "common humanity and with the natural world of which we are a part".
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> *4. Learning to attend and care*. UNESCO promotes freedom of thought and personal critical thinking. But it is also cautious the dangers of "acquisitive individualism and diminished empathy". The fourth pillar is created to attend to the balance of individualism and relationality, by emphasising *learning to attend and care*. This pillar puts our relationships with one another and with a more-than-human world at the centre of our practices of teaching and learning.

Although the Four Pillars of Education to Sustain the Commons have not been the foundation of studies in our field of mathematics education, there underlying messages of social and ecological justice are by no means foreign to the research in CME. In the teaching of mathematics, D'Ambrosio (2010) expresses three dimensions of ethics: respect for the other, solidarity with the other, and cooperation with the other. He then borrows form Whitney (2010) to elaborate on respect with an example, saying that if respect allows for playing with the new, how does it look if we replace 'solving mathematical problems' by 'playing around with it'? D'Ambrosio (2010) believes that respect is fundamental to this approach to learning mathematics. Children must be respected in

their search and in their attempts, even if not always successful. In another example, Jablonka (2010) considers the role of mathematical modelling, asking what kinds of images are conveyed about the reality to which these models refer, and what messages are conveyed about the relevance of mathematics for describing phenomena, for providing solutions, and considering the associated values. She explains that modelling is not about relying on strongly specialised knowledge, but evaluation of the "effectiveness and applicability of what a set of specific mathematical concepts and procedures does" (p. 99). Nicole et al. (2020) point to the curriculum, arguing for the duty of curricula to become not about disciplining, but living together as human beings with young people in teaching and learning and building new kinds of community. Finally, envisioning mathematics not just as lines, points, and places, but as space "where everything is in motion" (p. 52), Bishop (1990) notes:

> If your culture encourages you to believe, instead, that everything belongs and exists in its relationship with everything else, then removing it from its context makes it literally meaningless (p. 57).

In all the studies above, a common thread is to view mathematics as knowledge that is not independent of values, such as respect, interdependency, and solidarity; and to encourage curricula (the place of residence for the knowledges) to show this. For me, the critical point is exactly the belief that "everything belongs and exists in its relationship with everything else". This includes mathematical knowledges themselves. Here, I do not mean that knowledge of fractions relates to the knowledge of geometry, for example, or that algebra is related to patterns. What I mean is that mathematical knowledges are in relation to the person who is acquiring them, and the person who is acquiring mathematics is in relation to many other things, humans and nature. Neither the person, nor other humans, nor nature, is static. Hence nor would be the knowledges of mathematics. I believe that a deeper understanding of dynamic and in-relation mathematical knowledges is important to be able to conceptualise and effectively utilise the Four Pillars of Education to Sustain the Commons as a possible framework in the learning and teaching of mathematics. Let me explain

how I see the depth of the dynamic relationship of mathematical knowledge with interrelational epistemology.

Mathematics for Interrelations and Interdependencies

The Four Pillars of Education to Sustain the Commons are fascinating, but at the same time they raise questions: how would a mathematic classroom look if these four pillars were at the centre of mathematical activities? Considering these four pillars, what epistemological perspective could underpin these pillars? The following figure shows how I conceptualise these four pillars, connecting epistemological and theoretical roots to the practical aspects of mathematical activities.

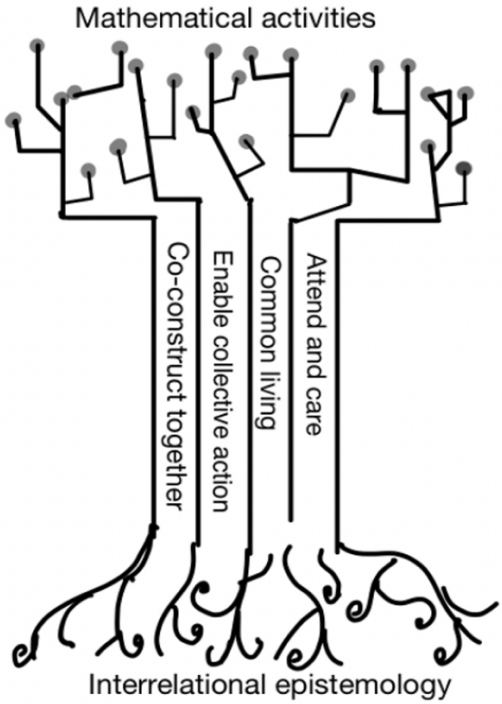

Figure 1 Roots and branches of learning maths to sustain the commons

Figure 1 suggests an image of the four pillars of learning rooted in interrelational epistemology. It also shows how, in turn, mathematical activities could stem from and maintain the interrelational ways of becoming to know. Let me give examples.

Using mathematics to *investigate racial profiling* – Gutstein draws on a story "*Driving While Brown/Driving While Black* " to examine data in relationship to the questions of racism racial profiling, an issue that "was a contested and real-life issue" for the students (2006, p 53). Gutstein

shared with the student's data from a racial profiling civil suit that was based on field report, in which student found the actual percentages of police stops of Latino and black drivers. He shares this story, for students to see concretely how data can tell a story about something as important as racism. His initial questions were about mathematics. For example: "How could you use mathematics to help answer the question of whether racism has anything to do with the Stops. Yet, the follow up questions were questions such as if the Latinos and blacks were treated badly. Interpreting the first and second sets of questions, I argue that the goal of this mathematical activity might not be to not only learn about data (statistics and probabilities) but to also reflect on the relations that the students are part of. Gutstein (2006) includes a reflection of one of the students. The student says:

> Yes, I think it is racial profiling because more Latinos are getting stopped although it's known that the whites would carry more stuff of the badder type [i.e., drugs] (NO OFFENCE but it's TRUE). What I think should be done about it is it should be stopped. They need to stop discriminating people because of their ethnic background. The questions that pop in my mind are: WHY ARE THEY DISCRIMINATING? WHY DON'T THEY LIKE US FOR WHAT WE ARE? WHY ARE THEY DOING THIS TO US (p.54)?

In an extension, reflecting on the second set of questions this activity could be an example of learning to co-construct together; learning to live in a common world; and learning to attend and care, when one works together, analysing the discriminatory factors in relation to race.

In another example, Kingan (2005) uses the mathematical concept of function in the graphing of carbon dioxide in the atmosphere and its exponential growth, to ask students to think about what might "involve people living together in a community supporting one another" (p. 242). She endorses the effect of learning mathematics on students if they realise the value of mathematics to themselves and society. Finally, Peterson highlights:

> To help my students understand that mathematics is a powerful and useful tool, I flood my classroom with examples of how math is used in major controversies in their community and in society at large. I also integrate math with social studies lessons to show how math can help us better understand the nature of social inequality. Kids are inherently interested in what is "fair," and using math to explore what is and isn't fair is a great way to interest them

> in all types of math concepts, from computation to fractions, percentages, ratios, averages, and graphing (2005, p. 12).

Common in all the examples above is an understanding of self-in-relation where the knowledges of mathematics become inherently part of to how one reflects on actions and interacts to build sustained social and ecological relationships. In this sense, mathematical knowledges of probabilities, statistic and functions are not abstract "things" to their end. Instead, they are means with which one engages with the webs of social and ecological interdependence. All examples above highlight knowledge as understanding and reflecting on one's position in the web of relationships (being about racial profiling or ecological issues). Among many others, these are implicit examples that view mathematical knowledges in relation to networks of other things. Furthermore, the discussions that follow such activities are important for ethical awareness and thinking about one's responsibilities. For example, the mathematical knowledge learnt by Gutstein's student made her aware of the ethical issue of ethnic discrimination, as she stated "They need to stop discriminating people because of their ethnic background". Further one can reflect on our responsibilities, as part of learning for attend and care, when we hear questions such as "WHY DON'T THEY LIKE US FOR WHAT WE ARE? WHY ARE THEY DOING THIS TO US?" I believe that UNESCO's four pillars make this view more explicit, in asking how mathematical knowledge could connect us to co-construct together, to collectively mobilise, to live in a common world and to attend and care.

To summarise I believe that the conceptualisation of interrelational epistemology and the Four Pillars of Education to Sustain the Commons could be a foundation to critically think about how mathematics (as a system of knowledges) could build the capacities for students to become ethically aware of the relations and dependencies that they are part of, as well as to see their responsibilities towards this web of interrelations. Students, as selves in relations, need to both create and sustain the webs that they are in-relation to. What role do mathematical knowledges play in creating and sustaining these webs? Going back to the metaphor of a tree, interrelational

epistemology is at the roots of becoming to know the kinds of things we are or are becoming to be-in-relation to. This is how mathematical knowledge is the basis for us to become in-relation to others. With this root, the Four Pillars of Education to Sustain the Commons could be a path to envisioning in what ways and to what extent mathematical knowledge might help us conceptualise the webs of interrelations in what we share, do, and build together. As in a tree in nature, the roots help the leaves grow, and the leaves help the roots to grow, circularly providing nutrition (means of growth) for each other.

1. How mathematical knowledge can connect us to study, inquire and co-construct together. As noted by UNESCO (2021), this pillar highlights the social dimensions of learning, towards constructivist pedagogical approaches and towards viewing their students as learning communities. It also points to the diverse and networked dimensions of knowledge. Regarding interrelational epistemology, for me, this pillar is more of the former: attention to the diversity of knowledges and how these knowledges help us to co-construct webs through which we become-in-relation to each other and to the common things of which we are part.

2. How mathematical knowledge can connect us to collectively mobilise. The second pillar is to empower learners to mobilise and take action together. As I mentioned earlier, being-in-relation means to have ethical awareness and assume responsibility.

3. How mathematical knowledge can connect us to live in a common world. UNESCO explains that "tolerating and respecting the rights of others and the ways of being of others is a first step. But the challenge for humans living on Planet Earth in 2021 is to make healthy, sustainable ways of co-living: with one another and with the planet". The third pillar in Education to Sustain the Commons orients towards *learning to live in a common world* by engaging with the "common humanity and with the natural world of which we are a part".

4. How mathematical knowledge can connect us to attend and care. UNESCO promotes freedom of thought and personal critical thinking. However, it is also cautious the dangers of "acquisitive individualism and diminished empathy". The fourth pillar was created to attend to the balance of individualism and relationality, by emphasising *learning to attend and care*. This pillar puts our relationships with one another and with a more-than-human world at the centre of learning.

Concluding Thoughts

In this essay, I attempted to conceptualise an epistemological view that could be a foundation to reflect on how mathematics as a system of knowledge could be a tool to better understand and refect on socially and ecologically sustained relationships. Within interrelational epistemology, I explained how knowledge (including the knowledge of mathematics) is perceived

as understanding of one's position in the network of other things. And how the learnt mathematical knowledges could affect the relations within which an individual is situated.

To better understand the relationships that are created and sustained by the learning of mathematics, I used a broader educational framework of Education to Sustain the Commons. Through examples, I talked about how the learnt mathematics help students to reflect about how to live with the commons, to learn collectively, to mobilise, attend, and care. I further extended the Four Pillars of Education to Sustain the Commons and the understanding of self-in-relation as an entry point into a view about ethical awareness and responsibility. I conceptualised ethical awareness as developing empathy by gaining new knowledges about the humans and non-humans with whom we are in relation. This ethical awareness is directly followed by responsibility.

Adding interrelational epistemology to the foundation of learning as interconnected and interdependent, I argue that and important role of mathematics is to understand that we are part of webs of the commons, without which we cannot live and to which we have ethical responsibility. Our responsibility is firstly the understanding that all knowledges (mathematics or any other) are co-constructed with all the things we are in relation to. We do not own any knowledge. It is our ethical responsibility to mobilise action for the wellbeing and good of the commons to attend and care. Mathematics is only another category of knowledges helping us understand where we are and what we need to do in the complexity of these interrelations and responsibilities.

References

Abtahi, Y. (2022). What if I was harmful? My experience of teaching of the dominant mathematics *Educational Studies in Mathematics Journal.* 108. 1-17. https://doi.org/10.1007/s10649-021-10117-1

Atweh, B., & Brady, K. (2009). Socially response-able mathematics education: implications of an ethical approach. Eurasia Journal of Mathematics Science and Technology Education, 5(3), 267-276.

Bishop, A. J. (1990). Western mathematics: The secret weapon of cultural imperialism. *Race and Class*, *32*(2), 51-65.

Boylan, M. (2016) Ethical dimensions of mathematics education. Educational Studies in Mathematics education, 92(3): 395-409. doi:10.1007/s10649-015- 9678-z

Coles, A., Barwell, R., Cotton, T., Winter, J., & Brown, L. (2013). *Teaching secondary mathematics as if the planet matters*. London: Routledge.

D'Ambrosio, U. (2010). Mathematics education and survival with dignity. In *Critical mathematics education: Past, present and future* (pp. 51-63). Brill.

Gutstein, E. (2006). *Reading and writing the world with mathematics: Toward a pedagogy for social justice*. London: Routledge.

Hunter, R., Civil, M., Herbel-Eisenmann, B., Planas, N., & Wagner, D. (Eds.) (2018). *Mathematical discourse that breaks barriers and creates space for marginalized learners*. Sense Publishers/Brill

Roth, W. R. (2007). Solidarity and the ethics of collaborative Research. In S. Ritchie (Ed.), Research collaboration: Relationships and Praxis (pp. 27-42). Rotterdam: Sense Publishers

Peterson, B. (2005). Teaching math across the curriculum. *Rethinking mathematics: Teaching social justice by the numbers*, 9-15.

Kingan, S. (2005). Rethinking and connecting algebra to real-world issues. *Rethinking mathematics: Teaching social justice by the numbers*, 238-242.

UNESCO (2021). Reworking Four Pillars of Education to Sustain the Commonshttps://en.

White, D. Y., Crespo, S., & Civil, M. (Eds.) (2016). *Cases for mathematics teacher educators: Facilitating conversations about inequities in mathematics classrooms*. Information Age Publishing.