The Role of Compassion and Empathy When Engaging With Tasks Concerned With Social and Environmental Justice

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In this paper, we raise questions about the role of student empathy and compassion when engaging with social and environmental justice issues — significant in a world where challenges associated with such disruptions are faced daily. We draw on data from a larger, nationally funded study on enabling students' critical mathematical thinking. These data were collected in a Year 10 classroom, where a task related to the current Australian housing crisis was implemented. Data were analysed using Geiger et al's critical mathematical thinking framework. Findings suggest that implementation of such tasks must include elements that promote student empathy and compassion.

Introduction

There is growing realisation that students must be empowered to understand and respond to the challenges of the Anthropocene (Watson & Smith, 2022), including the impacts of global warming and social inequality. This empowerment is crucial when forming judgements and making decisions as informed, responsible, and critical citizens (Geiger et al., 2023b). Such judgements and decisions should not be a product of rationality alone but must account for consequences that impact humans, other species, and the planet more broadly (e.g., Geiger, in press)—requiring thinking for the greater good. Engaging such thinking involves the capacity to empathise (understanding others' experiences/perspectives) and feel compassion (concern for others' suffering and desire to alleviate it) (e.g., Blue et al., 2018), as responsible decision-making draws on an entanglement of rational, empathetic, and compassionate practices. Further, research in mathematics education has highlighted the entailment of emotions and emotionally charged beliefs (Beswick, 2018), that drawing upon students' empathy and compassion, has potential to enhance their mathematics learning. There is, however, little guidance for teachers regarding pedagogies that support students' engagement with the range of thinking and emotional capacities such thinking demands.

How teachers can support students' rational, empathetic, and compassionate practices is a key question in the development of informed and responsible decision-making capabilities that draw on mathematics. In this paper we begin a response to the following research question:

How can teachers support students' rational, empathetic, and compassionate practices when using mathematics to address tasks related to socio-ecological disruption?

In addressing these questions, we present a synthesis of relevant research literature, and describe the theoretical framework used to direct research activity, including data collection and analysis. We then outline the methodological approach including the task used to catalyse student discussion, mathematical activity, and decision-making. Finally, we reflect on the role of teachers in supporting students' rational, empathetic, and compassionate practices when using mathematics to address tasks related to socio-ecological disruption.

Compassion, Empathy, and Socio-Mathematical Norms

Responses to the consequences of socio-ecological disruptions require not only rational

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processes, for example, attention to statistical analysis and logistics, but must also accommodate the needs of citizens and society at large. This means that to respond in an equitable and inclusive way, decision-makers (e.g., citizens, governments) must have the capacity for compassion and empathy to enable understanding of the plight of others. Mathematics can have a role in both generating responses to problems related to disruptions and in mitigating impact on those affected. Compassion and empathy also have a role in both cases — developing human sensitive responses to challenges and in mitigating impact in ways that are fit-for-need. Integrating compassion and empathy into teaching/learning, however, has significant implications for teaching/learning in mathematics classrooms.

Teaching and Learning in Relation to Socio-Ecological Disruption

There has been an intensification of concern by mathematics educators about their role in social and ecological justice, which has led to a rapidly developing global dialogue about mathematics education, the living world, and their entanglements with the ecological health of the planet. The dialogue that has developed within mathematics education, as well as more generally, is visible, for example, in the United Nations Sustainable Goals of Development (United Nations, 2015), the International Commission on Mathematics Instruction Study 27 on mathematics education and the socio-ecological (e.g., Coles, 2025), and in special issues and other academic work (e.g., Chan et al., 2021).

This discussion has moved from arguing for the importance of social/environmental justice (e.g., D'Ambrosio, 2009) to how teaching/learning can promote thinking and action in response to ever evolving challenges (e.g., Geiger, in press). At the same time, Vasquez et al. (2022) found that there was a paucity of relevant school level initiatives (e.g., curriculum, textbook tasks) that addressed this issue. Despite this current gap between the likely impact of disruptions and responses of education systems, Ada (2020) has conceptualised six change landmarks for how action in mathematics education can take steps to address this need: (1) more holistic and interdisciplinary mathematics curriculum development; (2) values focused pedagogies; (3) empowerment as change agents through attention to critical problem solving; (4) classroom resources aimed at fostering sustainability focused learning experiences; (5) pedagogical approaches that promote understanding of participatory decision making; and (6) sustainability focused teaching materials that can be localised and made relevant to students. Traces of these landmarks are evident in recent publications (e.g., Coles, 2025; Geiger et al., 2025).

While research is being conducted into how mathematics education can address sustainability issues, and by association socio-ecological issues, we were not able to locate studies that placed affects, such as compassion and empathy, as factors in making decisions about how to respond to socio-ecological disruptions in ways that address the needs of those experiencing related hardship. We argue that affect is key to engaging students with teaching/learning experiences aimed at developing critical and sensitive decision making.

Connections Between Emotion and Rationality, Beliefs and Cognition

The connection between cognition and affect has been a focus of research for several decades with knowledge and beliefs regarded as almost entirely cognitive and distinct from emotions. Goldin (2002) and DeBellis and Goldin (2006) described emotions as constituting a representational system, akin to a belief system. That is, emotions also encode information. Although it can be analytically convenient to distinguish emotions (affective system) and beliefs (cognitive system), there is evidence these systems are connected (Beswick, 2011). The entailment of emotions with beliefs adds to the sum of their connections and hence to the strength with which beliefs are held and their resistance to change. Beswick (2011) argued that when highly connected, challenges to our central beliefs are likely to evoke negative emotions which can manifest as resistance. Conversely, when a challenge or conflict is resolved,

pleasurable emotions may result. Emotions influence attention and memory (Hannula, 2002) and can arise from and influence beliefs about the relative importance of particular facts. We argue that if teachers can engage students' affective system along with their cognition there is potential for learning to be deeper, more meaningful and longer lasting. Problems that require mathematical reasoning and that also evoke emotions such as compassion and empathy are a powerful means by which the learning of mathematics can be enhanced by being rendered more memorable, while at the same time supporting students' ability to integrate mathematical understanding with learning about broader societal challenges.

Theoretical Framework

The larger project in which this paper is situated included the development of the Critical Mathematical Thinking (CMT) framework (e.g., Geiger et al., 2023a). The framework was developed to identify and describe cognitive and affective aspects of the thinking employed when making informed and responsible decisions about real-world situations, considering potential social and environmental consequences. It was designed as a guide for teachers when engaging students with problematic real-world situations in which mathematics is used to seek solutions while cognisant of associated consequences. Derived from relevant research literature, its key features coalesce around five dimensions—mathematical capability, critical capability, evaluation capability, reasoning capability, and dispositions. In this paper, we extend the CMT framework to include the preparedness to empathise and show compassion (Table 2).

Table 2

Critical Mathematical Thinking (CMT) Framework

Dimensions	Elaborations
Mathematical capability	Power over language, skills, and practices of using and applying mathematics, for example, understanding mathematical concepts and principles, identifying patterns and relationships, manipulating mathematical symbols and expressions.
Critical capability	Examining ideas, drawing conclusions, clarifying meaning, identifying, and analysing arguments, awareness of informal and cultural knowledge (e.g., social, political, environmental) and their influence on conclusions, considering the consequences of decisions and the ethical assessment of their impact.
Evaluation capability	Assessing claims and arguments (e.g., assessing strength of evidence, quality of data, reliability of sources), generating questions, generating aligned problems (e.g., validity of a solution if the circumstances change).
Reasoning capability	Logical thinking, inferring, proposing, and checking hypotheses, generalising, interpreting different information sources, generating evidence-based arguments (including integrated mathematical and extra-mathematical practices).
Dispositions	Believing mathematics is relevant to a real-world problem, showing initiative, taking intellectual risks, displaying perseverance, openness to alternative solutions, preparedness to empathise and show compassion.

Ernest (2002), for example, identified power over mathematical language, skills, and practices, and the critical capabilities needed to exercise participation in society as two domains necessary for mathematical competency. D'Ambrosio and D'Ambrosio (2013) further argued that critical citizenship requires wisdom when considering the suitability of specific mathematical solutions to real-world problems, emphasising the need to consider ethical and human centred responses to problems. Reasoning must be employed when developing evidence-based approaches to addressing problems and their consequences — integrating mathematical thinking and extra-mathematical contexts (e.g., Jeannotte & Kieran, 2017). This includes the capacity to construct logical arguments and draw valid conclusions from data. An

evaluative capability is needed to assess the strength of evidence (e.g., quality of data, reliability of sources) of claims and arguments—essential in the context of socio-ecological disruptions where mathematical evidence is often used to justify policy decisions, restrict or enhance personal and community freedoms, and shape public opinion (e.g., during the COVID 19 pandemic). This capability requires an understanding of how bias can be embedded in data collection and analysis. In addition, tasks based on disruptive phenomena are challenging, and require positive dispositions from students, who must persevere when progress is limited, and teachers, who must believe that students are capable of engaging with such tasks (Beswick, 2018). We see the preparedness to empathise with and feel compassion for those impacted by socio-ecological disruptions as essential when seeking to develop equitable, inclusive and just responses to socio-ecological problems.

Methodological Approach

The larger project used a design-based approach to develop, test, and refine theory about changes in teaching practice and student learning (e.g., Cobb et al., 2003). In this paper, we focus on the conditions that support the effective implementation of tasks that require students to engage with critical mathematical thinking—those concerned with socio-ecological issues.

Participants and Data Collection

In this paper, we report on one teacher working with their Year 10 students. The school was coeducational and located in an inner suburb of an Australian state capital city. We draw on video recordings of the classroom in which the teacher and students worked on a socio-ecological activity—the Airbnb task (described below). Students were provided with the task 24 hours prior to the 90-minute lesson in which they worked on the related problem. The lesson was conducted using an investigative approach aligned with Geiger et al.'s (2022) design and implementation framework for modelling tasks. Students were organised into groups of four to five of their choosing. The teacher provided initial impetus for the lesson by presenting the task, providing students with the opportunity to ask questions to clarify expectations about completing the task, and then allowing students to investigate the problem themselves. The teacher approached students during the lesson in response to questions, to monitor progress, and when he noticed an aspect of student thinking he believed required attention. At the end of the lesson students were brought back together for whole class discussion, catalysed by presentations from each group. The activity of student groups and the teacher were recorded via two stationary cameras and a mobile camera focused on the teacher. The comments of other students, in response to teacher questions or prompts, were also audible throughout the lesson. End of lesson presentations were recorded on one of the stationary cameras.

Task

The task was designed to provide teachers and students with the opportunity to exhibit behaviours that aligned with the CMT framework. The task consisted of text which described the situation and videos, drawn from the Australian Broadcasting Commission (ABC) website, that provided additional background. The text for task is presented in Figure 1.

Analysis

Video data were transcribed and analysed deductively using both critical and dispositional dimensions of the CMT framework as a lens. We sought instances of dialogue that provided illustrations of these dimensions in a process that led to the identification of sub-themes. As illustrative examples were identified, they were corroborated by a second member of the research team. Here we present examples of dialogue that reveal student orientations to compassion and empathy that influenced their approach to the task, and teacher interventions.

Figure 1

AirBnB and the Rental Crisis

Are short-stay properties like Airbnb the reason for the rental crisis?

The following video and media report discuss the apparent shortage of affordable rental accommodation because owners are making their properties available for short-term arrangements. This raises the concern that such properties are taken out of the pool of available housing for permanent residents.

Please discuss whether the Brisbane City Council (media report) made the right decision to impose a registration fee on properties that offer short-stay opportunities through online agents (e.g., Airbnb and Stayz) or are they overreacting? Justify your response using available information about the availability of affordable accommodation.

Investigate the rental prices and short stay accommodation in Gympie. Based on your findings suggest whether the Gympie Regional Council should implement a short stay registration fee as imposed in Brisbane. Who would be advantaged or disadvantaged? Suggest other possible avenues to alleviate the rental problems in Gympie. Justify all responses using available information.

Findings — Student Perspectives on Airbnb and the Housing Crisis

Soon after beginning the task, very different opinions emerged between one student, Wanda, and the rest of her group (three students). While three members of the group saw the imposition of a registration fee as part of a solution to the problem, Wanda argued that it would not help at all. The other members of Wanda's group expressed concern for the number of homeless people and those unable to get into the housing market, and while they conceded that a registration fee was not a complete solution, they argued that shifting rental properties from short term to long term would help alleviate the problem for at least some people in the short term. The importance of such a shift was highlighted by a point from a third group: "There are a smaller number of rental properties available on the market right now compared to Airbnb".

The teacher, Adam, picking up on this point, indicated that addressing the issue of the number of Airbnbs was a possible way to alleviate the housing crisis at least in part, but how this was done was important. A fourth group raised an objection to this idea, arguing: "If you own something, you should get to choose what is done with it!". Adam said he understood the point being made, but that the distinction between a *want* and a *need* was important. He asked the class if housing was a want or a need. The students responded unanimously that it was a need. Adam pursued his argument further, indicating that in the case of human need:

> …governments can take steps to inhibit the free market and limit peoples' ability to freely do what they want with their own things…if it comes down to it, people need a house to live in…and if the government sees there is a problem with supply and a way to fix it, that doesn't ruin someone else's financial position, then maybe they do have some license to act in that way.

Adam then asked if anyone agreed or disagreed. One student objected along the same line as earlier–governments cannot tell you what to do with your property. In response, Adam directed the student to the task description, saying this indicated that landowners were not being forced to give up their property, rather, the government was implementing a measure to encourage a particular action. The student then agreed this was reasonable. Another student, from a different group, pointed out that governments had the authority to take back property anyway: "But how different is that from involuntary buy backs–like road reserves–this is currently in place". Adam agreed, saying that it was not uncommon for governments to resume land even though people have a deed of sale and that:

> …we do not only have the free market for people to decide what they do with their land…there are already circumstances that the government sees it as necessary to take action to maintain the health and well-being of citizens.

Wanda, however, continued to argue that there was no point in applying a registration fee:

> Every Airbnb owner will be unwilling to change to renting ... it is most likely you will make more money out of Airbnb. If they changed to rental, say for a beach side property, they would have to put up the price to keep the same profit…people who can't afford rental properties in Brisbane right now, will not be able to afford the Airbnbs that would then be in the rental market…

Adam accepted Wanda's argument, even though this was from a purely financial perspective, but asked her to flesh out the argument and to provide support via "some numbers". The teacher went on to say that students also needed to consider who required the most help from government: "…the family that owns three or four Airbnbs by the beach, because currently legislation serves them, or the people in the rental market that need a house?" The students all agreed that people in the rental market requiring a house needed the most help. Wanda, however, came back to their same point: "But if you are making a lot of money from an Airbnb, how can you give that up to someone who doesn't have a house?"

When Adam replied there are issues of justice on both sides, those who might make less income from Airbnbs but also for people who have less access to housing. He made the comparison between housing and water as a human need – and that it would be seen by everyone that water could not be tied up in a way that some did not have access. Most students conceded this point, but some still seemed reluctant to move away from the notion of housing as personal property to be used in any way the owner seemed fit. Adam asked students to continue thinking about the tension inherent in promoting justice on all sides when pushing forward with the problem. He also reminded them of the need to develop a mathematical argument to support their response to the task.

Animated discussion continued in Wanda's group. One student argued that if there was no housing, people should not be moving to their city, they should just go somewhere else. Another said that this was not fair, and that people who needed housing were not those who were moving from elsewhere but people who were already in their city. Another argued that the rental crisis was an outcome of COVID-19 and that such an event "doesn't happen very often", indicating that things would sort themselves out in the long run, and no drastic action was needed.

Adam approached the group, to check on their progress. The team members other than Wanda, who was working on her own, pointed out that 200,000 people had arrived in their city between 2019 and 2024, while only 40,000 more homes were built. They had also found that there were 3,600 Airbnb listings in their city and that even if all of these were reassigned as rentals, it would not solve the problem. They further argued that, in this circumstance, it would be better to keep the Airbnbs for tourism, with 85% occupied for 50% of the year, which put money back into the economy and supported other industries. Adam commended the students on their reasoning and how they had evaluated different aspects of the problem, but also posed the question – does that mean the government should stop doing anything? The three students said, no and that the government had to invest more into building more houses.

At this point Wanda re-entered the conversation. She presented a carefully constructed mathematical argument which indicated that a registration fee would make no difference to the growth of Airbnbs. Adam asked Wanda to check the reliability of her sources and pointed out that his reading of the information was that measures, such as registration fees, while not reducing the number of Airbnbs, had limited growth in the numbers. Undeterred, Wanda maintained her position. Wanda then joined in with other members of the group arguing against building more houses as it was already too crowded. She also asked the rest of the group if they were willing to compromise their own standards of living for someone else to get a house and suggested that the solution was to stop population growth (tongue in cheek).

Wanda continued to argue along the same lines, saying that the median income from an Airbnb was $70,000 per year, which meant that if the property was returned to the rental market, the owners would have to increase the rent by $2,000 a fortnight, which made it inaccessible to regular renters. The other members of the group agreed that returning all Airbnbs to the rental market was not the whole solution, but something needed to be done to deal with the rental crisis and especially for those who were homeless. They suggested possibilities such as placing a cap on the number of Airbnbs, so at least new properties were available to the rental market.

Wanda eventually agreed that it was important to address the issues associated with the rental crisis, and that housing should be seen as a right and not a privilege, but did not change her position that any attempt to address the impact of Airbnbs would make a difference to those experiencing hardship

Discussion and Conclusion

Across the lesson, student activity and discussion touched on all aspects of the CMT framework. Students demonstrated *mathematical capability* in making use of demographic data and financial information to generate mathematical arguments that supported their response to the challenges at the centre of the task. Through discussion and debate, they exercised *critical capabilities* in analysing each other's arguments and by considering the consequences of decisions. Students assessed the strength of evidence when *evaluating* claims prosecuted by individuals or groups. They also took initiative and displayed perseverance (*dispositions*) when engaging with the problem.

Adam, the teacher, attempted to connect students' thinking to the ethical assessment of the impacts of their decisions, as well as seeking ways to empathise and experience compassion for those who were disadvantaged by the current state of the housing market. His attempts to do so appeared to make some difference to most students. In Wanda's case, however, the issue seemed to remain a matter of financial impact on Airbnb owners, and she was doggedly determined to maintain her position that measures to move Airbnbs into the rental market would not be helpful – this is what the numbers said and that should be the end of the argument.

Wanda had addressed the specifics of the task, thoroughly and thoughtfully—we accept that they had responded to the task as it was written. We saw other students, both in other classes in the same school and in other schools, take the same approach as Wanda. In these cases, students also resisted prompts from their teachers to think more broadly and to exhibit empathy and compassion towards those who were experiencing hardship.

In light of the approach adopted by these students, however, we now ask ourselves questions about how tasks could be constructed in ways that might promote empathy and compassion. What aspects of task design need to be considered? Are there resources that could be included that might evoke concern for those experiencing hardship or disadvantage. For example, what difference might there be if the ABC video clip had featured people experiencing housing precarity? Might pedagogies involving role-play or otherwise having students put themselves in the place of particular characters affected by the issue evoke emotional responses? We also ask in what ways can the socio-mathematical norms (Yackel & Cobb, 1996) of classrooms be shaped to support the empathy and compassion that may push students to look further than simply completing the task, and to find ways in which mathematics can point to sensitive responses to the difficult life circumstances experienced by others. Data presented in this paper demonstrate how Adam attempted to foster such socio-mathematical norms. One of our challenges, as the project progresses, is to generate insight into how these norms can be developed in ways that are most effective and how long it might take to establish a mathematics classroom in which empathy and compassion are seen as essential ways of working.

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