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Children's knowledge and experience of compost/ing

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ABSTRACT

The Soilsafe Kids education and research programme conducted focus groups about compost/ing in eight primary school classes in Tāmaki Makaurau Auckland, Aotearoa New Zealand in 2022 to understand what students learning at New Zealand Curriculum Level 2 (generally students aged 5-11 years old) know about compost/ing. Here, we present a qualitative content analysis of focus groups focusing on children's knowledge about the process of composting and the resulting material. In general, children ($n=117$) demonstrated a broad understanding of the typical process of composting and the materials that make up compost. Our findings contrast previous studies which have indicated children's comprehension of composting was poor. Despite participating in composting activities in schools, respondents more commonly associated compost/ing activities with their home systems where they compost with their families. Although these results demonstrate a considerable baseline knowledge of compost/ing understood by children, they also had many questions about compost/ing, mainly focused on the timing necessary to biodegrade, the underlying processes, and why we compost. These encouraging findings mean educators have a strong base on which to build lessons, but educators should also be mindful of bridging gaps in retention for greatest pedagogical impact, given our findings suggest that students recall off-campus composting experiences more strongly than on-campus ones. This should be further explored to ensure children have equitable access to composting experiences and knowledge.

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Introduction

For decades, municipalities around the globe have been sounding the alarm that their landfills would be at capacity during the first half of the twenty first century (e.g., Baldwin & Dripps, 2012; Swarthout, 1993a; Zhang & Forder, 2014). As our landfill capacity decreases and greenhouse gas (GHGs) emissions from our landfills increase (Blondin et al., 2015; Bolanos et al., 2020), it is evident that our solid waste disposal habits and processes, particularly in the Global North, need to shift. A substantial proportion of landfills' GHGs are due to the organic materials (specifically meaning as 'relating to or derived from living matter' here, not produced 'without added chemicals') deposited at these sites (Diprose et al., 2023; Lou & Nair, 2009; Rankin, 2024; Zhang et al., 2019). By disposing of these materials differently—especially critically considering both the distribution and rate of production of these materials—landfills will not only require less space but will also reduce the emission of GHGs (Baldwin & Dripps, 2012; Benyam et al., 2018). In fact, Déportes et al. (1995) note in their review paper on urban waste compost that two of their examined studies estimate up to 70% of the material by weight sent to landfills each year is compostable, while Palmerston North (Aotearoa New Zealand) identified in 2024 that half of the municipality's rubbish being landfilled could be biodegraded and/or reused (e.g., Rankin, 2024). One way to divert these materials is to compost them.

Compost*ing* is the human process of arranging organic material to be broken down by biological processes. It is worth noting that there has been an increasing use of biological processes that are technologically aided, such as through large-scale biodigesters used at the city level (Diprose et al., 2023; see discussions in Wing & Sharp, 2023). Here, though, our focus is on localized, technologically-unaided composting. Composting is known to 'reduce the dependence on chemical fertilizers, help recover soil fertility, and improve water retention and the delivery of nutrients to plants' (United Nations Environment Programme, 2021, para. 7). While the process of composting is a source of GHGs, there is broad consensus in the scientific community that landfilling results in higher GHG emissions compared to composting (e.g., Lou & Nair, 2009).

Compost is the product of layering 'waste' organic matter purposefully by human actors, which is subsequently broken

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down into humus by a vast army of more-than-human others (e.g., aerobic bacteria, fungi, protozoa, earthworms) (Wing & Sharp, 2023). This process of biodegrading materials and the resulting physical mixture (Åberg-Bengtsson et al., 2017; Ero-Tolliver et al., 2013) means that compost/ing is therefore both a process and a physical product. There are multiple methods of localized composting documented in urban contexts, each with its own benefits and potential pitfalls. Materials can be decomposed by anaerobic bacteria in tumblers (Trautmann & Krasny, 1997), on-ground piles (Swarthout, 1993a), bins (Schwarz & Bonhotal, 2017), by worms (Hashimoto et al., 2021), or by other decomposers like black soldier flies (Liu et al., 2019). Other methods such as using manure or mushrooms (e.g., Hwang et al., 2020) are less commonly documented. While aerobic composting is very common, it requires specific conditions to avoid developing a foul odor (Buelin-Biesecker, 2014; Estes & Fucigna, 2013). Worm farms are also a widespread practice, especially domestically (Cronin Jones, 1992; McGuire, 1987).

In this paper, we provide insight into children's knowledge of compost/ing in Tāmaki Makaurau Auckland, Aotearoa New Zealand (hereafter Auckland and NZ) by conducting focus groups in primary schools that already have composting systems in place to address the question: *What do students learning at New Zealand Curriculum Level 2 in Tāmaki Makaurau know about compost/ing?* This will not only allow Soilsafe Kids' Three-Day Programme to adapt based on our students' knowledge base, but it will also contribute to understanding the engagement in composting by Auckland students, enabling comparisons to other regions of New Zealand and around the world when and where this data becomes available and compared to previous generations.

Compost/ing at home and in educational settings

Compost/ing is a way children can connect to the natural world in their daily urban lives, contributing to the sustainability of their schools, and local environments. For example, regardless of the method used, composting has shown remarkable benefit to the amount of solid waste diverted from landfills by schools (Blondin et al., 2015), and there is existing evidence that composting is part of a suite of practices that help children be more conscious of the connections between their practices and their waste production (Chawla, 2007). The potential to make a tangible difference to the environmental credentials of school campuses is therefore convincing, and so too is the value of using compost/ing as an educational tool.

In fact, the United Nations' Educational, Scientific, and Cultural Organization (UNESCO) has listed compost/ing as a topic they recommend be covered in 'Education for Sustainable Development.' Their focus includes educating the public—including children—about sustainable waste management practices (UNESCO, 2017). Many educational engagement programmes about compost/ing focus on building generative behaviors with children as they are found to be more receptive to developing new habits and changing existing ones than adults (Bolanos et al., 2020; James, 2016; Kayihan & Tönük, 2012; Sorokowska et al., 2020; Waliczek et al., 2016). Further, many programmes anticipate that their messaging will also reach children's families and communities through discussions at home (Baldwin & Dripps, 2012, 2016).

Another vital aspect of content like compost/ing education regards children's connection with the environment. Almeida et al. (2023), Blizard and Schuster (2007), and Louv (2005) have all suggested that, as children spend more time using technology, they spend less time outside in nature especially if they live in an urban area. Such a disconnect with nature may also decrease children's knowledge about aspects of the natural world (Chawla, 2007) including fundamental processes such as decomposition, and potential human relations to this *via* compost/ing.

Home composting is now being targeted as an important strategy for reducing household organic waste; it is well-rehearsed that one third of the global food that is produced is wasted, and "that a further 17% ends up being wasted by retailers and consumers, mostly by households" (Zarocostas, 2022). Home composting has been associated with household sustainability in ways that perform sustainability outside scientific truths but rather, more sensorily, experientially and affectively (Waitt & Rankin, 2022). It has also been demonstrated to be an effective learning device to teach young children about broader environmental and sustainability concepts in more scientific framing, where household biowaste management practices can shape preschoolers/new entrants' understanding of organic matter decomposition (Marchal-Gaillard, 2024). This latter study is just one that helps to address what Gomes and Fleer (2019) suggest is a gap in empirical studies examining young children's opportunities to develop an understanding of scientific concepts at home.

Studies about compost/ing in educational settings predominantly focus on early childhood, secondary, and higher education (i.e., tertiary) educational settings. Many American universities have established composting systems in their dining halls and residential halls, often using the resulting compost to fertilize campus green spaces and consistently attempting to decrease their carbon footprints (Baldwin & Dripps, 2012; Mu et al., 2017; Torrijos et al., 2021). The impetus to compost can be attributed to generating revenue (Mu et al., 2017), providing student jobs (Baldwin & Dripps, 2012; Mu et al., 2017), and/or creating teaching laboratories (Mu et al., 2017; Torrijos et al., 2021). Compost/ing has also been used internationally as a learning opportunity in secondary education (Baldwin et al., 2016; Buelin-Biesecker, 2014; Cronin Jones, 1992; Trautmann & Krasny, 1997) and early childhood education (Fleer, 2015). Secondary science teachers often use compost as a context to discuss energy transformations (Minshew et al., 2017) and trophic levels (Leach et al., 1996; Trautmann & Krasny, 1997) through physical experimentation while early childhood educators describe how composting is a way to role model science discovery during outdoor lessons (Eugenio-Gozalbo et al., 2020; Fleer, 2015). Although composting has been an in-class exercise in early childhood and secondary education (Nxumalo, 1999), there are fewer studies describing composting in primary education.

Published evaluations of the outcomes of higher education, secondary, and early childhood composting projects tend to focus on unit content (e.g., Baldwin et al., 2016; McGuire, 1987; Stanley & Turner, 2010; Swarthout, 1993a, 1993b; Young, 1977), if habits have changed (e.g., James, 2016; Torrijos et al., 2021; Vossen & Rilla, 1997), and/or discuss the projects with adults (e.g., Blondin et al., 2015). While each of these aspects are important to document, they do not establish common student knowledge or students' misconceptions. Almost certainly, teachers are establishing what students know before they begin compost/ing lessons and are assessing student comprehension and recall of material at the conclusion of the lessons. Summaries of these aspects of the projects are not documented in the published record though, resulting in the multitude of external stakeholders having an incomplete understanding of what students know about composting and how ubiquitous knowledge or misconceptions are. This hinders external providers' abilities to support educators or to provide high quality learning experiences: lessons may be too basic or too advanced for the target students, resource development may not address misconceptions, and planning for future community-level education about the broad range of relations involved in compost/ing teaching and learning is based on scant data. This paper is therefore important in its contributions to taking seriously students' voices in knowledge production, establishing an understanding of students' baseline knowledge (and what they misconceive of) in composting in the context of the present study, and providing data and more targeted guidance around appropriate levels at which to pitch teaching and learning in this subject matter.

Context of compost/ing in education in NZ

Ideals similar to those being promoted by UNESCO can be seen when NZ's Ministry of Education defines Education for Sustainability as teaching that 'empowers learning communities with the values, knowledges, and skills they need to take meaningful action to ensure a thriving world' (Ministry of Education Te Tāhuhu o te Mātauranga, 2022, para. 1). Two example schools have implemented at-school compost programmes (Ministry of Education Te Tāhuhu o te Mātauranga, 2022). Additionally, there are many NZ-based external educational providers who support in-school composting systems including Garden to Table (gardentotable.org.nz/), Oke Charity (oke.org.nz), Enviroschools (enviroschools.org.nz/), Para Kore (parakore.maori.nz/), Ecosolutions (ecosolutions.org.nz/), and Soilsafe Kids (soilsafe.auckland.ac.nz/soilsafe-kids/). Although these providers often work with primary schools, compost/ing in educational settings is not limited to this stage of education with higher education institutions such as our own operating on campus composting initiatives. The number of successful external providers as we have seen in NZ suggests that compost/ing is included in primary education here despite little published academic literature featuring them.

One of the Soilsafe Kids' Three-Day Programme's goals in 2022 was to start to build a set of documented knowledge by asking students what they know about compost/ing. This would enable us to tailor future programmes and refine the Three-Day Programme in 2023 to build on students' baseline knowledge, rather than reinforce knowledge students already hold.

Theoretical framework

The Soilsafe Kids' initial curriculum development was led by two New Zealand-qualified teachers (i.e., meet the requirements to become registered teachers but are not registered with the Teaching Council of New Zealand) with support from a New Zealand-registered teacher. Our approach to teaching is guided by social constructivism (Bandura, 1989; Bodner, 1986) to allow students to engage with content at their own pace in an embodied way. A child-centric approach (Egli et al., 2021; Mitchell, 2006) with an emphasis on incorporating multiple cultures into the project was adopted (Tsang et al., 2023). This approach facilitated bringing community experts into the classroom with the Soilsafe Kids team (Tsang et al., 2023). Our underpinning child-centric approach created the opportunity to elevate early primary school children's voices in research.

The Soilsafe Kids programme research design is informed by equity theory (Adams & Freedman, 1976), prioritizing reciprocal relationship with participants providing knowledge and demonstrations in conjunction with data collection (Egli et al., 2019). This format allows reciprocity in our teaching-learning model and is closely related to the Māori concept of ako, which can be understood both as teaching and learning, as the learner and teacher are always continuously learning from each other (Te Kete Ipurangi, n.d.). In our practice, we implement the reciprocity of ako by capturing children's thoughts and perspectives for research purposes and then immediately give back by sharing a number of different ways that soil had been conceived of in an educational, diverse, and interactive set of workshops. Simply put, we applied an equitable ako-informed approach to our study design, so that we do not simply collect data from participants: there is intentional giving-back through learning opportunities, lesson plans, resources, and knowledge exchange.

Finally, this study is guided by the principles of Te Tiriti o Waitangi (1840), the founding document of Aotearoa New Zealand between the rangatira (chiefs) of iwi (nations) and the British crown. Key principles in Te Tiriti o Waitangi are tino rangatiratanga (Indigenous self-determination), establishing and maintaining meaningful relationships, partnership, protection, and participation. These principles have been enshrined into law through multiple acts of the New Zealand parliament in the past 180 years. Through Soilsafe Kids, we aim to uphold Te Tiriti o Waitangi by prioritizing mātauranga Māori (Māori knowledge) on soil and always ensuring it is the first content workshop offered in the Three-Day Programme. We also prioritize meaningful relationships with Māori partners as schools and community partners.

Positionality

We co-led, designed, and delivered the 2022 iteration of the Soilsafe Kids' Three-Day Programme; thus, the Soilsafe Kids Three-Day Programme is influenced by our lived experiences.

All of us are tauiwi tangata Tiriti, meaning foreigners with political and aspirational intentions around building relationships with Māori and recognizing the political history of NZ's formation. The term "acknowledges that Aotearoa is multicultural, that Pākehā aren't the only grouping brought together with Māori under the Treaty" (Dewes, 2022). Tsang is an earth scientist and educator who specializes in connecting research and communities. Sharp is an environmental geographer investigating NZ's multiple soil values and politics in relation to food systems and diverse community action, and to help guide future policy and planning; she also co-leads Soilsafe Aotearoa, Soilsafe Kids' umbrella programme. Egli is a social scientist and health researcher whose work focuses on children, communities and the neighborhoods in which children live, learn and play. In 2022, we all worked at the University of Auckland and lived in Auckland. We recognized the multitude of identities present in the schools and communities we were working with, acknowledging that many of them have lived experiences different to our own.

Methods

Soilsafe Kids' Three-Day Programme is a combined research-educational engagement programme that demonstrates how soil can be studied from many disciplinary lenses and worldviews (Tsang et al., 2023). Here, we have conducted focus groups consisting of students between 5 and 11 years old at six primary schools in Tāmaki Makaurau Auckland about students' experience of and knowledge about compost/ing. We undertake both inductive and deductive qualitative content analysis to establish what students' underlying knowledge is for further development of Soilsafe Kids. Given the exploratory nature of this study, we have used a qualitative approach to highlight all of the themes the students wanted to share rather than only emphasizing the most common themes.

Research ethics

This study was approved by the University of Auckland's Human Participants Ethics Committee (reference number: 23356). Prior to the beginning of the Soilsafe Kids' Three-Day Programme's workshop, principals, teachers, and parents or guardians of each student were required to sign a form giving consent for participation. Additionally, students needed to sign an assent form. All four signatures were required for a student to be considered a participant. Only participating students were included in the research group discussions. The beginning of the introductory workshop reiterated material from the participant information sheets provided with consent and assent forms. Immediately after, students were moved into groups. Before the recording device was turned on, each student provided additional verbal approval that they were comfortable with the audio of the group discussion being recorded (Supplemental material 1). See Tsang et al. (2023) for more information about the ethical considerations that guided the development of this study.

Participants and setting

The described focus groups were part of the larger Soilsafe Kids' Three-Day Programme, which was first run in 2022. All participants ($n = 117$) were students in classes that participated in the Soilsafe Kids' Three-Day Programme in 2022. At this point in the programme, we wanted a better understanding of what primary-aged students in Auckland already know about compost to ensure our workshops were building upon pre-existing knowledge and where they were learning about compost/ing to ensure effectiveness of our lessons. To ensure our dataset would encapsulate the breadth of English-medium students in Auckland, we worked with schools located in north, west, and south Auckland in rural to suburban locations across the full range of socio-economic backgrounds (Table 1). The schools varied in size, in distance and direction from the University of Auckland, and in the communities (socioeconomic and ethnic) from which they draw. All of the participating schools had pre-existing in-school composting programmes.

The students were all learning at NZ Curriculum Level 2 at the time of their participation as determined by their principals and teachers (Tsang et al., 2023). Generally, students learning at NZ Curriculum Level 2 are in NZ Years 1-6 inclusive (Ministry of Education Te Tāhuhu o te Mātauranga, 2007). Therefore, students had likely already participated in composting lessons that addressed at least one of the seven science learning objectives at Curriculum Levels 1 and 2 (Table 2). We would expect students who have studied compost/ing as a learning context for science lessons to focus on aspects such as the living things in compost and their needs. In addition to the NZ Curriculum's science achievement objectives, there are five key capabilities in science that span all of the Curriculum levels. These

Table 1. Summary of participating schools.

School	Year level(s)	Location	Setting	School size	Decile	% Māori & Pacific Islander	Composting practices
School 1	4 and 5	North Auckland	rural	under 100	9	6.5	School run
School 2	4	North Auckland	suburban	800-900	10	6	Previously school run; 2022: external provider
School 3	3 and 4	North Central Auckland	suburban	400-500	7	10	External provider
School 4	1 and 2	West Auckland	suburban	300-400	2	79	School run
School 5	5 and 6	West Auckland	suburban	300-400	4	44	External provider
School 6	4	South Auckland	suburban	300-400	1	80	School run

Until the end of 2022, NZ's Ministry of Education Te Tāhuhu o te Mātauranga classed schools by decile to represent the socioeconomic status of the surrounding community. Decile 10 schools were located in very high socioeconomic communities while decile 1 schools were located in very low socioeconomic communities. Each decile represented 10% of NZ's schools. This system was replaced at the beginning of 2023.

Table 2. Science learning objectives that can be addressed in composting lessons at Curriculum Levels 1 and 2.

Science learning objectives addressed in composting lessons
• 'Appreciate that scientists ask questions about our world that lead to investigations and that open-mindedness is important because there may be more than one explanation' (Ministry of Education Te Tāhuhu o te Mātauranga, 2007)
• 'Extend their experiences and personal explanations of the natural world through exploration, play, asking questions, and discussing simple models' (Ministry of Education Te Tāhuhu o te Mātauranga, 2007)
• 'Build their language and develop their understandings of the many ways the natural world can be represented' (Ministry of Education Te Tāhuhu o te Mātauranga, 2007)
• 'Explore and act on issues and questions that link their science learning to their daily living' (Ministry of Education Te Tāhuhu o te Mātauranga, 2007)
• 'Recognize that all living things have certain requirements' (Ministry of Education Te Tāhuhu o te Mātauranga, 2007)
• 'Recognize that living things are suited to their particular habitat' (Ministry of Education Te Tāhuhu o te Mātauranga, 2007), and
• 'Observe, describe, and compare physical and chemical properties of common materials and changes that occur when materials are mixed, heated, or cooled' (Ministry of Education Te Tāhuhu o te Mātauranga, 2007).

represent programmatic skills that students should be evolving as they mature as scholars. One of the key capabilities is 'Gather & interpret data: Learners make careful observations and differentiate between observation and inference' (Ministry for Education Te Tāhuhu o te Mātauranga, 2024, para. 8). As Level 2 learners, students participating in Soilsafe Kids' Three-Day Programme should have been introduced to the idea that scientists make observations to learn about the world. To ensure students are growing toward this capability, they should be provided opportunities and encouragement to make observations at NZ Curriculum Level 2. They may be able to make simple inferences dependent on their observation skills. Thus, in the focus groups, we would expect student comments to include some of their own observations, and we have designed the subsequent workshops to further this development.

For more detail about our recruitment approach, participants, and setting, please see Sharp et al. (2024) and Tsang et al. (2023).

Data collection

During the introductory Soilsafe Kids' Three-Day Programme workshop, students participate in small focus groups (group discussions) of approximately 5-9 children to gauge students' prior knowledge of, and interest in, compost/ing. Each group discussion was under 15 min. All students were invited to reply to every question (see Supplementary File 1 for focus group facilitator guide). Each group discussion was held in the students' classroom or in the play area immediately outside of the classroom. The audio of the discussions was recorded, ensuring that facilitators did not have to take notes and could focus on group dynamics and participation.

The audio was then transcribed verbatim during which the transcriber removed student identifiers from the data. Thus, comments could not be attributed to individuals during the coding process. Rather, the coder was only aware of which school's data were being analyzed and the school's attributes (Table 1).

Data analysis

Tsang then analyzed the transcripts by hand using inductive and deductive qualitative content analysis (Creswell, 2014; Forman & Damschroder, 2008). Initially, the data were read to establish a preliminary coding matrix. Once the preliminary coding matrix was created, codes were inscribed in the margins of the transcripts. The transcripts were then recoded to ensure agreement across multiple coding sessions. Data could be attributed to multiple codes. The final codebook is summarized in Table 3. Coded data were then grouped into themes to understand what NZ Curriculum Level 2 students in Auckland know about compost/ing.

Results and discussion

This study sought to determine what children in Auckland know about compost/ing through small group discussions. Despite being early learners, students' comments about compost/ing tended to demonstrate knowledge about the dual nature of compost/ing (as both a process and product), the different methods of composting, and why compost/ing is important. The key themes found were: the dual nature of compost: process and product; compost as a process; compost as a material; types of composting systems; importance of composting; benefits of composting; compost/ing as a preventative measure; learning about compost; and thinking about compost (Table 3). Many students were interested in learning more about compost/ing (Table 3). While all of the schools have composting programs, students' notable composting experiences have almost all been outside of school despite noting potential barriers to access (such as living in an apartment) or of time (for example, due to a new additional sibling). Although each of the following themes arose in each class, the depth of comments varied from one class to the next. Often, the youngest classes had the least to say while students studying in middle decile schools often had more depth of experience. Students at the highest decile schools normally had strong baseline knowledge, with the most scientific responses and spoke of out of school experiences less.

The dual nature of compost: process & product

While compost is both the process of creating compost and the material product that can then be added to existing soil to enhance its fertility and physical properties (Åberg-Bengtsson et al., 2017; Ero-Tolliver et al., 2013; Wing & Sharp, 2023), previous studies found that students tended to identify the material compost without recognizing or understanding the underlying process (Åberg-Bengtsson et al., 2017; Ero-Tolliver et al., 2013). Each group discussion opened by asking students to define compost/ing.

Composting as a process

Unlike in previous studies where students did not recognize composting as process (e.g, Åberg-Bengtsson et al., 2017), students in our study described the dynamic progression of composting in practice, from putting their food scraps into

Table 3. Soilsafe Kids compost focus group codebook with codes arranged in alphabetical order.

Code	Explanation	Example quotes from focus group transcripts
Alternate ending	This code explores what students think happens to material that could be composted but is not. It includes all data on a small scale (what they would do with material that did not make it into the compost bit) through to a global scale (what are the impacts of not composting biodegradable material.)	'they don't dissolve; they don't rot properly' 'if it's in the rubbish bin it makes the acid to the environment and then if you put it in the compost bin, it doesn't make it'
Barriers to composting	This code contains any reason students cited why compost/ing might be hard or not possible for someone, including them and their family.	'Because I have a little brother now, and he's probably gonna knock it down' 'So, we don't have like, cause we have a deck area, we don't actually have any grass. So, it's just a deck with some fish. So, the only place we could keep it is probably inside.'
Compost definitions	This code is how students defined compost as a noun.	'basically it's broken down fruit with worm poop and worms' 'Isn't it stuff that makes soil grow plants better?' 'cause it's not soil, it's compost, so you put it around the plants on top of the soil, and it helps the plant grow. It's like food for the plant.'
Compost descriptions	This code contains any descriptions students provided about compost/ing.	'I saw a whole mandarin in it, and it turned green. And then, it and then it was later looked like a pumpkin that's not ripe, really weird.'
Connection between compost/ing and soil	This code contains all comments about how compost/ing and soil might be linked. Soil may be explicitly named by students, or a type of soil may be noted (e.g., sand, mud).	'in the compost bin and it turns into soil' 'how the worms make it into like, like dirt' '…from the composting bin so they can break it down and they put it in the soil'
Feelings about compost/ing	This code contains data about how students feel about compost/ing.	'I hate it when you have to open it and smell it.' 'were so interested in finding bugs and worms' 'when you have to spin it, it's really fun'
Involvement in composting	This code is composed of comments about how students have (or have not) been involved in composting and what their role is (was).	'I'd take them out, put the skin in the bin and then I'd have to hide all of the evidence and put them in the compost thingy bin' 'I was out in the garden with my mum, and we were tipping the compost out into our worm farm, our worm bin. And then, I found all the pee under the worm bin, and I asked mum what it was. She said it's worm pee, and I was like "eww," and then I said, and then she said "it's used, it can be used like fertilizer and it can be used to like help plants."'
Life in the compost bin	This code contains references to the life that students have found or know to be in compost bins or involved in the process of composting.	'lots and lots of tiny bugs that every time you open it there's like hundreds of them'
Process of composting	This code is how students defined composting as a verb.	'the process of it is that worms eat it and poop and that's compost' 'There's just three big bins and all you have to do is shovel one to the other'
Questions about compost/ing	This code contains students' questions about compost/ing as this indicates what they do not know and what they are interested in learning more about.	'How long does it take to rot?' 'How does it biodegrade?'
Types of compost/ing	This code contains all references to the types of composting processes students are aware of, have watched, or participated in.	'Then the bacterias break it down, instead of the worms' 'I've got three compost bins at home' 'Now, we don't do it anymore because our chickens just eat everything.' 'So there's a worm bin monitor and then that, the worm, when that worm bin is full…'
What goes in compost	This code describes what students say should be put into compost bins.	'Compost is fruit that are left over after you've eaten it.' 'all different kind of food scraps'
Where are they learning about compost/ing	This code contains any comments about where they are learning about compost/ing.	'At my uncle's farm' 'My grandma does it, but she lives in Wellington'
Who's teaching about compost/ing	This code contains any comments about who is teaching them about compost/ing, including who is with them when they compost.	'I watched a Youtube video where he put a whole watermelon, by 10 hundred worms and then they gobbled it up' 'They just leave it in the compost, and I haven't seen them take it out… Nana and Poppa'
Why compost	This code contains all of the students' explanations of why we should compost.	'So the planet doesn't have to go through a mess and God will cry' 'the methane gas… [that's] not healthy for the environment cause it generates global warming'
Worms	This code contains all comments students made about worms.	'It would be interesting to see how the worms, how long it takes the worms to eat it cause there's so much compost and the worms are like tiny, tiny.' 'Why do worms need to be in the soil?'

buckets that are emptied into a compost 'system', through to the biological process the food scraps undergo in the compost system and then what happens to the resultant material after. In addition, students were able to describe multiple processes, such as worms eating scraps and the compaction of material, occurring in compost systems.

The majority of the students were familiar with vermiculture, or worm farming, for the processing of food scraps. Students from every school described emptying the compost bucket and providing the compostable scraps as 'going to the worms' so that the 'worms can eat it and poo it.' Students routinely described worms as eating the material provided with the resulting excrement as compost. Both worm 'pee' and worm 'poo' were repetitively acknowledged as the decomposition method in worm farms and as the output of the composting process that 'gives nutrients' and ensures 'your plants will grow very good [sic]', where 'it's the worms that make the magic happen'. It is unsurprising that the

students typically attribute decomposition to worms and were fascinated by them. In fact, one student commented that without worms, food scraps do not 'turn into compost; it just stays there… Nothing happens. It probably rots.' This is a surprising comment as it suggests the student does not understand the relationship between composting and rotting.

These comments also exemplify the importance of the role that students believe that worms have in compost/ing, and the relatively diminished understanding of other, less visible, and arguably less charismatic life, like bacteria and fungi, which were only mentioned at some schools (c.f., Sharp et al., 2024). Earthworms' visibility, reactivity to children's touch, and reputation as a safe species for students to interact with in garden settings mean that they are compost agents with whom children can build a vital relationship (Miller, 2007). We would also argue that worms are a gateway agent to, in this case, introduce other, more marginalized but crucial elements for meaningful education on composting and the environment more broadly.

Although the majority of students associated composting with worms, several students did comment on other decomposers with at least one other system being mentioned at each school. One of the few students commented that bacteria aided worms in breaking down materials while another pointed to the work of ants in doing this. A third student described how the worms and flies at home cause their family's food scraps to decay.

The students have also been exposed to composting processes with only microscopic decomposers: one school uses tumblers to encourage biodegradable material to decompose with students commenting that 'all the compost would go around and around and it helped it do it easier and faster,' pointing to key mechanism of this system- aeration, mixing, and subsequent heating. The student then added that 'crushing' was a process in tumbler composting, which we interpret as the process of materials colliding and reducing in size when tumbled. Another school uses a three-bin compost system. Children described the materials as 'slowly rott[ing] away' progressively as material is moved from one bin to the next. They commented that they know 'it's ready cause we put a thermometer in it… and then it cools down when we move it into each block and then we put it in the garden.' While they describe the rotting process and can describe its temperature curve over time, not one student was able to identify why the temperature changes. Rather, they believed the correct amount of 'old stuff' made the pile hot. Again, given that students learning at NZ Curriculum Level 2 are mostly exposed to visible macroprocesses, this explanation is unsurprising and would more appropriately be addressed in more advanced Curriculum Levels (Sorokowska et al., 2020).

Compost as a material

Students at all schools were generally very forthcoming about the physical product of compost; this is similar to previous international research about children's knowledge of compost (e.g., Åberg-Bengtsson et al., 2017; Ero-Tolliver et al., 2013). They not only described what compost is made of but also provided a broader understanding of compost including the life that makes composting possible.

The examples of the materials that can be put in the compost bin were comprehensive with one student noting that 'basically all things that come from Earth, so that's basically all our scraps from food, the garden, and what we use' will biodegrade. Many students were less comprehensive in their descriptions, but students at all schools commonly noted that fruit and vegetable scraps can be composted. The most frequent examples provided as compostable were apples, oranges, and bananas. A student commented that bread could not be composted while a classmate suggested that cake could be.

Given that that there is an array of composting 'rules' that are established in school, community gardens, and home environments that are contingent on the composting system used (e.g., open or closed, with additive 'biology' or not), these students responses may reflect their own experiential norms. It does, however, highlight the need to establish to students that there are multiple ways to compost which are dependent on context and process, and that often, composting processes are resilient to some extra additions, if not in large quantities.

In some cases, there were obvious points of confusion among students. Non-edible materials, including 'decayed bush' such as leaves, grass clippings, tissues, paper, and cardboard, were identified as compostable, in line with external education providers' (e.g., Garden to Table and EcoSolutions) lesson plans. Students did not always agree on this point, though, with a couple of discussions about if non-food items could be composted. Interestingly, compostable packing was never mentioned despite multiple studies, such as Auckland Council (2023a) and Diprose et al. (2023), raising concerns that compostable packing may disrupt collective composting efforts or confuse the public about what is compostable. Despite the children's clarity, we see confusion in adult discourses about what the local municipal composting programme does not accept to avoid concerns of contamination (Auckland Council, 2023b).

Rather than describe what compost is made of, a few students described compost by its attributes. One described it as visibly 'rotting and dead things' while many students defined compost as soil, dirt, or a growing material recognizing the dynamic, temporal dimensions of compost's liveliness. Multiple students also described the smell of compost.

Overall, student responses were diverse and informed as to answering the question '*What is compost?*' in a way that demonstrates that compost is both a process and a dynamic product. This contrasts to previous studies conducted (e.g., Åberg-Bengtsson et al., 2017).

Types of composting systems

The students in aggregate identified nine ways to compost. Worm farms were, by far, the most popular composting system to discuss in every class, again indicating their ability to engage students. Six of the eight classes have worm farms

while the seventh class uses a tumbler system. The eighth class uses the three-bin method of composting.

Multiple students mentioned their compost/ing at home. A limited area of Auckland was also involved in a pilot of a municipal food scraps composting programme during our data collection period (Auckland Council, 2023a). Therefore, the number of students referring to the municipal food scraps programme was surprising although several comments were about where students had previously lived. Other cities in NZ have offered municipal composting programmes for years (Diprose et al., 2023). A couple of students mentioned a 'special' location where their family leaves biodegradable material to decompose; one student associated this action with the holiday period in particular. Finally, feeding scraps to chickens, black soldier fly farms, and putting eggshells in gardens were each mentioned. Altogether, these responses showcase a diversity of composting methods to which students have been exposed.

We suggest that exposure to different types of composting methods, could influence students' likelihood to compost and use those options later in life, as consistent with Oehman et al. (2022) who noted adults' concerns about 'food waste separation leading to odor, pests, and messiness in the home, ultimately resulting in a distinct "yuck factor" … as particularly strong for individuals who had no past experience separating food waste'.

This however does not dismiss that some students also had negative associations with compost/ing which could equally discourage them from composting in later life. The negative comments were all related to adding to the compost bin as a chore mainly because they did not like the smell although one student expressed disliking worms. Three students were especially interested in the worms, though, and felt that others may feel the same way as students 'were so interested in finding bugs and worms' in class that they did not participate in other aspects of the lesson. The other two students were fascinated by how worms eat and found watching the changes 'fun.'

Not all comments were negative, though. The idea of composting being fun was repeated by two other students when they commented they like spinning the tumbler because 'it's like exercise.' These positive associations may suggest that students would be willing to compost in the future. One student who no longer composts stated they 'would like to do it again.'

These comments suggest the younger generations are cognizant of a need to reduce waste for future sustainability, and show promise for actual change if these perceptions and behaviors are carried into adulthood. We suggest that having the exposure of multiple different composting systems would make it more likely to identify a composting system that will be useful in their own contexts, which includes aspects like space, seasonal temperature variations and practicability. Previous work, such as by Mustapha (2013), corroborates this, where households in Canada tend to use different composting methods depending on their setting. We take from this that being enabled to be adaptable is of essence, to encourage composting behaviors later. Teachers who would like to support this type of work and broaden the types of composting systems they are exposing their students to are fortunate to have published resources such as McGuire (1987), Stanley and Turner (2010), and Schwarz and Bonhotal (2017), and Trautmann and Krasny (1997).

Benefits of compost/ing

Compost/ing can not only be viewed as benefiting the environment but can also reduce the contributions of negative processes such as GHG emissions. Students provided a range of reasons when asked, 'why should we compost?'

Students recognized planetary (through individual to collective scales) benefits in composting. In general, students commonly referred to compost/ing preventing 'rubbish' from being ubiquitous; they are not interested in being surrounded by waste. Rather, they want everyone to help 'clean up the planet' and advise that 'you don't have to throw everything in the bin.' By keeping the planet 'tidy', students expressed how we can help worms, bugs, and other creatures stay healthy by not adding 'acid' (which was clarified to be methane) to the environment, suggesting an awareness of soil and compost's connections to climate change.

Compost/ing also feeds animals and enhances the soil; students from one class highlighted the hedgehog found in the compost bin when we arrived that morning. In addition, most students frequently commented that compost/ing benefits soil by keeping it healthy by contributing 'very high nutrients' and by making 'the soil be all moist so stuff can grow in it better.' They viewed this as equivalent to 'vitamins' for the soil. Without this action, some students believed you could not be sure if the soil was healthy, suggesting that they felt it was necessary that humans supported environmental quality.

Compost/ing was also suggested to be beneficial by almost all groups because of its effect on garden health. One student commented that 'if we didn't have composting, we wouldn't really have any garden', but other students were more nuanced. Generally, they viewed compost/ing as feeding the garden for stronger, healthier plants and trees. One commented on how gardens retain more moisture with compost while another observed that three weeks after their dad added compost around plants 'they grew very big.'

Students provided more scientific explanations when they commented that plants' roots gather energy as they do not have mouths and that compost is a source of energy. At a different school, students explained that compost/ing encourages plant growth which requires turning carbon dioxide into oxygen. Humans benefit from more oxygen, so creating compost should be a cyclical process. Both these explanations demonstrate an advanced understanding of the underlying, abstract science, and a sense of reciprocity around human environment relations, that is uncommon at Curriculum Level 2 (Ministry of Education Te Tāhuhu o te Mātauranga, 2007).

Compost/ing as a preventative measure

In general, students compared composting to throwing away 'rubbish' or recycling. For example, they stated that 'composting is like kind of reuse plastic.' This association may be related to the co-location of the 'rubbish,' recycling, and composting bins in most classrooms. If materials were not

composted or recycled, students commonly expressed that all other materials would go 'to the dump.' Students were always critical of this, saying that this happens when people are not 'thinking about the soil' because this action allows 'rubbish' and compost to mix, which is bad for the environment.

They provided several reasons why biodegradable materials should not be sent to landfills. First, they explained that biodegradable materials at landfills 'don't dissolve; they don't rot properly' and then conceded that if they do rot, this only happens 'after a million years.' Another way of expressing this idea came through when students explained a climate change connection, that biodegradable material in landfills put 'acid [methane in]to the environment… [but] if you put it in the compost bin, it doesn't make it.' Finally, two more nuanced explanations were provided as to why biodegradable materials should not sent to landfills. In general, all of these responses demonstrate a strong understanding of both the macroscopic and microscopic processes occurring at landfills.

One explanation was that biodegradable materials create 'methane gas… and it goes around the planet and makes global warming.' They further explained that fruit generates more methane than plastic, which is true when these items are landfilled. There were multiple comments about how composting benefits the ocean; most comments fairly contributed that keeping 'rubbish' out of the ocean was a benefit to composting, as they were concerned that 'rubbish' (i.e., landfilled materials including organic material) reaching the ocean would kill wildlife. The concept that 'rubbish' kills animals spanned multiple schools and relates to the NZ Curriculum's (Ministry of Education Te Tāhuhu o te Mātauranga, 2007) focus on living things and their needs at this educational stage.

Students at a different school suggested that biodegradable materials in landfills increases the likelihood of animals eating 'rubbish' or becoming trapped by waste when scavenging for food. They cited an example video that they had previously watched in class to substantiate this idea. This was the sole reason provided to explain why Auckland - a city they provided as a place where landfills are almost at capacity (e.g., Orsman, 2020; Our Auckland, 2020; Waste Management, 2022)—should manage biodegradable materials locally to protect subaerial wildlife elsewhere.

The ideas being expressed about why composting is a preventative measure are much more detailed than previous studies such as Åberg-Bengtsson et al. (2017) despite the children participating in the study being approximately the same age. Based on Åberg-Bengtsson et al. (2017)'s call to teach a deeper understanding of why composting is necessary, this suggests that the contexts our children are learning in have begun working towards solving this frustration. These ideas are also being linked to other issues and curriculum subjects, such as topics in geography and ecology, in an unexpected way for students learning at Curriculum Level 2 (Ministry of Education Te Tāhuhu o te Mātauranga, 2007).

Learning about compost

Despite all composting at school, most stories that students told about previous experiences of composting took place off-campus. In fact, students normally needed reminding of their school compost/ing system to mention it. Even then, comments about school programmes were generally limited to only a couple of words. One student recollected more, explaining how large the composting system was and the dump truck that removed their compost, but this experience was at their old school. Despite students regularly being assigned 'worm bin monitor' as a classroom responsibility or the role of composting garden waste, students did not convey what could be construed as key messages contained in their compost/ing classes.

Students did give accounts about compost/ing elsewhere with almost all stories featuring parents and/or extended family members. Many times, this interaction would be at a family member's home, and one student reported 'when I was included with compost when my family went to our marae (meeting ground for Māori extended families and communities) and composting was there.' Almost an equal number of students stated that 'tak[ing] out the compost' was one of their chores at home. Generally, a new garden sparked interest in establishing a compost system.

Additionally, a handful of students described watching composting videos, including on YouTube. This suggests that students are interested in compost/ing and are seeking to supplement their knowledge with technology aids. Not only will this help ensure a well-informed future population (Almeida et al., 2023; Blizard & Schuster, 2007; Chawla, 2007; Louv, 2005) who is connected to nature, but it also means that we cannot assume students' knowledge of compost/ing is only based on classroom teaching. This finding is consistent with a related study on children's understandings of food and soil connections (Sharp et al., 2024). This further establishes the need to continue to assess student knowledge of compost/ing into the future.

Factors that contributed to reducing or halting composting activities and associated out-of-school learning were also varied. One student cited new chickens meant their family no longer composts. Another commented that they have since moved away from their grandmother who composts. A third stated that their old house had municipal compost bins, but their new one does not. Several other students mentioned that the birth of younger siblings ended composting at home while several systems had been disrupted when, for example, younger siblings knocked bins over or put the composting worms into the family refrigerator.

Other students cited reasons why they have never composted at home. Several mentioned not having a yard, so they would 'keep it probably inside' and 'that'd make the whole house stink.' The obstacles to composting combined with notable interest in composting at home suggests again that introducing children to a diversity of different ways to compost (e.g., aerobic/anaerobic, large/small systems, under sink/in garden, with time intensive/time poor options) might provide familiarity, knowledge and physical access with, of, and to composting that might be pervasive in later life.

Importantly, students' focus on home composting also raises the question of how to increase the memorability of school composting lessons so that all students, regardless of their living situation, have equitable learning opportunities

and may begin to compost as they grow older and their home situations change.

Thinking about compost

Despite many opportunities to learn about compost/ing, we found the vast majority of students still want to know more! This likely stems from the time they spend thinking about compost/ing and observing it.

A composting system offers an opportunity to make observations over time and link them to interpretations (Ashbrook, 2015; Ministry of Education Te Tāhuhu o te Mātauranga, 2024); teachers seem to be taking advantage of this (e.g., McGuire, 1987; Schwarz & Bonhotal, 2017; Stanley & Turner, 2010; Trautmann & Krasny, 1997). When asked what food scraps look like after a week of decomposing, students explained the color and size changes using the example of a watermelon turning green and becoming progressively smaller and more 'ugly' until it became a 'grey color, scrunched up… like paper.' Colors and color changes were common descriptors with reports from 'dirt with a little bit of color in it, it you put a little bit of food coloring in' through to 'like green beans' and yellow. They also demonstrated how they are starting to interpret their observations by suggesting that the green color in the compost bin is due to mold.

Students were also very vocal about what compost bins and composting smell like, speaking to the multiple types of observations students are being taught to make (Ministry of Education Te Tāhuhu o te Mātauranga, 2024). Generally, the minority of students who made olfactory observations did not like the smell of compost bins with one student even suggesting that the smell functions as a possum repellent. Other descriptors included 'stinky,' 'smells gross,' 'smells like bananas', 'like worm poop,' and 'soil.' The association with bananas is likely due to the number of peels being put into compost bins as this was very commonly mentioned. While it is important students learn to make olfactory observations, it should be noted that poorly smelling compost is indicative of anaerobic conditions in the composting system. In a lesson, rather than a focus group, it is important to make this connection so that students know how to adjust their composting behaviors in the future.

A few students also commented on what compost feels like although they did not agree. While some students described the texture of compost as 'squishy' and 'soggy', others used the terms 'hard,' 'crumbly', and 'crunchy.' Depending on composting practices and the observation timing, all of these adjectives are correct. In summary, the student who stated 'I'm very interested in watching it a lot… cause it's nice to see how it changes' is likely not alone; the students' detailed responses highlight the time they have spent observing compost (Ashbrook, 2015).

These changes also reflect the curiosity that students have about compost/ing, something that changes visibly over time, in extended investigations, and a site of multiple types of learning. Most of their questions can be grouped into three categories: timing to biodegrade, underlying scientific processes, and why compost.

The most common question is related to how long it takes for something to biodegrade. One student summarized the common state of knowledge when they stated 'all I know is that I put it in. I wait a few weeks and days, and then I take it out, and it's compost.' Students' estimates of how long it takes for materials to decompose ranged from 'a couple of days' through to 'maybe like six months.' Upon further discussion, one group of students decided that the amount of time depends on the material with bread taking longer than fruits and vegetables. While the answer itself is brief, the students' interest in watching compost/ing suggests that this answer could take the form of a classroom investigation (Ministry of Education Te Tāhuhu o te Mātauranga, 2007). Other common questions are more difficult for students to observe and construct answers for themselves in early primary school.

Many of the questions posed by the students have quite abstract answers for early primary school (Ministry of Education Te Tāhuhu o te Mātauranga, 2007). Often, students wanted to know how compost is being created. A student stated 'I want to know the steps it goes through cause… I don't know how it actually happens.' This aligns with Åberg-Bengtsson et al. (2017)'s previous finding that young students do not understand the microscopic processes and demonstrates on target learning with Curriculum Level 2 (Ministry of Education Te Tāhuhu o te Mātauranga, 2007). Some students posited that the material is dissolving or rotting while another suggested that the compost itself is growing. A few students connected the process with worms and wanted to know more about the worms themselves. They were especially interested in how worms eat as they believed that worms 'don't have teeth or a mouth.' These questions frequently linked back to the timing question as students recognize that worms are much smaller than the fruit pieces they are eating.

Many other questions dealt with why we compost. Although we had asked students this question, they wanted more details. For example, we were asked how compost helps soil and 'why do worms poop fertiliser?' They also wanted to know why 'fruits and vegetables grow better with compost and mulch? How does [compost] help things grow?' These questions are related to other queries about if soil contains vitamins and to explain what micro- and macro-nutrients are. As the group discussion prompts did not contain these terms, this question speaks to the students' vocabulary.

A few students had unusual queries. They were 'how do you tell whether soil is healthy or not?' and 'how can you tell which side is which' of a worm?

Strengths and limitations

This study builds on previous global research on children's knowledge about compost/ing, and it provides new insight into children's views on compost/ing in Auckland, New Zealand. Being part of the Soilsafe Kids' Three-Day Programme means students' questions about compost/ing are answered before the end of the school day. While the Soilsafe Kids' educational component occurred after our group discussions, students generally seemed curious and

interested in participating. This enthusiasm likely bubbled over into their contributions in the form of positive comments and thoughtfulness. As we only spoke with eight classes, these results are not representative of all students, especially as many of these classes participate in composting programmes prior to participation in Soilsafe Kids. In instances of wet-weather when focus groups had to be conducted inside, the quality of the recording often made it difficult for the transcriber to accurately hear all spoken contributions clearly. It is possible that this means that children who were positioned further away from the recorder and those who naturally have quieter voices are less represented in the final transcripts and therefore the results.

A strength of this study is that all researchers who conducted focus groups with children were trained in child-centered focus group facilitation prior to undertaking the data collection. Egli (an experienced child researcher) trained all Soilsafe Kids facilitators on group dynamics, and making sure every voice is respected, valued and heard, specifically for this age group of children. Several of the facilitators were trained teachers or had previous volunteer experience with students of this age. Further detail on the focus group training is provided in Sharp et al. (2024) and Tsang et al. (2023). While the influences of power and dominant personalities can never be completely removed from focus groups, this training is evidence of the care taken to collect focus group responses from all children who participated.

Implications

This study has found that primary school students in Auckland have stronger than expected baseline knowledge about compost/ing. This is important for external educational providers who are regularly engaging with classrooms to know to ensure that students' knowledge about compost/ing is increasing with each engagement. Not adapting lessons appropriately could lead to student boredom and eventually disengagement, which would be counterproductive to sustainable development goals.

Based on our conversations, we found that students who had just entered the school system often had the least to say. In many cases, the students were early Level 2 Curriculum learners and younger than other focus group participants. Thus, they would have less life experience, and likely confidence, to draw upon. Despite this, they were the least likely to say they had previously composted and no longer do. This could suggest that as students age, their lives become more complex and some practices such as composting become less possible in full schedules, less desirable, or less habitual. This could indicate that middle to upper level primary school classes should have a larger focus on composting at school than lower level primary school classes to ensure students have consistent exposure to composting as they age. This would allow for deeper scientific discussions since students would have stronger observation and interpretation capabilities and already have an introduction to science. By building upon home composting experiences, this would also help ensure that all students have equitable access to the science of composting, regardless of their living situations. This may be especially important as more municipalities introduce composting schemes to encourage students to build composting habits into their adult lives.

Surprisingly, despite ongoing lessons and practice in compost/ing at school, students often did not associate learning about compost/ing with school. Based on the study's limited geographical reach, it is important to explore if this is only true in Auckland classrooms or more broadly. To do so, similar focus groups should be conducted elsewhere to establish if this is noted elsewhere. Both teachers and the external education providers who focus on teaching students how to compost may also want to explore why familial and community education about compost/ing is more memorable to students than in-school lessons. Once this is better understood, it will be important to modify current lessons to ensure all students understand and have the opportunity to engage with compost/ing regardless of if they have access to the equipment and space to compost at home or in community areas.

While children discussed worms in our study we recognize that these more visible, affective and 'charismatic' fauna (Lorimer, 2007) are but an introduction to appreciating the invisible, often marginalized, but vital decomposers like microinvertebrates, and microbes such as bacteria and fungi. The wider context of this recognition of such agents of decomposition is its scaling to a more fulsome recognition of more-than-humans and their influence on our world in breaking down waste and generating nutrients for our food production; how necessary they are to our daily functioning, our environmental and ultimately human health.

When educators design composting lessons, it is vital to consider how our students are growing up. As small domestic spaces become more common, there is the potential for students to become less connected with nature. Either family, communal, or school level composting is one way to ensure a continued connection, but efforts should consider what is feasible for students. While advocating and exposing students to expensive or space-intensive systems will increase their knowledge bases, small-scale, inexpensive solutions should be highlighted too.

Conclusion

Our discussions indicate that students in Auckland are more knowledgeable about compost/ing than as documented in previous, global studies. While these results suggest that Auckland communities are incorporating compost/ing into their daily habits, students' responses indicate they have both knowledge gaps and interest that needs addressing. Although we would not expect early primary students to be able to describe product and process beyond the macro-scale, there was clearly more and diverse knowledge present, and student responses indicated they were learning much more about composting outside of school. By ensuring all students, equitably, have memorable opportunities to compost in school, we can ensure all students—including those living

in urban areas—can connect with nature and the environment around them.

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Data availability statement

Data are not available.

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