New Zealand Journal of Educational Studies
https://doi.org/10.1007/s40841-026-00466-x

ARTICLE

Building Futures: Engaging Students with Dioramas in STEAM Education

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Received: 1 May 2025 / Accepted: 9 June 2026

Abstract
This study examined the perspectives and experiences of teachers and students in constructing dioramas. It was conducted in a small rural secondary school in Aotearoa, New Zealand. The three-dimensional models acted as tools for helping students visualise and represent ideas, supporting the development of environmental and sustainability concepts. The study involved four teachers collaboratively teaching a combined Year 9 and 10 class within an integrated STEAM (Science, Technology, Environment, Arts, Mathematics) programme, where students were challenged to design and construct imaginary habitats of future homes and local environments as dioramas, merging scientific knowledge with creative expression. The purpose of using dioramas extended beyond artistic representation; they provided a tangible way for students to engage with climate science by modelling ecosystems, illustrating interdependencies, and simulating the impact of human actions on environments. Through this process, students explored cause-and-effect relationships, considered adaptation and mitigation strategies, and envisioned sustainable futures. Dioramas acted as cognitive bridges, supporting learners to develop understanding of abstract climate science concepts into concrete, visual narratives that encouraged role play and dialogue. Themes emerging from the study included how the students identified and expressed their understandings of possible futures through diorama models, how they incorporated climate-change actions and solutions into their designs, and how the construction process prompted reasoning and discussion. The strengths of diorama construction lie in its ability to tell a story, make a claim, activate dialogue, and, importantly, help young people imagine and articulate sustainable futures.

Keywords Diorama · STEAM education · Sustainable futures · Qualitiative research · Story telling through models

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Published online: 18 June 2026

Introduction

The aim of this study was to immerse learners in designing and constructing imaginary habitats as three-dimensional dioramas in a teaching programme in a rural, state, co-educational secondary school in Aotearoa New Zealand. A diorama is a model representing a scene with three-dimensional figures, usually in miniature, but sometimes life-sized often found in museums (Insley, 2008). In this study, four teachers collaboratively taught a combined Year 9 and 10 class (students aged 13–15 years). During the project's planning stage, the teachers raised the issue of rising student anxiety due to the overuse of austere environmental perspectives in previous programmes. Adolescents often express anxiety about their future (Jones & Davidson, 2021), and programmes focused on raising environmental awareness do not always lead to the necessary changes in behaviour and personal action (Bright & Eames, 2022). Students can encounter environmental issues of varying complexity and significance. The teachers recognised that diorama model making could boost student engagement, and it may provide a meaningful context for learning environmental concepts. Additionally, students could evaluate ecological evidence in the model designs, applying reasoning, examining different perspectives, and weighing trade-offs for a sustainable future. The integrated curriculum programme involved the students studying climate science, alternative futures, local history, and practical model making as integrated topics during a 12-week inquiry.

Context of Learning

The school adopted a STEAM integrated curriculum approach, combining multiple subject areas within authentic and relevant contexts to motivate and engage students during their initial years of secondary education. As part of this, students undertook an inquiry into local recycling practices, which included conducting surveys, visiting a recycling centre, investigating the presence of microplastics, and preparing presentations on the environmental impacts of recycling. They organised a sustainability expo featuring interactive booths on composting, renewable energy, and water conservation. Midway through the unit, students began designing and constructing dioramas, three-dimensional models representing their homes and local environments, to articulate a vision of a sustainable future. The models included redesigned houses and community spaces that reflected environmentally responsible practices. The science component of the programme focused on climate science, with lessons dedicated to exploring concepts such as the greenhouse effect, the water cycle, photosynthesis, plant and animal adaptations, respiration, food webs, and plant physiology. In addition, a series of weekly workshops functioned as envisioning sessions, encouraging students to engage in discussions about their aspirations for a sustainable future. These workshops emphasised goal setting and the development of skills necessary to pursue those aspirations. Students were prompted to consider questions such as: What personal and professional roles could they adopt to promote sustainability? How might these roles manifest in practice? To enrich the inquiry, guest speakers from the local marae, a conservation organisation (Forest and Bird, 2026), and the regional council [1] visited the class to share current environmental initiatives. Through these interactions, students gained insights into organisational roles, reforestation projects, town planning, and biodiversity conservation. They produced sketches, drawings, paintings, and draft plans to conceptualise sustainable communities and housing designs. Dedicated classroom time was allocated for the creation of physical models, referred to as dioramas, that embodied these ideas. Students worked collaboratively in small groups, with access to a range of materials and resources to construct their models. Teachers developed a set of characteristics for future-oriented STEAM inquiries and compared these with those from previous programmes (see Table 1). Discussions during teacher meetings highlighted the need for a stronger emphasis on developing scientific ideas within the context of personal and societal issues. Rather than having students work individually on science inquiries, a cooperative approach was hoped to foster a more collaborative learning environment. This enabled an opportunity for students to co-construct dioramas, share perspectives, and engage in meaningful dialogue with peers.

Theoretical Overview

The construction of dioramas offers science learning cognitive outcomes (Washinawatok et al., 2017). When students create three-dimensional models, they develop spatial reasoning skills that are essential for interpreting scientific phenomena such

Table 1 Characteristics of future-oriented STEAM inquiries, identified by the teachers

Less prominence on:	More prominence on:
Passive learning	Active learning, greater tactile, hands-on construction using materials to draw, build models and diorama
Exploitation of the environment	Responsibility as kaitiaki, guardians of our ancestral lands, resources, and culture
Working alone	Collaborating with a group that simulates or represents authentic groups found in society such as a scientific community, iwi or an environmental group
Acquiring science knowledge	Acquiring conceptual understanding and applying knowledge in making and evaluating personal, societal and global decisions
Closed questions with one solution	Open ended questions allowing opportunities for students to discuss solutions
Focusing exclusively on writing completion	Active construction allowing students to build, create, and interact with materials, involving multiple senses, and in support of dialogue
Austere futures	Hope, personal agency

A kaitiaki is a person or group that is recognised as a guardian by the tangata whenua (tribal group with authority in a particular area). For instance, a hapū (sub-tribe) may be the kaitiaki for a lake or a forest.

[1] In Aotearoa New Zealand, a regional council is a local government authority responsible for region-wide environmental management, including freshwater, coastal areas, air quality, natural hazards, and public transport planning.

as ecosystems, terrestrial systems, and structural design. Dioramas support conceptual development (Gkouskou & Tunnicliffe, 2017) by helping learners move from everyday understandings to scientific concepts. For example, modelling food chains or energy flows within a diorama makes abstract ecological relationships concrete observable. Through this process, students engage in systems thinking (Hipkins, 2021), recognising how plants, animals, and environmental factors interact within a larger whole. They can become more aware of scale and proportion, which reinforce scientific ideas about relative sizes and distances, whether in microscopic structures or terrestrial models. Dioramas can function as scientific models (Wallace et al., 2022), enabling prediction, explanation, and hypothesis testing. Students can manipulate variables, such as adding or removing entities similar to shifting species in a habitat (Shafto & Coley, 2003), to explore sustainability scenarios and understand cause-and-effect relationships. This approach aligns with futures thinking (Dator, 2009), highlighting that the future is not fixed but shaped by choices and actions. Furthermore, building a model of the environment, combining visual, tactile, and linguistic modes, can strengthen scientific literacy (Tunnicliffe & Reiss, 1999) as students articulate observations and reasoning through both models and explanatory texts. In an era where imaginative role play and active construction are diminishing in classrooms (Nicolopoulou, 2010), scholars advocate for reinstating these practices to support creativity and deeper learning (Fleer et al., 2024; Lutsenko & Lutsenko, 2022). Dioramas, therefore, are not merely artistic projects but pedagogical tools that integrate visual literacy, scientific reasoning, and collaborative problem-solving.

Understanding the value of dioramas as pedagogical tools therefore requires attention to how learners perceive, interpret, and construct meaning through visual and material forms. John Berger asserts that *"the way we see things is affected by what we know or what we believe"* (Berger, 1972, p. 8). Our perception is shaped by prior knowledge and beliefs, while images and three-dimensional models, in turn, influence how we conceptualise objects and their contexts. The active construction of artefacts (Lodge, 2007) serves not only as a communicative act but also as a problem-solving tool for children. Drawing and tactile manipulation of objects provide learners with tangible, concrete, and communicable records of ideas (Brooks, 2009), enabling them to externalise and refine their thinking. Visualisation of abstract concepts elevates cognitive engagement, allowing learners to move beyond everyday reasoning toward scientific reasoning (Tytler et al., 2020). Visual imagery directs attention to compositional elements like size, repetition, colour, texture, and proportion, all of which influence interpretation. Rose (2023) stresses how spatial organisation, such as scale, position, and arrangement, supports understanding of relationships between objects. Similarly, Häggström and Schmidt (2021) note that drawing helps young people visualise their thoughts, offering opportunities for experimentation and transformation of ideas. These processes are essential for abstract thinking, which underpins literacy in science and technology.

This study draws on the metaphor of *reading the visual* (Schirato & Webb, 2004), where young people interpret physical and social realities through visual discourse. Here, discourse refers to socially constructed meanings embedded in representations, such as dioramas, that communicate ideas through spatial and symbolic arrangements

(Kress & Van Leeuwen, 2006). This shift toward image-based semiotic landscapes highlights the role of multimodal communication in science learning.

Methods and Analysis

The project began when the author invited teachers with established interests in sustainability education and STEAM-integrated curriculum to participate in a meeting focused on shaping future research directions. Building on this collaboration, the study adopted a methodology similar to that described by Hunter et al. (2010), which examined student and teacher perceptions of learner competencies within the New Zealand Curriculum (Ministry of Education, 2007). An action research approach was appropriate for this study because it stressed iterative cycles of planning, acting, observing, and reflecting, enabling practitioners to address real-world challenges while generating meaningful insights (Cohen et al., 2018). This methodology aligned with the project's collaborative nature, as participating teachers were active contributors to the research process. Action research allowed for ongoing adaptation based on emerging findings, fostering professional learning and curriculum innovation in authentic classroom contexts. Furthermore, its focus on practical problem-solving and stakeholder engagement ensured that the research outcomes were directly relevant and applicable to teaching practice, making it a suitable approach for achieving the dual goals of inquiry and improvement.

Data gathering to inform the research was a series of semi-structured interviews with teachers and students, the spontaneous conversations with students, and photographic images of the student drawings and diorama models. Throughout the project 31 students and four teachers participated in group interviews; the four teachers were interviewed twice. Over the twelve-week period, a total of 17 dioramas were constructed, with associated interviews, provided material for analysis. Ethical approval was granted by the University Ethics Committee, and informed consent from the students and teachers was sought in accordance with the University regulations. The data analysis employed grounded techniques in a sense that the researcher was open minded in the approach by seeking to identify main trends emerging from the data (Corbin & Strauss, 2015; Delamont, 2012). All interview conversations were transcribed and summarised in extensive notes. The transcribed data from the audio files used NVivo (https://www.qsrinternational.com/nvivi/home), a qualitative data analy sis, to store and arrange the data. Further examination of the transcripts with a line-by-line analysis in NVivo and Fathom Dynamic Data statistical software were used to identify and categorise themes. A selection of scripts was reviewed to identify themes and trends evident in the scripts. In the final stage of analysis, a cross-case comparison was undertaken to explore participants' interviews across multiple dioramic features. This comparative approach functioned as a form of methodological triangulation, strengthening the validity of emergent categories and themes (Chung et al., 2019; Lam et al., 2013). Variations in interview responses and dioramic analysis were instrumental in shaping a matrix that systematically captured students' interactions. Table 2 offers a summary of this matrix, including the identification and the associated sub-codes that reflect participant voice. These criteria enabled a nuanced under-

Table 2 Dioramas-items of analysis, key coding and sub key coding affordances1-5

Items of analysis	Dominant diorama feature identification	Idea generation and thematic focus [a]	Environmental and scientific understandings [b]
Role play	People, shelter, living spaces, animals and plants	1,2,3,5	1, 2, 3, 4, 5
Key features of ecological/sustainable practices	Animal and plant husbandry/farming/diorama design	1,2, 3	1, 2, 4
Identification/position/scale of objects/entities	Animal and plant artefacts, repetition, arrangement	3,4,5	1, 2, 3, 4
Integration of futures scenario	Housing, living spaces	1, 3, 4	3, 4,5
Story telling/social relationships	Day to day life descriptions	1,2, 3, 5	3, 4, 5

[a] 1-Generating and sharing ideas 2 = Personal issues; 3 = Societal issues; 4 = Global issues; 5 = Language development/Oral language development.

[b] 1 = Supporting ecological, animal/plant relationships; 2 = sense of scale; 3 = Locating/mapping specific climate science knowledge; 4 = Relevance to real-world; 5 = human actions on natural environments.

standing of how the dioramas were enacted and experienced differently. The matrix functioned not only as an organisational tool for data but also as an analytical lens through which commonalities and divergences in student narratives could be identified. This structured approach (Creswell, 2013) enabled a nuanced account of the complexity and diversity inherent in students' understanding of dioramas, revealing patterns related to spatial design, ecological concepts, and representations of future scenarios.

Items for analysis were identified as:

- The way students identified and expressed their own identity, values, and how their actions affect others through *role play.*
- How the students represented features of *ecological and sustainable practices* through dioramas, illustrating biological entities (e.g., animals, plants), water and energy consumption in family life, plant and animal husbandry, farming.
- The different ways dioramas were used to communicate *scale*, *size*, *choice of materials*, *repetition* of plant and animal entities and objects.
- The different ways dioramas were used in conjunction with the *future oriented* scenario.
- The different ways dioramas offered opportunities to describe way of life, social relationships and *tell stories*, how they fostered oral language.

The key coding (see Table 2) was used to develop themes from the scripts. This analysis was accomplished using a grounded approach to allow trends to be identified from the data. The analysis identified material and social representations, including shelter and living spaces, animals and plants, practices of animal husbandry and farming, diorama design, artefacts and their arrangement, and descriptions of everyday life. The set[a] of coding relates to idea generation and thematic focus. It includes descriptions of: students generating and sharing ideas; addressing personal concerns, exploring societal and global issues; and fostering language and oral communication skills. The set[b] emphasised environmental and scientific understanding. It involves ecological relationships between animals and plants; developing a sense of scale; mapping climate science knowledge; connecting learning to real-world contexts; and examining human impacts on natural environments. Following this the researcher met with the teachers to review findings and to confirm sub-codes within each of the main code headings. For example, under heading two-Dominant diorama feature identification, there are five items of analysis in terms of role play; key features of ecological practices; identification/position and scale of objects; integration of futures scenario; and storytelling. The particular affordance was recorded using five (1–5) second level sub coding categories, one for each affordance. Thus, the research was able to identify and record the nature of the particular affordance. This research is based on a single case study drawn from one participating school within the broader integrated STEAM curriculum project.

Findings

Generating and Sharing Ideas

One of the strengths of the diorama construction activity was its ability to stimulate students' idea generation. As students fabricated their models, there was occasion to articulate and share their ideas. This active space for conversation, combined with the hands-on nature of the task, contributed to making diorama construction an engaging experience, with much talk and chatter observed in the classroom. This is consistent with research indicating that construction activities promote dialogue and enhance social interaction (Häggström & Schmidt, 2021; Lodge, 2007). The recordings of the classroom activities and the interviews provided qualitative data which revealed how students perceived and interpreted the diorama modelling. Students identified

Table 3 Examples of environmental issues identified by the students

Personal issues	Societal issues	Global issues
What is the most sustainable mode of transportation to school: walking, cycling, taking the bus, or being driven?	How can the local community promote energy efficiency?	Why do countries have different carbon emission guidelines?
Which type of tree is more beneficial for timber, fruit production, and firewood: evergreen or deciduous?	What are the most energy efficient houses?	Which forests and marine ecosystems around the world should be conserved?
How can we make our meal choices more sustainable?	Which forests and wetlands in our area should be prioritised for conservation?	How can countries collaborate to sustain the world's oceans?
What type of house should be built for the future?	Where should the new town hall be built, what should its design be, and what materials should be used?	

40 examples of sustainable actions for environmental health using their dioramas to share ideas. Based on the analysis, environmental issues and questions, identified by students were categorised into three levels: personal, societal, and global. Table 3 highlights student questions, reflecting their ideas on environmental issues. Classroom conversations ranged from individual actions to global cooperation. Some students held misconceptions about key scientific concepts, including the water cycle, food chains, and energy generation. These misconceptions were revealed during discussions involving the diorama activities with their peers and teachers. The teachers played an important role in identifying knowledge gaps and proactively strengthening student understanding as they worked with their students. It highlights how the dioramas acted to serve as a tool for feedback, guiding teachers in providing formative information and planning next learning steps for students.

Teacher Perspectives

Insights into the school's learning environment emerged primarily through classroom observations with participating teachers, which revealed a commitment to supporting students' ideas and questions. Teachers described the classroom atmosphere characterised by mutual respect and encouragement for emerging ideas. Rather than expecting dioramas to be perfect replicas of real-world objects or scenes, teachers valued the thought processes behind students' work, an approach resonant with *playworlds* (Fleer, 2020). The pedagogical focus was creating a learning space where students sought meanings to express through dioramas, drawings, and discussions. The teachers stressed that constructing models served as a meaning-making tool, enabling students to explore cause and effect, across dimensions of place, time, and relationships. Viewing construction as an iterative process rather than a rigid developmental sequence allowed teachers to guide students in articulating and refining their ideas over multiple sessions. Teachers described how the dioramas can enact reasoning. For eample:

> Building the models in the classroom allowed students to select and use simple tools and resources like scissors, cardboard, paint and glue, the tools provide the space to not only make things, but they allow the students to make choices, they can build on their ideas and appreciate the climate action decisions. (Teacher A).

> They allow students to visualise themselves within the model. They make models of themselves, people, trees, animals, shelter, this develops their understanding of scale, place and size of objects. They see their relationship with plants and animals-this I think is really important. (Teacher B)

These approaches encouraged students to revisit, re-contextualise, and reflect on their dioramas, with models remaining accessible in the classroom for ongoing development. According to the teachers, this flexibility fostered student engagement, as learners appreciated the opportunity to express their ideas creatively through model-making and dialogue. Teachers commented on the value of student dialogue. For instance:

> Students had the freedom to create in their own way. They had time to build and make, take steps in planning, assembly, and while this was happening, they could talk and discuss their own life, and what changes could be made for the future. (Teacher C)

> This approach bridged the gap between understanding climate change and actually taking action. Knowledge alone isn't enough, during class, I heard students discussing possibilities and practical steps they could take. (Teacher D)

Student Experience and Representation

Two key themes were identified in the analysis of diorama construction analysis. The first theme revealed that dioramas acted as catalysts for role-play activities, enabling students to connect these scenarios to their own identities, values, and the impact of their actions on others. Students reported 16 distinct examples of role-play engagement, five of which were referenced by multiple participants. These interactions included verbal exchanges, gestures, and physical movement during both the creation and use of completed dioramas. Representations of people, through variations in size, position, and scale, further supported these performative experiences. Such engagement allowed students to envision future possibilities by acting out imagined scenarios. This process fostered conceptual understanding of biological ideas, including food chains, the interdependence of plants and animals, and environmental processes such as the water cycle and electricity generation. Interview data indicated that these interactions encouraged students to apply scientific vocabulary, reason about cause-and-effect relationships, and explore abstract concepts. This finding aligns with research on the role of play in younger children, as a means of fostering conceptual understanding with social interaction and imagination (Fleer, 2024; Nicolopoulou, 2010). The multimodal nature of diorama work, combining visual, spatial, and gestural modes, reflects Kress and van Leeuwen's (2006) argument that such three-dimensional objects expand opportunities for meaning-making beyond traditional text-based approaches. In this study, students were often observed making decisions and discussing the specific roles of the dioramic objects such as farmed animal enclosures, vegetable plots, and selected trees for food and carbon storage. These discussions were student-initiated, where different tools were selected and manipulated to construct models for the particular entities. The following excerpts illustrate students' conversation about their diorama designs, focusing on the collaborative construction process, the integration of role play, and connections to future careers.

> We discuss what we see in our homes and town. We talk about photosynthesis, respiration, water cycling to show why we have the animals and plants in the diorama. Our process is like talk, think, and create. When someone suggests a

> new idea, we think how it fits, debate it, and decide together. If we agree, we plan how to make it and figure out the materials we'll need. (Student A)
>
> I like the way I can imagine the future, it's interesting, to think about being a scientist, farmer, park ranger or someone who works in a forest. In the models we can imagine the jobs to do, and the jobs at home. (Student B)

The second theme focused on teachers' observations of characteristics of student learning with dioramas. These included supporting students' reasoning, describing social relationships within the diorama, and fostering an imaginative sense of place for family life. Storytelling emerged as a central feature of these social descriptions. Such affordances align with multimodal learning theories, which emphasise the integration of tactile, visual, and linguistic modes to scaffold complex thinking (Jewitt, 2008; Rose, 2023). The construction process encouraged collaboration, dialogue, and learner-centred facilitation, echoing Vygotskian perspectives on social interaction as a driver of cognitive development (Vygotsky, 1978). This finding aligns with research highlighting narrative as a tool for science learning, enabling students to situate abstract concepts within meaningful contexts (Bruner, 1996; Brooks, 2009). Students articulated how they might adapt behaviours to reduce environmental impact, proposing ideas regarding their way of future life. Student verbal exchanges described the ideas of reusing water; growing communal gardens between families; sharing meals with neighbours; and generating energy for homes in the local area, as illustrated in the following quote:

> We believe people will need self-control. To survive by 2100, almost everyone will need to grow vegetables and trees. Petrol cars will be banned, anyone who drives one will face fines. In our diorama, there are no cars; people move along pathways that crisscross the countryside or use public transport. We've included a communal kitchen and dining area, like a food hall, where families share meals. Everyone contributes to growing and preparing food each day. (Student C)

Fig. 1 Annotated student drawing of a cross-section of a house titled the home-dome

Fig. 2 Student diorama of a sustainable farm for a family

Fig. 3 Student diorama of a sustainable house

Fig. 4 Student diorama of the future town hall and community centre

In the following section is a drawing depicting a future home (Fig. 1), photographs of three dioramas as examples selected from the study of 17 dioramas (Figs. 2, 3 and 4), and along with a brief interpretation of each. These figures indicate the emergence of learners developing a multifaceted empathetic understanding of future worlds, an increased ability to attune perceptually to new ways of observing, listening to, and experiencing environmental knowledge through diorama experience and representation. Notable shifts in the content of student dioramas and drawings, as well as their reflections through the project, suggest that different forms of experience had taken place.

Figure 1 depicts an annotated diagram of a house intended as a future home concept, representing an early stage in the progression toward diorama construction. The student's drawing details the functionality and dimensions of individual rooms, incorporating symbols for plants, people, water storage, and solar panels to create a complex, interconnected spatial arrangement. This illustration exemplifies how the student used drawing to conceptualise living spaces and articulate their intended functions. Notably, the student identifies horticultural practices, such as cultivating food on a rooftop garden and incorporating a scaled vegetable plot. Through this process, the notion of a home is extended beyond conventional representations to envision alternative ways of living in the future. The opportunity to draw and annotate specific functions served as a step in transitioning the student's ideas from two-dimensional sketches to three-dimensional diorama construction.

Figure 2 illustrates a diorama constructed by a pair of students, representing a small sustainable farm alongside a home designed to accommodate an extended whānau of approximately twenty people. The model incorporates detailed representations of functional spaces, with labels identifying key structures and features. Symbols denoting plants, animals, people, water storage systems, and solar panels are integrated throughout the scene, creating a comprehensive depiction of interconnected elements within a sustainable environment. During the interview, the students articulated their aspirations for future living arrangements, emphasising reduced reliance on private vehicles, increased time devoted to food production, and active care for farm animals.

Figure 3 captures a typical scene of students collaboratively engaged in the construction of their diorama. An outcome of this activity was its capacity to support narrative development, enabling students to engage in active construction while envisioning future scenarios, creating, imagining, and role-playing. This particular group designed a model structure that incorporated wind power for electricity generation, featuring a tall A-frame house situated on a mountain top, equipped with rotating turbines and interconnected floors accessed via stairs and ladders.

Figure 4 depicts a diorama representing a futuristic town hall and community centre, designed collaboratively by two students. The model illustrates the functionality of various spaces and incorporates symbolic elements such as tree planting for community food production, figures representing people, water storage systems, and funnel-like structures intended to channel sunlight into the auditorium. The features reflect the students' emphasis on harnessing natural light and heat to support renewable energy solutions, particularly solar power.

Discussion

This research shows that teachers and students could identify the benefits of dioramas for learning. However, these benefits appear to depend on the interaction between active model construction, future-oriented thinking, and environmental knowledge. Students' examples underscore the multidimensional nature of dioramas and their ability to facilitate reasoning in an open inquiry context. Through drawing, construction, and three-dimensional manipulation, students engaged in reasoning and meaning-making, orchestrating verbal and gestural claims alongside role-play. These findings reveal that diorama construction and associated multimodal tasks offer particular affordances. These affordances align visuo-spatial claims, supporting a body of literature about the benefits of multimodal nature of science teaching and learning (Kress & Van Leeuwen, 2006; Prain & Tytler, 2022; Wallace et al., 2022). The teacher interviews also revealed that students required contextual knowledge of ecological and environmental systems to help construct the models. Decisions and claims regarding sustainable practices, as well as the choice of materials and objects, necessitated background knowledge for implementation. For instance, some students encountered difficulties in understanding plant physiology, selecting appropriate plants, and recognising the role of plants in food production, these were noted in the interviews. As with similar studies using drawing (Brooks, 2009; Lodge, 2007; Tytler et al., 2020), some of the dioramas exposed surprising misunderstandings or gaps in the students' knowledge. The gaps underscore the teacher's crucial role in identifying these knowledge gaps and taking steps to address them. It also highlights how dioramas can serve as a tool for developmental evaluation, guiding both teachers and students in the learning process. Additionally, it was important for students to engage in a range of learning activities such as field trips, talks from regional council speakers, and lessons on plant and animal adaptations, and food chains during the initial stages of the project.

Generating and sharing ideas through diorama construction proved to be a prominent finding. The activities allowed students to explore and express their thoughts on environmental issues at personal, societal, and global levels. Students identified 40 examples of environmental concerns and used dioramas to brainstorm sustainable actions for environmental health. Similar to other diorama studies (Gkouskou & Tunnicliffe, 2017; Washinawatok et al., 2017) this approach facilitated role play that ranged from individual actions to global cooperation, helping to clarify common misconceptions about ecological ideas. The classroom environment was supportive, encouraging creativity and mutual respect. Teachers focused on the ideas and concepts behind students' work rather than expecting complete reproductions of real-world objects. This focus allowed students to explore imaginary objects using different contexts and relationships, fostering a deeper understanding over time. Importantly, dioramas also served as a medium for storytelling, enabling students to engage in active dialogue, envision future scenarios, and connect with environmental challenges. The iterative process of constructing and discussing dioramas promoted collaboration, making learning a dynamic and interactive experience. Overall, diorama construction helped students develop a multifaceted understanding of environmental issues and encouraged them to think critically and creatively about sustainable solutions.

Conclusion

The findings presented in this paper provide evidence of the impact of diorama construction on students' ability to visualise and articulate their ideas. The process of building and interacting with dioramas enabled concepts to be brought more clearly into consciousness, supporting engagement with abstract notions of sustainability and future-oriented design. Through this creative process, students explored questions related to environmentally responsible housing, community planning, and sustainable practices. The purpose of using dioramas extended beyond artistic representation. The models served as tangible tools for engaging with climate science by illustrating ecosystems, demonstrating interdependencies, and simulating the effects of human actions on natural environments. In doing so, students described cause-and-effect relationships, considered adaptation and mitigation strategies, and envisioned pathways toward sustainable futures. Dioramas functioned as reasoning bridges, to help develop climate science ideas through visual narratives that stimulated role play and storytelling. When integrated into classroom learning, dioramas acted as enduring records of students' thinking and conceptual development, resources that could be revisited by both teachers and learners and shared within the wider community. Moreover, dioramas provided insights into young people's ecological thinking and documented their cognitive growth over time. By creating visual representations of their ideas, students were able to operate at a metacognitive level, reflecting on their own reasoning and refining their understanding. The strength of diorama construction in this project lies in its capacity to tell a story, make a claim, activate dialogue, and, most importantly, enable young people to imagine and represent a sustainable future. This was a small study involving only one school and class. Future research could investigate the effectiveness of this approach with larger groups of students and follow the development of their knowledge and capabilities over a longer duration.

Funding Open Access funding enabled and organized by CAUL and its Member Institutions

Declarations

Conflict of interest The author reports no competing interests.

Ethical Approval Division of Education Research Ethics approved FEDU033/21.

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