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Designing a system of learning materials to explain climate change to children

Summary

Our climate is changing faster than anticipated, creating an urgent responsibility for educators to prepare children for global warming and help them understand what is happening and how everything is interconnected. Inspired by the Montessori method, this project explores the process of designing a set of learning materials to teach children (aged 6 to 9) about climate change. These materials were tested in a Montessori school and a state primary school over 5 weeks, using a qualitative research methodology of observation and semi-structured interviews. A cross-curricula approach, grounded in systems thinking, proved to be an effective way to break down and organize the content for this topic. A variety of different types of learning materials were designed including: card matching, experiments, listening to sounds, collaborative drawing, and engaging with physical materials. The hands-on learning materials that directly reflected their purpose, proved to be the most effective in achieving the learning outcomes. A consideration of how the design process followed many of the Montessori principles is explored, whilst also identifying a need to be more flexible with the Montessori approach and use the method as a springboard for new ideas.

Keywords: Montessori, design, learning activities, global warming, systems thinking

Słowa kluczowe: Montessori, projekt, zajęcia edukacyjne, globalne ocieplenie, myślenie systemowe

Introduction

The systems we have designed to produce, consume, and dispose of the things humans need are leading to global warming, a threat to all forms of life on planet Earth (Doerr 2021). These systems are complex, touching many different industries and areas of society, so they can be hard to explain and understand. But children of all ages are starting to see and hear about the effects of climate change and want to understand what is happening. Educators have a responsibility to prepare children for a world in which many of the jobs of the future are likely to involve changing and developing these systems. As stated in a recent strategy paper by the Department for Education (2022): "Green jobs will not be niche. We anticipate that sustainability and climate change will touch every career." Teachers need

a cross-curricula approach to teaching climate change to children, as the topic touches on many different subject areas.

Through the design of a variety of learning materials, tested in schools with primary school-aged children, this research project aimed to explore a new way of teaching climate change, focused on simplifying the topic into a set of small interconnected parts. The approach was grounded in systems thinking (Wright, Meadows 2009) and inspired by the Montessori method (Duffy, Duffy 2002) which exemplifies the idea of breaking down learning into its smallest parts, in order to build an understanding of the big picture. Montessori is well-known for her creation of a complete set of learning materials which she designed following a set of clearly defined principles, hence her materials served as a key source of inspiration for this project.

I established a set of three research questions around which the results of this paper are structured.

A. How might systems thinking be used to explain climate change?

As educators, we have a responsibility to better prepare children for global warming, by helping them understand how everything is interconnected. Whilst teachers seek ways to weave the topic of climate change into the other subjects they are required to teach, there is limited guidance on how to do this. Dolan (2021) begins to address this gap with a variety of ideas and approaches in her book *Teaching Climate Change in Primary Schools: An Interdisciplinary Approach*. Whilst the case studies in this book provide a rich source of inspiration for how to teach different parts of this topic, I found myself lacking an overarching structure to explain how everything fits together. I began exploring how to structure content on climate change into a system, following the guidance of Wright and Meadows (2009: 11) who state that "A system must consist of three kinds of things: elements, interconnections and a function or purpose."

However, it must also be noted that I do not work in the field of climate change, therefore this project was limited by my ability to interpret and communicate the information I gathered accurately.

B. What types of learning materials are most effective?

As a designer, I wanted to develop an understanding of how children learn and also to find out what types of materials and methods support them best. Much of my motivation for this project stemmed from my desire to develop my design practice, following over 20 years working in large educational companies as a designer and illustrator. I was aware that different subjects have a dominant learning method, for example: science uses experiments and reading uses books, but I didn't understand what made a particular approach more effective than another. I read a series of interviews with designers of different types of children's products in the book *Designing for Kids: Creating for Playing, Learning and*

Growing (Castella 2019) and it became clear to me that it would be most valuable to use this research project as a space to play and explore a variety of different ways of learning, observing which resonated with children the most.

C. How might the Montessori approach influence this work?

The Montessori community are seeking materials to explain climate change, a topic which didn't exist when Montessori was developing her own materials 100 years ago. Inspired by the way each Montessori material is focused on teaching a single concept, stripping away anything that isn't necessary or relevant, I wanted to explore how the Montessori materials might evolve so as to find ways to explain how the climate is changing. As I studied the materials from Montessori's own handbook (Montessori 2016) and from her elementary curriculum (Montessori 2020) I began to see how each of the different materials builds upon the last, in order to explain a larger idea. It's evident that Montessori education embraces thinking in systems, especially when it comes to teaching about sustainability (Sutton 2009), however there is still an opportunity to expand the materials offered on this topic.

Methodology

This research project followed an iterative design process structured around 6 key stages: **Discovery > Definition > Ideation > Prototyping > Testing > Evaluation**. Different phases of this cycle were repeated as needed, which allowed me to iterate and develop the ideas and designs as soon as a new insight or piece of information surfaced (Castella 2019).

I gathered the qualitative data for my research by observing children using the materials I had designed in a classroom setting. This approach aligns with the Montessori method which places a strong emphasis on the observation of the child and was how Montessori developed her own didactic materials. As I was also facilitating the sessions, it was necessary to record each session with video and audio so I could focus on the participants during the sessions and then replay the footage later to document and reflect upon my observations.

At the end of every research session I talked to the children individually, asking them a similar set of questions each week to understand their experience using the materials and to answer any questions they had for me. This provided an opportunity for the children to share their own ideas with me and for us to discuss how we could include their ideas in the next iteration, bringing them into the process of developing the materials with me. These interviews were semi-structured allowing the conversations to flow freely and set the children at ease, encouraging them to say exactly what they thought, and creating some space for them to say things they might not have felt comfortable raising in front of their peers.

As the majority of children in the UK attend state schools, I decided to conduct my research in a state primary school as well as a private Montessori primary school where I could assess if these different learning environments had any bearing on how the children

engaged with the materials. At the Montessori school I recruited a group of 13 children who were part of a multi-age class all between 5 and 9 years old. At the state primary school I recruited a group of 6 children who were all 6 years old. I conducted a total of ten sessions, five for each group, once a week for 5 weeks.

As I was working with children in a classroom setting there were many ethical considerations for my research including; getting written permission from school gatekeepers, gathering child and parental consent, providing all participants and their parents with information about the project and explaining how they might withdraw at any time if desired, as well as the pseudonymization of participant data and protecting the data collected. My research proposal was approved by the research ethics panel at Anglia Ruskin University and I endeavoured to follow the BERA ethical guidelines for educational research (British Educational Research Association 2018) throughout my research.

Explaining climate change

In this section I will share my explorations for defining and structuring the content of climate change into digestible chunks of information in consideration of the research question: **How might systems thinking be used to explain climate change?**

In the discovery period, I focused on reading and gathering influential literature written on climate change, both from online organizations founded in scientific research like NASA (n.d.), World Wildlife Foundation (n.d.) and National Geographic (n.d.) and books which explored things like systems thinking (Wright, Meadows 2009), plans for reaching net zero (Doerr 2021), and case studies of teachers teaching climate change (Dolan 2021).

In order to structure the content I began to organize all the ideas I'd gathered into some kind of order to tell the story of climate change. As I considered the history of how we've ended up changing our climate, it became clearer to me that our human needs to feed, house, and support a growing population have become a driving force behind our need to produce more things, for which we are heavily dependent on the extraction and burning of fossil fuels. The irony of this situation is that our production processes are damaging the natural systems that exist to support our human needs in the first place, causing climate change. I restructured the story to better reflect this observation with our human needs threading down as well as across. A grid of elements began to emerge with content flowing in both directions, showing interconnections between all the parts and turning the elements into a system.

I began thinking about the content for each element in the system. I wanted the children to be able to read and engage with the content independently from an adult, so I decided to target the average 6 year old's reading ability, based upon the national curriculum in England (Department for Education 2013). In order to write the content I needed to consider what a child really needs to know about each of these elements, so I wrote short digestible chunks for every element in the system that answered the following four questions:

a. What is it?
b. Why do we need it?

c. Where does it come from?
d. How does it affect people?

As the elements within the system were all dependent upon one another, I began considering how I might strengthen the system design visually. It occurred to me that the Montessori geometry cabinet was a perfect example of how similar items can be grouped together, whilst sitting within the same cabinet. I began thinking about the rows of content in my system as a set of layers in a box, with each shape representing one individual element (e.g. Air), each group of 4 elements sitting in its own layer (e.g. Human Needs) and each layer with a specific place in the climate box (e.g. Layer 1).

Then I began to explore how each shape might evolve, to apply more visual definition and a pattern to the system. I assigned simple geometric shapes to each of our human needs (see the white cards in Fig.1) and the shape in the next layer would evolve from the previous one. For example in the fossil fuels layer (see the black cards in Fig. 1) the shapes bulged out representing the way fossil fuels are adding waste to the system. At the same time the global warming layer (see the red cards in Fig. 1) left a hole in the middle of each shape, reflecting the way global warming is leaving a hole in the environment. The system was coming together, with elements, interconnections, and a purpose now defined.

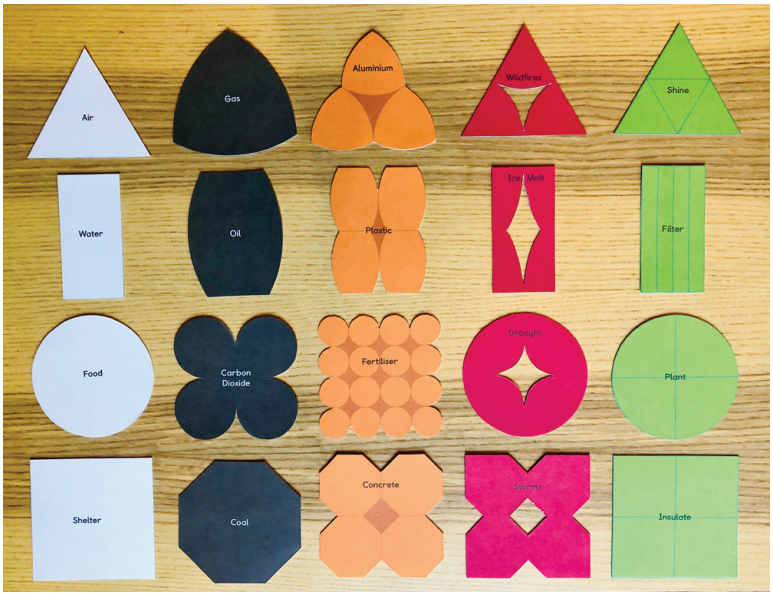


Figure 1. Developing the shapes across the system

Source: own research.

Designing learning materials

In this section I will focus on answering the research question: **What types of materials are most effective?** Design is like a dance between what you are trying to communicate and how you do this. There is an inevitable back and forth of adjusting the content to work with the materials and vice-versa in order to reach the most creative and effective solution. Pestalozzi, known as the "Father of Modern Education," believed in developing the powers of "Head," "Heart," and "Hands" (Pestalozzi Society online). I was interested in exploring how these qualities could become an integral part of engaging with my materials, importantly connecting children to ideas and feelings through their senses, as well as their minds.

I was attracted to the playful nature of the toys and experiments designed by Arvind Gupta (Gupta online) and felt it was important to explore how children use their "heads and hands" to conduct experiments by themselves. I was also aware that climate change can feel like a rather abstract concept as the causes are neither visible nor tangible, so I wanted to create a set of physical materials that children could use their "hands" to touch and observe. I was inspired by Montessori's thermic tablets, which include materials like wood, cork, metal, and glass, that children touch to gauge the temperature differences between them.

In order to introduce more "heart" into my materials, I studied the work of artists, musicians, and writers dedicated to raising awareness about climate change. I discovered eco-acoustician Matthew Burtner, who recorded the sounds of glaciers melting in the wilderness of Alaska, and turned these sounds into musical compositions, evoking an emotional reaction to climate change (Kern 2019). I wanted to find a way to use sound and art to address the feelings children may have about this challenging topic.

By the end of my discovery period, I had uncovered so many different ways to explain an idea to children, that I decided to use this research opportunity to explore a different type of learning material for each layer within the climate box. After much experimentation, the climate box prototype ended up consisting of 5 stackable cardboard boxes; each box represented a layer in the system and contained a different type of learning material (see Fig. 2A, B). In the following sections I will go into more detail about each layer of the box.

A. **B.**

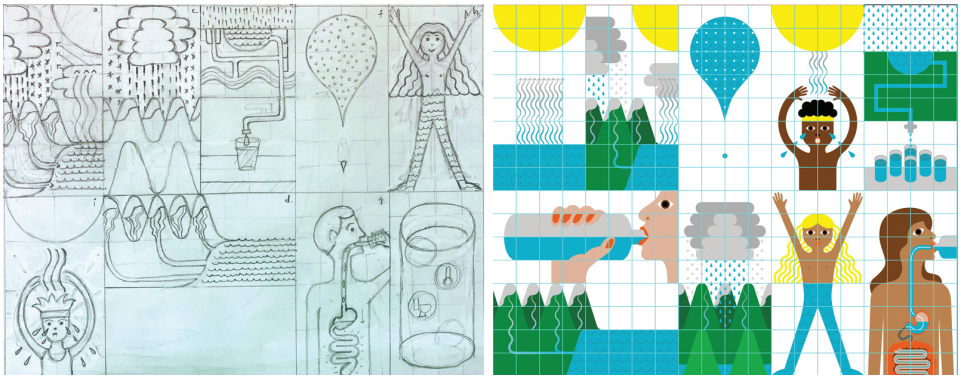
Figure 2A, B. The climate box prototype

Source: own research.

Layer 1: Human needs

The aim of the first layer of the climate box was to teach children about our basic human needs. The elements in this layer are: **air, water, food,** and **shelter**. I created a set of 8–10 illustrated cards for each element that connect together to make patterns.

I started by sketching the initial ideas on paper and then digitized them in the computer (see Fig. 3A, B), added copy, and printed several tests in different sizes (see Fig. 4A, B), in order to create a set of prototypes to test with children.



A. **B.**

Figure 3A, B. Sketching ideas and redrawing digitally

Source: own research.

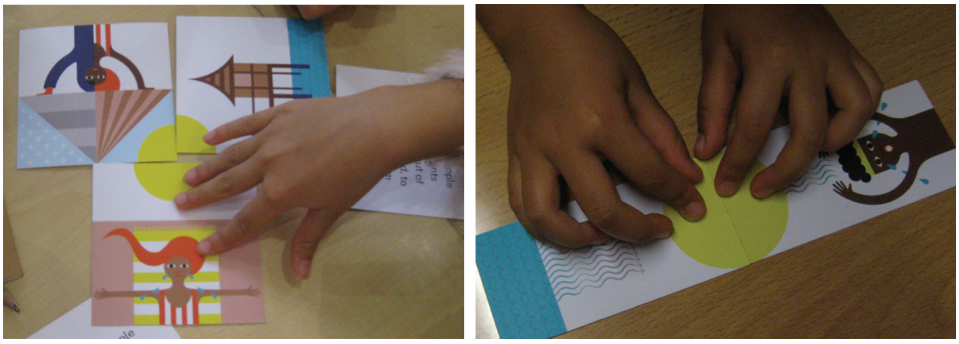
A. **B.**

Figure 4A, B. Printing tests of designs

Source: own research.

I created a set of lesson plans for testing each layer of the climate box in the classroom with groups of children. For this first layer the children were asked to read the cards aloud and explore how the cards fit together to discover patterns.

In observing the children working with the cards, one of the key findings was that children were visibly frustrated when the cards didn't fit together, but delighted when they found a pattern. One child proudly declared "It's made a sun, a whole sun, I knew it was going to make a sun!" (see Fig. 5A, B).

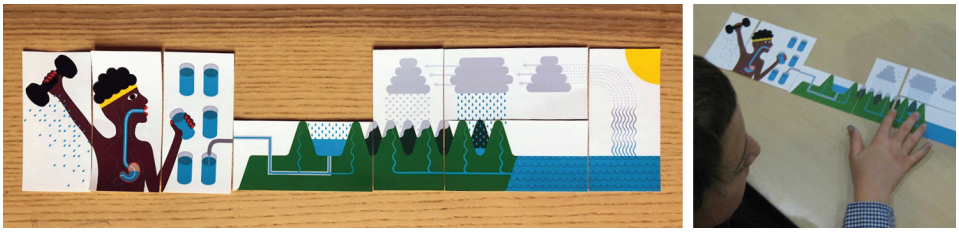


A. **B.**

Figure 5A, B. Children connecting cards

Source: own research.

The following week I iterated the designs so all the cards fit together seamlessly and asked a child to try the cards again (see Fig. 6A, B).



A. **B.**

Figure 6A, B. Iterating the card designs

Source: own research.

The process of immediately iterating the designs was very rewarding, both for me as the designer and for the children who were able to see how their feedback was having an immediate impact on the work.

Layer 2: Fossil fuels

The aim of the second layer of the climate box was to provide children with a hands-on way to learn about the fossil fuels we're burning to meet our human needs. The elements in this layer are: **gas, oil, coal,** and **carbon dioxide**. I created a set of 4 paper fortune teller games (see Fig. 7A–C) and 4 illustrated instruction booklets to guide them in doing simple science experiments using everyday household items (see Fig. 8A–C).

A. **B.** **C.**

Figure 7A–C. Set of paper fortune tellers

Source: own research.

A. **B.** **C.**

Figure 8A–C. Set of instruction booklets

Source: own research.

In this session the children were asked to play with the fortune tellers in pairs, reading aloud the information about fossil fuels that they found inside, and then follow the instructions in the booklets to conduct the science experiments. As an example, one experiment required children to try and extract the chocolate chips from a cookie using toothpicks, in order to get a sense of the challenge of extracting coal from the Earth.

In observing the children playing the fortune teller game, whilst they were very engaged in the game, they didn't seem to remember the information they read out. I realised that the fortune teller device was actually distracting them from the primary purpose of the material, to learn about fossil fuels.

However, the children loved doing the experiments and were able to easily explain what they had learnt, for example, a child who had conducted the oil spill experiment said: "Once you've put oil in the ocean then it's almost impossible to get it out." Learning-by-doing seemed to be a very effective way of teaching children about climate change. There could be some real benefits to creating an experiment for every element in the box, providing a hands-on way to compliment the other learning materials.

Layer 3: Mass production

The aim of the third layer of the climate box was to explore the properties of real man-made materials that are mass-produced by burning fossil-fuels. The elements in this layer are: **aluminium, plastic, fertilizer,** and **concrete**. I created a set of 3D geometric shapes out of each material (e.g. 4 concrete cubes, 4 aluminium pyramids etc.) as well as a set of adjective cards, picture cards, and explainer cards to label and describe the materials.

In these sessions the children were asked to observe and touch the materials, and then place the adjective cards and the picture cards next to the materials they best described.

In observing the children engaging with the set of physical materials, I realised I had become too focused on making the materials form perfect geometric shapes, so they would fit into the system I had designed, and forgotten that it was more important for the children to play with the materials and experience their different properties and behaviours. I had mistakenly prioritized form over function. One child referred to his set of materials as a "mini-museum" showing the way he perceived them to be precious objects (see Fig. 9).

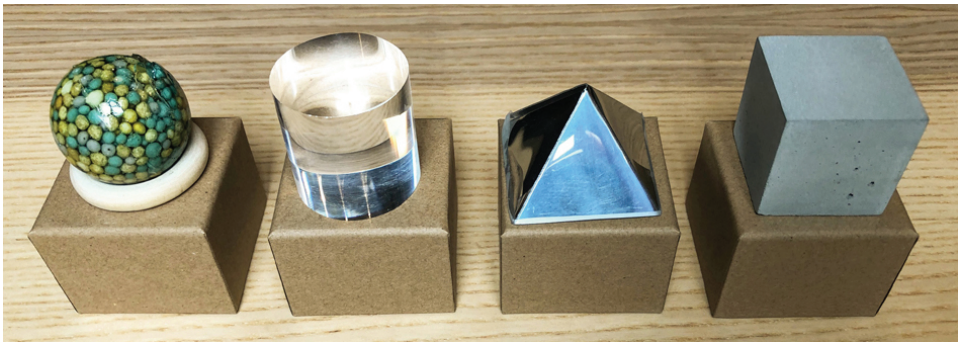


Figure 9. Mini-museum

Source: own research.

The children also struggled to match some of the adjectives to the correct materials (see Fig. 10), as they couldn't engage with the materials, owing to the way they had been formed into specific shapes. For example, one of the adjectives for aluminium was "flexible", but the structure of the aluminium pyramids meant they became quite rigid and the children didn't know that this material could also be flexible.

In both groups I observed children looking through the plastic cylinders and becoming excited when they noticed that everything through the cylinder was magnified (see Fig. 11). These materials were harder to iterate in one week, but I learnt that I need to recreate these activities so they engage the children in using the properties of the materials to solve a problem, as opposed to simply labelling and describing the materials with cards.

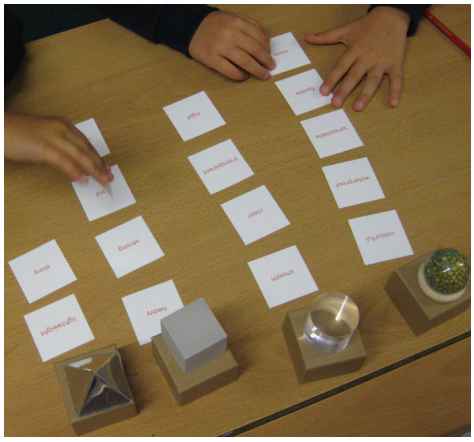


Figure 10. Matching adjective cards to materials

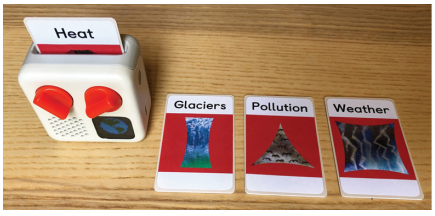
Source: own research.

Figure 11. Using plastic cylinder to magnify things

Source: own research.

Layer 4: Global warming

The aim of the fourth layer of the climate box was to find a creative way to show the impacts of global warming and to support children in processing how that makes them feel. The elements in this layer are: **heat, glaciers, pollution,** and **weather**. I created a set of audio cards (see Fig. 12A, B) with the sounds of extreme weather, and tracks with the work of poets and musicians focused on climate change.



A.

B.

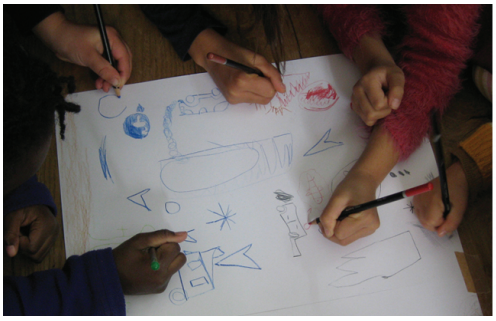
Figure 12A, B. Audio cards with Yoto (online) audio player

Source: own research.

In this session I asked the children to sit in a group, close their eyes, and listen to the set of sounds of extreme weather, and then write down how these sounds made them feel. This was followed by the group working together to create a collaborative drawing of the world, upon which they were asked to layer some of the sounds they had heard over their drawing, showing the impacts of climate change on the world.

In observing the children trying to guess what they were listening to, I noticed the activity deeply engaged their imagination. For example, when listening to a wildfire, one child said: "Ooo, I imagined a dragon breathing fire." Some children also acted out the sounds with their bodies, swaying left and right to the sound of the wind. When I asked the children to write down their feelings about global warming, I noticed some of them found it hard to describe their feelings with a single word. This age group seemed much more comfortable expressing their feelings through movement and pictures than with words.

Whilst drawing the impacts of climate change into their drawings, one child scribbled over the entire drawing with blue thunder (see Fig. 13A, B) upsetting some of the other children in the group. The activity demonstrated the way we all impact each other, opening up a discussion about why it's so important that we learn to share the planet and its resources together.



A.

B.

Figure 13A, B. Children drawing together

Source: own research.

Layer 5: Sustainable ideas

The aim of the last layer of the climate box was to share some of the amazing ideas people are developing to address climate change, and to inspire the children to come up with their own ideas. The elements in this layer are: **trees, seaweed, plants,** and **sunshine**. I created a set of four cards, each with a set of 4 innovative ideas that unfold from the centre of the card (see Fig. 14A–D). I also gave the children a box of real sustainably made products for them to play with (see Fig. 15), like an edible spoon and a pen whose ink was made out of carbon (Air Ink online).

A. **B.** **C.** **D.**

Figure 14A–D. Unfolding cards

Source: own research.

In these sessions I asked the children to unfold the cards and read the ideas aloud, play with the real product samples, like writing with an Air Ink (online) pen and then design their own inventions for the future.

In observing the children unfolding the cards, I found they didn't work very well in a group setting, as they were too small and fiddly for more than one child to see at a time. Like the fortune teller this paper device seemed to be a distraction from the content inside.

The children were much more interested in the real products that they could use and test themselves, like the edible plates and straws they tried eating, and the pen made out of carbon emissions they tested drawing with. These materials successfully stimulated the children's imaginations so they were able to develop some very creative ideas for how to reinvent the future. For example, a child came up with an idea for charging cars saying: "And if there's like magnets, or mini charging stations on the road, and then in the tires when you drive over them then it kind of charges the car a bit."

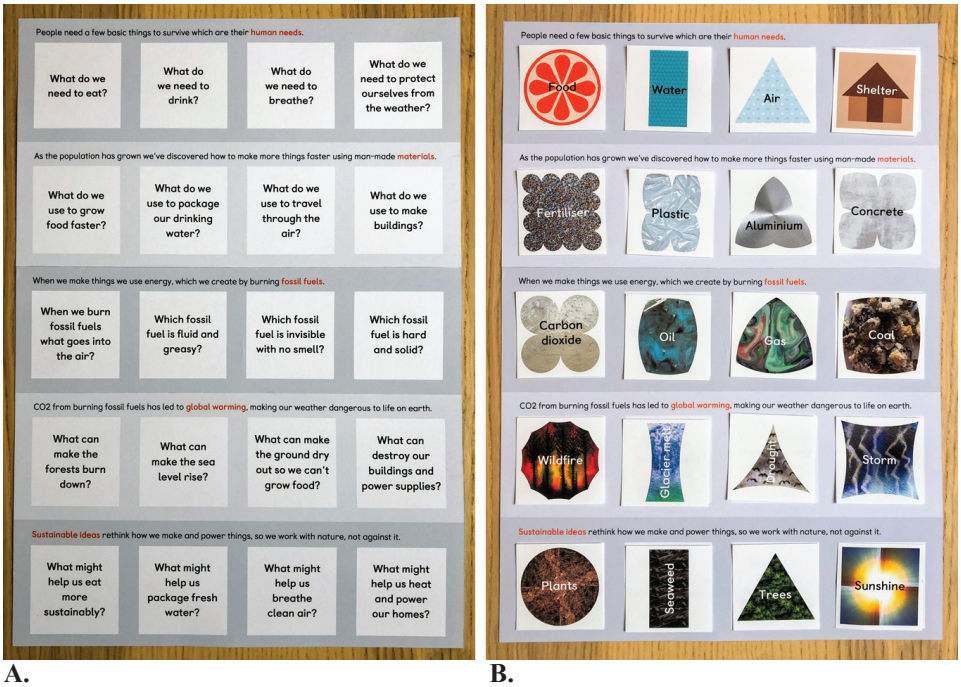
Figure 15. Sustainably made product samples

Source: own research.

As the weeks progressed I had noticed that whilst the children were able to identify each of the elements in the system, they sometimes seemed confused about how the layers related to one another. One week a child asked if the elements on the grid were connected

vertically as well as horizontally stating, "…are air and aluminium and drought altogether in some way?" I realised I needed to do more work to ensure the children understood how things connected, and so I created an additional activity for this purpose. Using the grid of elements I'd put inside the lid of each layer, I created a grid of questions, and a set of visual cards that matched each question (see Fig. 16A, B).

With each group I handed out the visual cards to the children, and we took turns reading through the questions in the grid. The goal was to cover each question with the correct visuals, so the children put their card over the right question when it was read out. The children appeared to really enjoy testing their knowledge in this way, and by the end of the sessions I could see this activity was really helping to embed the connections into their memories.



A. **B.**

Figure 16A, B. The grid game

Source: own research.

The influence of the Montessori approach

In this section I will focus on answering the research question: **How has the Montessori approach influenced my work?**

Connections to cosmic education

Montessori (2007) described her idea of "cosmic education" as "All things are part of the universe, and are connected with each other to form one whole unity" (Chapter 1, para. 6). Her approach is grounded in cross-curricular learning, where children are encouraged to develop a deep understanding of a topic by learning about all the subjects that fit into that topic. This project closely follows the thinking behind cosmic education as children can only really grasp what climate change is by breaking the topic down into its smallest parts and learning how all the different parts affect one another.

Applying the Montessori principles

One of Montessori's principles was to focus on **"isolating each concept"** of learning first, before connecting ideas together. Montessori (2012) stated "If one sense is isolated, it seems to be enhanced in its power of perception" (Lecture 10, para. 3). For the fourth layer of the climate box I asked the children to close their eyes whilst listening to the isolated sound of each weather pattern. This allowed the children to really focus on what they were listening to, filling their imaginations with ideas.

Many Montessori materials include a **"control of error,"** which means their design allows the child to independently and automatically understand if they have achieved the task correctly, and to self-correct themselves if necessary (Montessori 2014). In the first version of the illustrated cards I made for the basic human needs layer 1, the initial designs didn't connect together seamlessly, which the children immediately noticed and found frustrating. So in the following version, I redesigned the cards so they made a seamless pattern. The children were much happier being able to see if they'd laid the cards out correctly and self-correcting their work when necessary.

Another key principle of the Montessori method is to allow the child to direct its own learning and **work independently** of a teacher. In the second layer of the box I created a set of visual instruction guides for the children to conduct the experiments by themselves. I paid attention to the copy in the book to ensure most 6 year olds were able to read the directions independently. I took photos of each step of the experiment so the children were able to see exactly what they needed to do next. I observed the children completing these experiments and noticed how much they enjoyed being able to do the whole activity by themselves.

Montessori believed that the materials we provide to children should be **aesthetically beautiful** and appealing, to aid in the child's desire to learn: she states "beauty in the school invites activity and work" (Montessori 1956, cited in: Lillard, McHugh 2019: 8). In the third layer of the climate box I'd tried to create a set of beautiful, perfectly-formed, aluminium pyramids, but quickly learnt that the rigid structure of the pyramids didn't allow the children to bend the aluminium and experience one of its key properties: flexibility. I learnt that the true beauty of a learning material is not just how it looks, but how the child is able to engage with it and manipulate it.

Differences between the state school and the Montessori school

Whilst the difference between the two school environments was not the primary purpose of this study, for which an entire piece of research could be dedicated, I did notice some differences in how children were able to engage with the materials due to the learning processes and cultures of these different environments.

In the **multi-age class** at the Montessori school I quickly noticed how the older children seemed to instinctively and happily teach and support the younger children in the group. In contrast, at the state school where all the children were the same age, there was more debate and comparison over who did what and when. As the facilitator, I did far less guiding at the Montessori school and the activities seemed to flow more easily, even though it was a much larger group.

This sense of flow was also supported by the fact that the Montessori school followed a 3 hour **work cycle,** whilst at the state primary school the day was organized into a sequence of shorter learning periods of just over an hour each. It was easier to run the sessions at the Montessori school as I was able to let the children flow at their own natural pace, spending more time on an activity when needed.

An important factor affecting the two different groups was the radically different **size of the schools**. The kids at the state school were part of a class of 28 children, within a school of about 450 pupils, so a stricter schedule was required to accommodate all the different needs of the students at the school, such as sharing one playground and cafeteria. At the Montessori school the 13 children I conducted my research with, made up the entire primary school meaning it was far easier to be more flexible with the structure of their day.

Whilst the Montessori school was better set up to nurture the needs of each individual child, the **culture** at this large state school supported the children in different ways. For example, they were encouraged to stand up in front of the whole school at assembly and tell everyone about the project. The children were initially nervous, but as they spoke their excitement about what they'd learnt and their confidence grew. Challenges like this, when managed right, can strengthen kids and prepare them for the variety of experiences they are likely to encounter in the future. There was an overall feeling at the state school of belonging to a large diverse community. The Montessori school was a smaller vibrant community, notably restricted to those who could afford to pay **tuition fees**.

Conclusions

The role of designer as teacher

I wore many different hats throughout this project; as a designer imagining and making things, as a teaching guide planning and facilitating sessions, and as a researcher observing and evaluating. I had a tendency to make the prototype first and think about planning the lesson next. This meant I'd often end up looping back to the ideation phase to add a set of cards

or instructions to the material so they could be used effectively. I quickly realised a lesson planning phase was missing and needed to be added to my iterative design process like this:

Discovery > Definition > Ideation > **Lesson Planning** > Prototyping > Testing > Evaluation.

By bringing the designer and teacher mindsets together, I gained a deeper understanding of the role of teachers and their needs. To create effective learning experiences and materials for children, it's important to work as closely with the teachers as with the children, as the facilitation of the materials is essential for their success.

A curriculum for climate change

By creating a system to simplify and organize the complex topic of climate change, I was able to identify the smallest number of components needed to explain the topic, laying the foundations for a curriculum in this area. I was very aware that the 5 short sessions I did with the children, one session for each layer of the box, would have been more effective with more time. Ideally we would have covered one element per day, one layer per week and the whole topic over the course of half a term. The topic of climate change is huge and constantly evolving, so the system could also be expanded in both breadth and depth as new areas emerge in this space.

Different materials for different purposes

I explored many different types of materials for the different parts of the climate box, some of which were more effective than others, such as the experiments used to learn more about fossil fuels in layer 2, and the drawings used to show ideas in layer 5. Whilst the children were clearly engaged by the wide variety of different materials I shared, I think my biggest learning as a designer was that the most effective learning materials expressed their primary purpose in their design and utility. For example, the folded paper fortune teller was more of a novelty to the kids, distracting them from actually learning about fossil fuels, which was the goal. But imagine if the fortune teller's primary purpose had been to explain the difference between a 2D object and a 3D object, then folding a flat piece of paper into a 3D shape would have been a very effective learning material. So the learning materials that reflected and behaved in a way that brought the content to life, were more effective at teaching the learning goal.

Developing the Montessori approach

Maria Montessori has been a huge source of inspiration for the materials I designed, with her approach and principles providing a foundation for my thinking process and resonating with my own instincts as a designer. Today there is a clear need to provide materials that support the teaching of climate change, and given the speed at which the climate is now changing,

the goal must be to reach the largest number of children as quickly as possible. But I have noticed a tension with those in the Montessori community who are committed to following her approach exactly as she described it, and others less attached to her ideals. As stated by Lillard and McHugh: "Beyond not omitting any material, neither does an authentic Montessori classroom add material, such as worksheets or commercial toys, to the sets developed by Dr. Montessori" (Lillard, McHugh 2019: 7). This implies a rigidness to the approach, tying it firmly to a set of ideas developed over 100 years ago, before climate change was even recognized?

I strongly believe that more collaboration between different educational approaches would enable educators and designers to improve the effectiveness of their teaching and the design of new materials. We all have the ability to collaborate and develop, to learn from the past and change the future. Afterall, ultimately collaboration is the only way we still have the potential to stop global warming.

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