Chapter 10

E-STEM in Everyday Life: How Families Develop a Caring Motive Orientation Towards the Environment

Sylvia Christine Almeida and Marilyn Fleer

Abstract Internationally there is growing interest in how young children engage with and learn concepts of science and sustainability in their everyday lives. These concepts are often built through nature and outdoor play in young children. Through the dialectical concept of everyday and scientific concept formation (Vygotsky LS, The collected works of L.S. Vygotsky. Problems of general psychology, V.1, (Trans. N Minick). Editor of English Translation, RW Rieber, and AS Carton, New York: Kluwer Academic and Plenum Publishers, 1987), this chapter presents a study of how families transformatively draw attention to STEM and sustainability concepts in the everyday practices of the home. The research followed a focus child (4–5 year old) from four families as they navigated everyday life and talked about the environments in which they live. Australia as a culturally diverse community was reflected in the families, whose heritage originated in Europe, Iran, India, Nepal and Taiwan. The study identified the multiple ways in which families introduce practices and conceptualise imagined futures and revisioning (Payne PG, J HAIA 12:2–12, 2005a). About looking after their environment. It was found that young children appear to develop concepts of STEM, but also build agency in exploration, with many of these explorations taking place in outdoor settings. We conceptualise this as a motive orientation to caring for the environment, named as E-STEM. The study emphasises for education to begin with identifying family practices and children's explorations, as a key informant for building relevant and locally driven pedagogical practices to support environmental learning.

Keywords Environment · Sustainability · Agency · Transformative · Young children

S. C. Almeida (✉) · M. Fleer
Monash University, Melbourne, Australia
e-mail: sylvia.almeida@monash.edu; marilyn.fleer@monash.edu

10.1 Introduction

Growing environmental changes do impact on young children directly and indirectly. Yet the research suggests that very little attention has been directed to identifying children's experiences or to determining how everyday environments at home and in the community shape perspectives and motive orientations (Hedegaard, 2012). Despite young children's views generally not being documented as part of the research, there is evidence that they do have agency, with some research showing that they can and do productively 'contribute ideas, energy and creativity to managing and solving local [environmental] issues' (Davis, 2015, p. 16). But as yet, we do not know enough about how families create the conditions to support their children to be agentic about caring for the environment.

This chapter is concerned with presenting the findings of a study that sought to determine how families in everyday life create the conditions for children's explorations of STEM, but with a focus on caring for the environment. Known as E-STEM (Environmental – Science, Technology, Engineering and Mathematics), the goal of the study was to examine how some families living in Australia, contribute positively to the cultural formation of children in ways that develop a motive orientation for caring for the environment. Although debates exist in relation to terms, such as environmental sustainability education (Madden & Liang, 2017), environmental education (Davis, 2009), education for sustainable development (Siraj-Blatchford, Mogharreban, & Park, 2016), we focus primarily on a broad conception of environment as conceptualised by Payne (2014) where we foreground the child's everyday experiences in the home and community. Community experiences are often embedded (although not limited to) outdoor settings that offer rich learning and play opportunities for young children.

To achieve the goals of this chapter, we followed children over time in a broad range of everyday contexts in order to gain insights into how families and communities introduce STEM thinking in informal settings, such as homes, playgrounds, and community events. In drawing upon cultural-historical theory (Vygotsky, 1987), we analysed how children's experiences informed their understandings about the world around them as a particular form of cultural formation. The findings are presented in the latter part of the chapter. We begin this chapter by discussing the literature relevant to the focus of the study.

10.2 Background Literature on Sustainability

Overall, studies of early childhood sustainability and environmental education have made important contributions to sustainability, with contributions from Canada (Elliot & Krusekopf, 2017), Chile (Simonstein, 2016), China (Zhou, Liu, Han, & Wang, 2016), Kenya (Macharia & Kimani, 2016), Korea (Park, Shin, & Park, 2016), Norway (Heggen, 2016), Portugal (Folque & Oliveira, 2016), Sweden (Kultti,

Larsson, Arlemalm-Hagser, & Pramling-Samuelsson, 2016), Turkey (Haktanir, Guler, & Ozturk, 2016), UK (Siraj-Blatchford, 2016), and the USA (Mogharreban & Green, 2016). What emerges is a plurality of pedagogical practices (Arlemalm-Hagser, 2017) for the development of a concept of sustainability (see Pramling Samuelsson & Park, 2017), with some international comparisons between early childhood educators (Japan, Australia and Korea) showing that traditional nature based approaches dominated (Inoue, O’Gorman, Davis, & Ji, 2017).

Studies focused on early childhood have mostly been “fragmented and ill defined” (Siraj-Blatchford et al., 2016, p. vii.). To rectify this, the OECD has funded research, and this important work has identified biodiversity, climate change and disaster risk reductions as key for future change and that these should be tackled more systematically (Siraj-Blatchford & Pramling-Samuelsson, 2016). While there are some cultural-historical studies focusing on environmental education through everyday experiences in early childhood (Edwards & Cutter-Mackenzie, 2013), there is limited understanding of how the learning of concepts supports a caring environmental orientation or action at home.

In line with a need for more systematic focus in research, Young and Elliott (2014) have recognized not only meaningful contexts for learning concepts of sustainability, but have identified key concepts that young children are capable of engaging in in support of caring for the environment. Young and Elliott (2014) have suggested that the concept of sustainability can be realized through early learning (Young & Elliott, 2014) of big ideas, such as, conservation, life and food cycles, biodiversity, endangered species. Similar content areas have been documented by Desjardins and Wakkary (2011). These studies focus on a conceptually oriented approach and can be clustered around core concepts of E-STEM that the study reported in this chapter is interested in.

Studies relevant to the focus on family appear to be far and few between with limited research into children’s experiences at home and its impact in later life as pointed out by Payne’s (2005a) who found that parents played a key role in developing what he called green environmental sensibilities. Families raised children’s consciousness of caring for the environment in everyday routines in the home. In interviewing families about their practices across three generations, Payne (2005b) found *doing* as an approach to learning was central to how these families enacted environmental activism. Habituation and naturalism emerged as the dominant practice. There was a meshing of real, direct, active and embodied experiences as part of the daily routines. Payne says that the families fostered “an ethos or culture that a positive difference” could be made “through one’s everyday actions and interactions” (p. 92). As with the previous study, Payne (2005b) noted that families found it was not important to teach ecological knowledge but that consciousness raising, a sense of agency, resourcefulness and lateral power in ‘sustaining’ were found to be central for caring for the environment. He conceptualized the independent relations of household members and plants, animals and so on, as *oikos* – environmental house or place.

Intergenerational research by Meeusen (2014) has also demonstrated that families pass on environmental concerns to their children, but only in families engaged

in effective communication with their children. The study undertaken in Belgium, surveyed parents and their adolescent children and noted no gender differences. Communication also featured in a Danish qualitative study by Grønhøj (2006) when examining green consumer practices associated with organic food, water and energy, waste and transport. Mostly, families' interactions were conflict-ridden, and families mostly dealt with day-to-day practices with inconspicuous consumer behavior.

Payne (2014) has suggested that the everyday lives of children goes beyond nature and includes broader contemporary developments, such as the internet and how this mediates life in the home. For instance, "Children now experience unknown people, virtual images or abstract events on the other side of the globe in cultural settings, socio-environmental conditions and time frameworks utterly different from their own" (p. 69). It has been argued that meaningful contexts in early childhood for realizing these learnings include, biodiversity audits, creating frog bogs, bird baths and feeders, and making compost, worm farms and vegetable patches (Young & Elliott, 2014) all of which are mostly situated in outdoor learning contexts.

In line with these earlier studies we were interested to know how families create the conditions for the cultural formation of their children related to E-STEM. We examined the organization of young children's participation in everyday routines in the home and across their communities, in order to better understand how E-STEM learning in everyday practice positively contributes to the caring of the environment. In particular our research sought to delve into knowing how families frame children's conceptual thinking over time to inform and support their actions in solving everyday problems, particularly meaningful problems associated with sustainability and caring for the environment.

10.3 The Study

Our research aimed to shed light on how STEM concepts give opportunities for environmental exploration in everyday family contexts where a child's cultural formation is in the process of developing. In line with this aim we sought to identify and understand how diverse families with their children:

1. pay attention (or not) to environmental and scientific problems that arise informally in everyday life
2. create the conditions (or not) for children to seek out and use STEM concepts in order to solve meaningful problems in everyday life that are linked with environmental issues

10.3.1 *Participants*

The research had 5 focus children in the age range of 4–5 years and their extended families from one state of Australia in order to capture a broader range of family members engaged in everyday scientific problems. The participants exemplify the Australian representation of cultural heritages originating in Europe, India, Iran, Nepal and Taiwan.

10.3.2 *Procedure*

Stage One: Families Filming Everyday Practices and Routines Using a digital GoPro *action-camera*, families filmed everyday practices in their home and communities over a period of 2–6 months. The *action-camera* was mounted to a small cap/headband, and given to a focus child from each family.

Each family was visited 3 times in the course of the data collection period for collection of video content and for informal in situ interviewing. We collected over 14 hours of data per family.

Stage Two: Preparation of Stimulated Recall Video Content The research team examined the data for examples of practices associated with everyday concepts and STEM concept formation, and where participation structures for learning are organised in the context of solving problems. Segments of video material were put on to memory sticks, and sent back to the families, and then subsequently used as the basis for focus group interviewing.

Stage Three: Focus Group Interviewing Using stimulated recall techniques (Lyle, 2003), the families attended two focus group sessions throughout the data collection period to discuss the videos, photographs, and any other items with the research team they felt explained their home contexts and previous STEM problems that they may have solved with their children. These sessions were conducted in family homes with the research team members. These moments of data were used during the stimulated recall interviews to deepen conversations.

At the conclusion of the data collection period, families were brought together for a final focus group discussion of their materials and the edited movie files on memory sticks. This culminating session was an important event for children and their parents involved in the research to celebrate the work they do together as families and foreground the learning opportunities that their everyday practices offer to their young children.

Stage Four: Data Analysis and Synthesis The analysis was informed by cultural-historical theory. Young children experience their physical world every day of their lives through participating in family routines and different activity settings. Mostly

children experience their physical world at an everyday level, such as when composting food scraps (decomposition), sorting rubbish into different bins (materials and their properties), or when harvesting vegetables from the garden (growth, life and living). When these routines become consciously understood as specific concepts during discussions and actions with their families, it can be argued that families are supporting the cultural formation of the child. Captured in curriculum and in the literature as STEM concepts, STEM concepts are human cultural inventions. Analysing the relations between everyday and scientific concepts helped us to better understand the practices of the families. We used Vygotsky's conception of everyday and scientific concept formation to determine when and how families dynamically helped their children to understand STEM concepts to explain the observed family practices of caring for the environment. How children entered into these practices and how families created the conditions and participation structures was further theorised using Hedegaard's (2012) conception of motives and demands.

The researchers synthesised data from Stages 1, 2 and 3 using Vygotsky's (1987) conception of everyday and scientific concept formation to determine when and how families dynamically helped their children to understand STEM concepts to explain the observed family practices of caring for the environment. How children entered into these practices and how families created the conditions and participation structures was further theorised using Hedegaard's (2012) conception of motives and demands.

10.4 Findings

The findings of our research point towards significant and meaningful links made by families with their children in relation to caring for the environment while at the same time learning STEM concepts. The two main themes addressed in this chapter are:

Everyday family practices that give time and space to the cultural formation of E-STEM.

Everyday adult-child interactions that support the cultural formation of E-STEM concepts.

10.4.1 Everyday Family Practices that Give Time and Space to the Cultural Formation of E-STEM

Intentional practices that support meaningful environmental and STEM related everyday concepts appeared to be deeply embedded in many of the families' everyday practices. Parents, grandparents, siblings, uncles/aunts and local/community

Table 10.1 Everyday family practices linked to STEM concepts

Everyday routines	Agentic practices	Organised activities to support abstracted learning
Everyday walks	Creating cloth bags at home to support children’s interests in reducing use of plastic bags	Investigate projects to further extend children’s interests, for example in rainbows or volcanos
Skype conversations and digital searches	Searching for online materials - weather and tornados to see how these are formed	Learning from online videos and shows about science concepts, like where things come from and how things are made
Building and gardening with extended family		Special ‘lessons’ organised by aunty to support learning of the water cycle, including making special props and experiments

green spaces seem to play a crucial role in supporting links between practice and concepts (see Table 10.1).

The study found that adults provided opportunities both explicitly and implicitly to feature STEM in children’s lives. There were three types of routines evident in the families we followed.

First, at the **implicit** level, everyday practices featured families giving time and space for children to experience the outdoor environment. By creating routines, like working with family members in the garden, children physically explored life and living, and positively experienced the localised footprint of food production. Similarly, everyday walks and visits to the park gave children opportunities to experience the outdoor environment, and to have the possibility to experience nature and all that this affords. These examples shown in Table 10.1 Column 1, illustrate E-STEM at the everyday practice level because children viscerally experienced their outdoor environment, thus building everyday conceptual foundations for later noticing and potentially abstracting from these concrete experiences. At the everyday level, we theorise that children are building experiential understandings of the E-STEM concepts such as, the footprint of local food production, where in the future comparisons could be made to the quality/organic nature of the produce bought or questions asked about the footprint when buying vegetables. Similarly, observation of the local biodiversity featured in children’s lives when visiting parks, and these experiences were in some families only at the everyday conceptual level because adults did not draw attention to E-STEM concepts to explain the practices. Consistent with the research of Payne (2005a) these early practices are thought to positively impact on later beliefs and values expressed by adults when remembering their early experiences of nature.

Second, our findings show that other families engaged explicitly in E-STEM practices at the everyday level. For instance, in making carry bags to take to the shops, families actively demonstrated sustainable practices (Table 10.1, Column 2). These practices are illustrative of working at an everyday conceptual level in E-STEM because children experience making bags, using these bags when shopping, and knowing from family dialogue that they replace the use of plastic bags.

This example is illustrative of an agentic practice to reduce plastics and avoid problems of plastics in the waterways. Making calico bags demonstrates an important practice and orientation to caring for the environment. But it does not show in itself, what level of scientific understanding children have about the risks of plastics for the biodiversity of the waterways or other important E-STEM concepts. At the everyday level, this practice and others like it enacted in the family homes, builds foundations for practical actions important for later deeper conceptual understanding of E-STEM. This is in keeping with the key role of everyday concepts as theorised by Vygotsky (1987).

Third, at the abstract E-STEM conceptual level, some families introduced to children important STEM concepts that would help them better understand big ideas in caring for the environment, such as, learning about the water cycle, or searching for information associated with the weather. STEM concepts introduced by the adults in the families appear to matter, as they seemed to follow the everyday conceptual pathways that children experienced or showed interest in. A typical example from the data set follows in the next section. Importantly, the introduction of abstract concepts (Table 10.1, Column 3) could meaningfully explain the everyday practices and routines (Vygotsky, 1987), and therefore could theoretically open up opportunities for children to act with conceptual understanding in the future.

Together, the implicit and explicit everyday family practices noted in the data (Table 10.1) suggest that children's cultural formation of E-STEM was in the process of developing. Important practices and family routines associated with nature appeared to be orienting children towards acting in support of their environment. By families giving time and space to experiencing nature, or engaging in practical everyday activities in support of caring for the environment, important pathways for later E-STEM understanding were being laid.

10.4.2 Everyday Adult-Child Interactions that Support the Cultural Formation of E-STEM Concepts

A second major finding related to the importance and diversity of adult-child interactions in support of caring for the environment. We noted a clustering of interaction types associated with explicit or implicit E-STEM content, but also valued family practices some of which were intergenerational but not necessarily focused on caring for the environment.

Profiles of adult-child interaction that were identified are discussed in relation to the implicit and explicit E-STEM practices as introduced above (horizontal axis). The vertical axis captures the continuum of direct and indirect instruction by the adults across families and contexts (Fig. 10.1).

In the previous section, implicit E-STEM interactions were noted through how the family provided time and space to walk through to the local park and experience nature and when making calico bags. Details of three examples from different

environmental contexts (Table 10.1) follows, where adult-child interactions are shown. In the first example, Edgar is making a parsley dip after harvesting the herb from the vegetable garden as shown in Fig. 10.2.

Vignette 1: Uncle’s veggie patch
The following vignette from a home visit where the family is sharing data and recalling their experiences. Mum prompts Edgar to explain what they did with the GoPro yesterday. They took it to Uncle Shane’s veggie patch. Edgar with his Mum’s help explains that the veggie patch is in the front door and they picked parsley to make special dip. Edgar helps his Mum make it.

Mum: Yesterday where did we go?
Edgar: Hmmm
Mum: Uncle Shane’s veggie patch
RA: Ohh and where is this veggie patch?
Edgar: Mum can you help me say
Mum: OK. Uncle Shane’s veggie patch is our in the front yard and Uncle Shane lives next door. He is Riley’s daddy. And what did we pick from the garden?
Edgar: To make my special dippy
Mum: Yes to make your special dippy. What do we need?
Edgar: Parsley
RA: Do you know how to make your dippy? Do you help your mom?
Edgar: Yeah I do ((Go Pro video and conversation during Home visit 2)

Fig. 10.1 Typologies of adult-child interactions that support the cultural formation of E-STEM concepts

Fig. 10.2 Harvesting food from the vegetable garden

Fig. 10.3 Interactions focus on practice

This example can be conceptualised along the horizontal continuum as closer to an implicit E-STEM profile of the cultural formation of the child to caring for their environment. This pedagogical practice is illustrated in the bottom left side quadrant, as shown in Fig. 10.3 below. In this example, the family pedagogy is oriented towards practice because no instruction or mentioning of E-STEM concepts is evident. However, it is an important everyday practice about nature and the harvesting of food.

We also noted similar nature activities in other families, but where a different kind of interaction was evident. Examples of family pedagogy that gives more explicit E-STEM content follows in Vignette two and three. The second vignette is

Fig. 10.4 *Vignette 2* Noticing small detail in the environment and looking to find out more

related to a nature walk where ‘noticing and subsequent researching’ is illustrated, and the third vignette features story narratives to foreground the changes in the same environment over time.

Noticing and researching: What we found was that families not only engaged in practices in support of caring for their environment, they also created opportunities for noticing the biodiversity in nature when on family walks but with a view to researching STEM concepts to give greater scientific meaning to what was observed. For instance, Vignette 2 taken from the data set elaborates the environmental pedagogical features of family practices for making conscious valued forms of STEM concepts at the everyday level. As will be shown below, the families’ everyday practices appeared to feature many opportunities for supporting children to notice ‘little things’ in nature using all their senses. In Vignette 2 Fig. 10.4, the image shows the family examining a branch of wattle that they found outdoors. Banoo noticed some features of this wattle and so the family decided to bring a part of it home in order to further explore it through researching in books and on the internet.

A big part of the conversation between the adult and the child was comparing the leaves and blossoms of the found branch, to the images on the computer with Banoo then exclaiming ‘*So it must be the same*’ (GoPro video data shared during Focus group interview 2, Family Banoo). This was a family practice which was encouraged in Banoo since Banoo was a baby and had continued over time. According to the mother, ‘*Even when Banoo was very young, when Banoo was in my arms, I encouraged her to touch leaves*’ (Focus Group interview2, Family Banoo).

Narratives for foregrounding environmental changes over time: Vignette 3 is a narrative that featured through reading books and passing down family stories. This is especially foregrounded in Edgar’s data where storytelling and passing down family values are important in the family (particularly about DIY such as composting and gardening and preserving food).

Vignette 3: Mum Explains That Story Telling Occurs Often

Grandma talks about stories when she was a child living locally and things that her own mother told her. Mum explains that stories and talking is often about how the area has changes over time, especially in relation to past generations of the family (fourth generation living in the local area). Talking about how the land and natural environment and talking about how things have changed, having to be careful about impact on the environment and sustainable use of resources. Since the family has lived in the same local area for four generations, there is sharing and talk about how the local environment has changed over time and Edgar is often part of this conversation.

This is exemplified in the conversation below:

Mum: We do a lot of story telling and (looking at his sister) will make up stories at night for the boys. A lot of these are traditional stories like Goldilocks and the three bears etc where we will change the names

Grandma: But I tell a lot of stories too. Like I'll tell stories about mum – my mum or my dad or when I was a child and we could roam all around the cliff and we would build cubby houses..... things that my mother told me and I now grasp and take those contexts in. I think my mum was remarkable so I tell things that she did when she was growing up.

Mum: And I think this is where – we are third and fourth generation living here in this area – we talk about it a lot. Like when we drive to school we talk about, isn't it funny how grandpa used to play marbles here because there was so much bush and trees. And now isn't it a bit sad that there are no trees around (Focus group interview 1, Family Edgar)

It was found that some families mentioned indirect attention on abstract concepts of E-STEM through deliberately embedding learning within everyday practices. For example, one of the participants said:

Grandma and Mum are both teachers, and talk a lot about how learning is 'embedded' in E's everyday life. Rather than pre-planning for learning, it usually occurs as opportunities arise throughout the day. Mum values the pedagogical abilities of both the early childhood teacher and family day carer. It is evident that both Mum and Grandma are both very aware of, and extend, the learning that occurs during kinder or day care (Researcher field notes after Focus group interview 1 and 2, Family Edgar).

These examples can be plotted on to the typology shown in Fig. 10.5 in the bottom right quadrant.

While intentional and purposeful learning of science and sustainability was evident in families' everyday practices, there were a number of planned educational interventions. These opportunities arose on an ad hoc basis and families maximised the learning potential these provided. For instance, visiting zoos, aquariums, historical places, old mining towns, botanical gardens as well trips to home countries and

Fig. 10.5 Interactions focus on bringing together E-STEM concepts with practice

other overseas destinations provided many learning opportunities. But there were also organised activities specifically for the instruction of E-STEM concepts. What we found when analysing the data, was that some families appeared to teach concepts to their children when on excursions, and others when setting up organising activities specifically for this purpose. There were two ways that this tended to happen in the families in our study. Some families directly taught abstract concepts through setting up activities associated with an interest. An example of a simulation is given further below to illustrate this profile of family pedagogy (Vignette 4). Some families directly taught E-STEM concepts in a formal manner to their children, as is shown in the cooking example further below (Vignette 5). Both vignettes focus on teaching concepts, but not necessarily on caring for the environment at that moment.

10.4.2.1 Indirect Attention on Abstraction

Simulations of STEM concepts: In Vignette 4, Sahil's family organised many activities to support his interest in lava, tornadoes and volcanoes as a follow up to learning at his centre. The following typical example shows a carefully crafted and designed activity creating volcanoes using baking soda and water along with Sahil's favourite cars (Fig. 10.6).

Aunt Mary explains how the hot molten rock comes to the surface of the earth. Sahil asks how this can be, and she explains. Then she adds the vinegar to the 'volcano' to make the 'lava'. Sahil pretends to touch it saying 'its hot, its hot'. (Family focus group interview 2 sharing Sahil Phone video explaining volcanoes).

This example of everyday practice can be plotted in the top left-hand quadrant because the focus is on direct adult-child interaction through creating a simulation to feature STEM concepts. It is an abstracted concrete activity (Fig. 10.7).

Fig. 10.6 *Vignette 4* Setting up specific activities at home to learn about abstract concepts - simulations

Fig. 10.7 Indirect attention on abstraction

10.4.2.2 Direct Instruction of Abstract Concepts Not Related to the Environment

An everyday routine that was popular among the families was cooking. Some families especially involved their children in this practice, using the opportunities to highlight specific STEM concepts. What we noticed was that some families used cooking from a view of learning science and family traditions, but did not make explicit links to the environment or sustainability. Vignette 5 of ‘cooking with concepts’ follows.

Anita is seen participating in the process of making chappatis which is a daily family routine (Fig. 10.8).

Anita is rolling some dough with a rolling pin while Mum asks what is happening. Anita explains what it is.

Mum: when you are rolling the dough what is happening to it?

Anita: It's getting circle

Mum: It is changing its shape, mm?

Fig. 10.8 *Vignette 5*
Cooking without concepts

Mum then points out that the dough was a ball but now it is flat and round. (Phone video shared by family)

Mum encourages Anita to keep rolling to see if it can be made thinner. 'A' looks at the dough and explains that it looks like a diamond shape, and then a 'lemon shape'. (Go Pro video data and Family focus group interview 2)

The adult is questioning and describing what is happening mathematically and to some degree scientifically during the process of making the chappatis. The focus group interviews suggested that the activity was also seen by the adult as a way of staying connected to family traditions and the ethnic practices of their culture. Science concepts like, rolling, pushing, pulling, and mathematical concepts, such as, thick, thin and shape, provide contexts for Anita's everyday conceptual development. There is also an explicit foregrounding of STEM concepts through direct instruction by the adult. But as with the example of the vignette of volcano simulation, there is no specific mention or link made to caring for the environment or sustainable practices in food security, footprint, etc., as was found in the earlier examples. This adult-child interaction example of cooking with a focus on concepts is plotted in the right top quadrant because the interaction is direct and explicit (Fig. 10.9).

Overall, the study found a range of pedagogical profiles, and these were focused on STEM concepts (biodiversity), E-STEM practices (making calico bags), and also valued family and cultural practices (cooking) that were not necessarily associated with the focus of this chapter. However, the latter pedagogical practices gave context for better understanding how different families created the conditions for the cultural formation of E-STEM.

Fig. 10.9 Direct instruction of abstract concepts

10.5 Discussion

By investigating the practices of our focus families, we were able to examine how in the different home contexts, children were being oriented towards caring for their environment as part of their cultural formation. Through using a typology to map and analyse practices, we were able to make visible both adult-child interaction types (vertical axis) and the degree of STEM concepts introduced to children (horizontal axis). The typology gave the possibility of noting if STEM concepts were made explicitly conscious to children and if they meaningfully supported the children to care for their environment. Figure 10.10 brings together the exemplars introduced in this chapter within the typology.

As might be expected, a diversity of pedagogical approaches was evident across the families for orienting children to the environment. What we noticed was that STEM concepts were being introduced regularly to the children – some explicitly and others more implicitly. However, not all families made links with the STEM concepts in support of looking after the environment. These families clustered in the top two quadrants of the typology. What we learned about these families was that direct adult-child interaction focused on learning STEM concepts, such as cooking with children and the volcano activity. We also learned that this direct instructional interaction type appeared to be closely aligned with the learning of abstract STEM concepts. But the context seemed to be meaningful for the children, even though the interactions were not at all related to caring for the environment. Learning about caring for the environment did not appear to be conceptualised by these particular families as something to be taught directly to their children.

All families knew the goals of the research and were active agents in documenting what mattered to them about E-STEM for their child. So it was surprising that

Fig. 10.10 A diversity of pedagogical approaches in families for supporting E-STEM

E-STEM was not featured in the actions of the families when showcasing valued family practices through video recording everyday practices.

In summary, the families in our research who adopted more direct adult-child instruction of STEM did not practice E-STEM instruction explicitly. This raises questions for us as researchers. Could these families potentially have a more broadly framed view of the environment, whereby direct instruction of STEM was thought to give conceptual understandings in support of future thinking and action in caring for the environment? Could E-STEM not be viewed by these families as an abstract concept? Payne (2010) has said that when researching green families that they are “far more interested in an everyday ecopolitical education” of their children than building a conceptual orientation that is “factually driven” (p. 228). We suggest that in our families, adult-child interaction is about learning STEM concepts for future meaningful actions – that is, learning concepts that they can use later to make informed scientific decisions which could support caring for the environment. Theoretically, our families could be thought to be conceptually oriented and potentially future driven. Further research would be needed to confirm this theoretical proposition.

In turning to the bottom quadrant of the typology, we also learned that families who were more implicit in their actions, appeared to use everyday practices to embed learning of concepts, but with a motive orientation towards caring for the environment. Those families who clustered in the bottom two quadrants of the typology exhibited practices that oriented the children to the environment, such as the making of calico bags or researching biodiversity of their local community. We suggest that E-STEM learning is being established at an everyday level and is being oriented to immediate action, but with future understandings of the science concepts associated with caring for the environment being laid.

Finally, our findings suggest that those families who are orienting their children to E-STEM appear to be more implicit in their interactions. It is possible that caring for the environment is considered by these families as something that they wish to make visible to their children within the practice of everyday life, rather than as specific lessons abstracted from the practice of the environment. It would appear that the children are being shown ways to act in support of the environment through participating in practices, such as making calico bags, harvesting food, or studying plants after walking in the park. These family experiences appear to afford an action oriented approach to the environment, such as, researching, using alternatives, experiencing local footprint, which when taken together could be theorised as agentic, future oriented practices, that support the next generation to care for the environment. However, more research is needed to have confidence in this theoretical proposition.

10.6 Conclusion

This research aimed at better understanding the contexts of young children who come from diverse cultures and who are supported by their families with learning about their environment including play and learning in nature and outdoors. Theoretically, a cultural-historical reading of our findings would suggest that children's everyday experiences are important in building future imaginings of sustainable practice and foundations for learning or acting with knowledge of E-STEM in the future. Focusing on the child's perspective of their lived everyday contexts, is a new focus for research that has the potential to yield base line data that can inform future studies into understanding how the diversity of families who live in Australia interact with their children in support of caring for the environment.

A key finding of our research was the crucial role adults play in helping children transition from everyday concepts to E-STEM concepts through their lived experiences. These happen either from direct, intentionally set up opportunities or embedded instances that are harnessed by families for delving deeper into learning about caring for their environment. Our research showed the deep connections between STEM and E-STEM learning and how families orient children to the latter through indirect interactions. Foregrounding conceptual connections is suggestive of the potential for building children's motive orientation in support of environmental and sustainability practices and future action. Payne (2005a) suggests that in his research, "parents' eco-pedagogy and praxis (re)constitute the environmental actions and learning of their children" (p. 2) as part of everyday family practice. Bottcher and Dammeyer (2016) in the context of disability introduce the concept of imagined futures which helps explain this finding. They suggest that families have an imagined future in mind as part of the upbringing of children. Families want the best for their child, and they organise experiences in line with this goal, regardless of how far away that imagined future might be. Incrementally, families build the experiences and understandings daily in line with their goal of the imagined future.

How families do this varies, such as an explicit or implicit focus on E-STEM and direct or indirect instruction. The typology of family practices presented in this chapter is a first step in theorizing this relationship that we found between adult-child interactions and direct and indirect E-STEM conceptual oriented practice. However, more research is needed across a broader number of families if we are to understand E-STEM practices in family homes can bring about lasting change in support of our fragile environment.

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